# COMMUNITY NUTRITION FOR DEVELOPING COUNTRIES

# COMMUNITY NUTRITION FOR DEVELOPING COUNTRIES

*Edited by Norman J. Temple and Nelia Steyn*


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This book is dedicated to Anthony and Katie
Norman

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The two most special people in my life:
my husband Maxwell George Hounsell and my daughter Simone Steyn
Nelia

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# FOREWORD

For more than two decades, advances in information and communications technologies, the Internet, and the World Wide Web have been instrumental in initiating fundamental changes in the practice of post-secondary education. Since 2002, when UNESCO first coined the term "Open Educational Resources" (OERs), there has been an exponential increase in access to free online learning content and applications. According to UNESCO, OERs can be defined as digital materials that can be re-used for teaching, learning, research and more, made available for free through open licenses.

The work you have in front of you has been authored by nutrition practitioners and experts based primarily in Africa. These authors present their views and expertise on nutritional issues relevant in different developing world contexts. This etext does not seek to be either a complete guide to nutrition in developing countries, or an all-inclusive account of how developing world nutritionists practise their craft. Rather, each chapter attempts to highlight a specific issue of importance for nutritionists, especially community nutritionists, as well as other health professionals in the developing world.

In the developing world context, the Internet and digital access using mobile devices present new means by which learners can access, produce, and share information and knowledge. In Africa, people face challenges in accessing textbooks and learning materials in general. This etext has been edited by Norman Temple, a nutrition professor and researcher at Athabasca University (AU), together with Dr Nelia Steyn of the Human Sciences Research Council in Cape Town, South Africa.

Africa has been a leader in the OER movement beginning with the Cape Town Open Education Declaration in 2007 to "accelerate efforts to promote open resources, technology and teaching practices in education." Of particular relevance to this etext on nutrition is the complementary 2010 Cape Town Declaration of the XVth World Congress of Food Science and Technology supporting the Budapest Declaration on Open Access, recognizing the need for open education in nutrition, food science, and technology. More recently, the UNESCO Guidelines for OER in Higher Education were drafted in South Africa, while the African Virtual University has become recognized as a world leader in the development of OERs in three languages (English, French, and Portuguese).

AU, as Canada's online distance university, is an appropriate partner for this initiative. It established one of the first open access journals, the International Review of Research in Open and Distance Learning (IRRODL). And it was the first Canadian university to sign both the Cape Town Open Education and Budapest Declarations and implement an open access policy. This was followed up with the establishment of the world's first open access university press: AU Press, which is co-publishing this etext.

A principal advantage of using OERs is the ease with which the content can be localized or otherwise customized or adapted without the problems associated with copyright protected content. Nowhere is this clearer than in its application to online education in general, especially in developing countries where local contexts differ sharply. Student learning can vary from individual to individual, from country to country, and from program to program; OERs provide the needed flexibility to allow for reuse, modification, and openness.

In keeping with its mission as an open university, AU is delighted to provide this book under a creative commons license, thereby removing financial barriers to its accessibility. As the former president of AU, I take pride in what our staff has accomplished and recognize the particular contribution that this book's authors are making to the global extension of our mission.

The topics in this etext have been chosen specifically to highlight issues of concern in developing countries with especial regard to community nutrition. The text begins with a look at the food and nutrition environments that prevail on the African continent at all age levels; the management of the most common diseases and other ailments; the needs of nutritional education; community-based nutrition programmes; and the role of governments in food policy.

Since these international declarations, an even wider range of institutions have developed OERs, creating a rapidly growing and accessible ecosystem for quality educational content and applications. Moreover, with

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the growing enactment of use-limiting copyright legislation in many jurisdictions, the pressures on institutions to prefer OERs over proprietary content, with its restrictive licensing and technological protection measures, are intensifying. OERs and etexts are increasingly being seen as necessary for those institutions that provide learning in digital environments. Digital Restrictions Management used by the publishing industry, coupled with the exorbitant pricing of proprietary textbooks, are bringing us closer to a tipping point, after which etexts and other forms of OERs will become the dominant media for delivering learning content and applications.

OERs will form part of any solution that supports the realization of the UNESCO Millennium Development Goals through this global partnership for gender neutral universal education. In particular, this will help to address the goals of food security, poverty eradication, child and maternal health, and a healthier population.

**Frits Pannekoek**
***President Emeritus, Athabasca University, Canada***

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# PREFACE

Until now, courses in community nutrition taught at universities and colleges in developing countries have relied, in the main, on American or British textbooks. But the nutrition-related health challenges with which developing countries must grapple differ considerably from those found in highly industrialized Western nations, as do the community settings in which health services and nutrition programmes are delivered. The present book owes its existence to an earlier volume, *Community Nutrition Textbook for South Africa: A Rights-Based Approach* (2008), on which we also collaborated. As its title indicates, that book focused specifically on South Africa. We soon realized, however, that a pressing need existed for a similar book aimed at developing countries more broadly.

The overriding goal of this book is to enhance the health and well-being of low-income populations throughout the world by improving the quality of nutrition programming available in local communities. Well-educated nutrition professionals are, of course, essential to this goal. Community nutritionists work in diverse settings, including schools, hospitals, workplaces, and local clinics, as well as health departments. (The term *public health nutritionist* is to some extent synonymous, although that term often implies a somewhat narrower range of duties carried out in the context of a government department.) Nutrition professionals are charged with assessing the nutritional status and requirements of individuals and groups and with planning, implementing, and evaluating programmes designed to address those needs. This volume is for those studying to become such professionals, in hopes of working to better people's lives.

Existing textbooks on community nutrition tend to be prohibitively expensive for most students in developing countries. As an open access publication, this book can be downloaded from the Internet by anyone, anywhere, at no cost from the AU Press website. This innovative approach to textbook publishing clearly holds great potential for overcoming a major barrier that separates students in developing countries from high-quality textbooks. We therefore applaud Pamela Holway–for her hard work and dedication to this volume–and Athabasca University Press, located in Edmonton, Canada, for seeing it through to publication. We also thank the Food and Agriculture Organization of the United Nations for allowing us to use material from our previous book.

Three dozen authors collaborated in the writing of this book. Their collective wealth of experience comes from having worked in diverse countries spread across Africa, Europe, Australia, and North America. Most of them now hold university positions, but some are employed in government departments or by research organizations. In assembling this multi-talented team, we have, we hope, created a rich mixture of knowledge, experience, and deep understanding.

Nutrition is very much a work in progress. We are confident that today's generation of students and young researchers will build on the ideas of today, adapt to the new realities of change in developing countries, and help solve the many challenges that confront us.

**Norman J. Temple and Nelia Steyn**

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# INTRODUCTION

*Norman J. Temple and Nelia Steyn*

Back in the 1960s the nutrition and health situation in such countries as the UK and USA was dramatically different to that in Africa. The UK and USA were (and still are) dominated by the Western diet and Western diseases. But the vast majority of Africans were still eating a traditional low-fat, high-fibre diet. Their disease pattern was also completely different from the British and American experience: instead of Western diseases, they had such problems as nutrient deficiencies and infectious diseases. Of course, there were pockets of people eating a Western diet and developing Western diseases. The white population in South Africa is one obvious example.

Fast forward to today and we see a radically changed world. Africans, whenever they have enough money, are as fond of Western food as are those in the UK and USA. And, following in the footsteps of the Western diet, they are experiencing an epidemic of Western diseases. To exemplify, the available evidence indicates that whereas undernutrition is still rife on the African continent, the prevalence of obesity now rivals that of severe stunting. We can point to countries like Mauritania and Lesotho where severe stunting in children younger than five years is estimated at 16.5% and 15.0%, respectively, while obesity in women between the ages 15 and 49 is estimated to be at 16.5% and 16.1%, respectively. But much of Africa, especially its poor rural areas, has only taken a few steps down this road. As a result people residing in those areas have a similar disease pattern as did their parents and grandparents.

This scenario repeats itself across much of the developing world. Some countries (Bangladesh, for example) resemble in many ways the poor rural areas of Africa. By contrast, more and more developing countries have adopted a pattern of diet and disease that is fast "catching up" with that of the UK and USA. This phenomenon is now commonly referred to as the nutrition transition. Typically it refers to the habitual consumption of a diet which is high in energy, total fat, saturated fat, *trans* fats, sodium, and added sugar. Generally, it is low in fibre, many essential micronutrients, and fruit and vegetables. It is commonly referred to as an energy-dense and low micronutrient-dense diet because it has a high caloric value with a poor intake of many essential nutrients such as vitamins A and C, iron, and calcium. This is also the typical reflection of a diet associated with the development of obesity, particularly when coupled with physical inactivity. This scenario is associated with the surge of obesity taking place in many developing countries, in both children and adults. It further explains the increasing prevalence of chronic diseases of lifestyle such as type 2 diabetes in low-income countries.

This very brief and broad overview of diet and disease around the world explains why this book is so vitally important. A nutritionist working in a small town in Africa or India needs to understand the changing dietary patterns that characterize the developing world, as well as the accompanying pattern of diseases. The book is primarily intended for community nutritionists, often referred to as public health nutritionists. We are confident that the book will serve as an invaluable resource for anyone engaged in that type of work. But the book is actually more than that: it will be of much value to people working in such areas as medicine, nursing, and public health. A government official charged in developing health-care policies, for instance, would be well advised to keep a copy close at hand.

The book starts with a chapter that examines issues of human rights in relation to community and public nutrition. This serves to remind us that food security is a fundamental human right. The chapter includes a full explanation on the Millennium Development Goals. This is followed by Chapter 2 that makes a detailed exploration of the challenge of food insecurity. Following this Chapter 3 discusses dietary patterns in different countries, especially in Africa and South Asia. Together these three chapters form a theoretical base for the tenets of nutrition in the developing world. It covers common theories and constructs to support the nutritionist who has to face the challenges of promoting a healthy diet in a developing environment. It also


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reinforces what is known and common to many developing countries and equips the health professional of today with important facts.

Chapter 4 provides a detailed account of the concept of the nutrition transition. The chapter is an excellent framework for a better understanding of some of the factors and mechanisms responsible for the changing patterns of diet and disease around the world. Indeed, many readers of this book will see the nutrition transition at work in their everyday lives. The nutrition transition can today be regarded as one of the most serious nutritional health challenges which the community nutritionist or dietitian has to cope with in the twenty-first century. Since it is growing at an alarming rate across the world, the health professional will need to find innovative ways of dealing with this while at the same time still trying to cope with the outcomes of undernutrition and its legacies.

Next come four chapters on nutrition challenges across the lifecycle (Section 2). It is, of course, crucially important for community nutritionists to have a sound understanding of the nutrition challenges when managing such high-risk groups as pregnant women, children, adolescents, and the elderly. While this information forms the basis of most textbooks on nutrition, the current text focuses on the essential elements of the lifecycle in developing countries who are still dealing with poverty and inadequate health services. In a sense these chapters encapsulate the services which can be provided with few resources even under adverse conditions of health and poverty.

The book then turns to a range of critically important issues concerning the place of nutrition in both the prevention and nutritional therapy of various nutritional and health disorders (Section 3). The first of these chapters looks at the sometimes insufficiently appreciated multiple nutrient deficiencies, which are still, alas, a subject of huge importance across much of the developing world. This is followed by a chapter on the management of HIV/AIDS, TB, and other infectious diseases, which are still major causes of morbidity and mortality in low-income countries. After this comes a chapter on diarrhoea, another condition associated with poverty and poor health which is likely to remain with us until such time as good environmental health is a way of life in all countries. The rest of the section reflects the sharp contrast of dietary imbalances and excesses associated with the major nutrition-related chronic diseases, namely cardiovascular disease, type 2 diabetes, obesity, and cancer. This section perfectly illustrates why this book is destined to play a vital role in the training of tomorrow's generation of community dietitians and nutritionists: it tells the full story and underscores the importance of nutrition in relation to health and disease as it will present itself to practitioners in developing countries. Once again the emphasis is on prevention and management under conditions of poverty and poor health resources.

A fully competent community nutritionist should not only have a broad knowledge of the issues presented in the earlier sections of the book, but such a practitioner must also be skilled at translating, simplifying, and conveying this information in the local context. The first chapter of Section 4 surveys and critically evaluates the topics of food guides, food labels, and food tables that reflect current recommendations for the intake of nutrients. This information is important for two major reasons: first, so that community nutritionists properly understand these issues and can therefore explain them to others, and, second, so that when the opportunity presents itself, readers are well informed and can play an active role in the development of policies in this area. The second chapter in Section 4 presents in-depth advice on the delivery of nutrition education. That chapter can be regarded as the weapon of defence of health professionals who operate under conditions of poverty and lack of resources. Teaching people to fish for themselves is an essential tenet underlying community nutrition principles. Often, however, this is one of the most difficult aspects of improving health, especially when people expect pills for cures and are reluctant to accept responsibility for their own health.

Section 5 addresses intervention strategies and comprises three chapters that cover the vitally important subject of community-based nutrition programmes. These chapters provide much valuable information for anyone planning such an activity in relation to successful experiences in different settings around the world. The section will no doubt help contribute to nutrition practitioners moving away from "doing something," the Achilles tendon of many interventions, to "doing something sound," with a high probability of making a difference. This section also emphasizes the importance of people "owning" their own health. This implies that they should be involved in all the phases of interventions if these are to be successful. The concept of sustainability is another theme that runs through all health interventions; lack of sustainability is illustrated by interventions which have failed to make a difference.

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All previous sections have aimed to improve population nutrition by extolling the benefits associated with improved nutritional practices. This is based, almost entirely, on voluntary choices. But the degree of success achieved by this approach is, typically, quite modest. For instance, if education was enough, on its own, to persuade people to adopt a healthy lifestyle, then cigarette smoking would have disappeared long ago! A major part of the reason for continued poor choices is that the environment around us is not always supportive of a healthy lifestyle. The limited degree of success of strategies based on persuading populations to voluntarily adopt healthy practices brings us to the vital and very thorny issue of government policy. In many areas – food prices, food advertising, and the amount of salt added to food, to give but three examples – government policy can potentially achieve much improvement in population health. In many such cases, this approach is considered, by some practitioners at least, to be far more cost-effective than alternative strategies, such as education or medical treatment. The two chapters dealing with issues of policy (Section 6) are therefore crucially important.

Nutritionists and dietitians of the future will need to be more aggressive in their approach to developing effective policies. This can be done by providing governments with sufficient and irrefutable evidence so that they accept the need for the development of appropriate policies. This evidence also needs to show the cost-effectiveness of policies in relation to money which governments have to spend on health care to deal with such health problems. In many instances the cost savings alone can make a difference to how governments act.

Section 7 equips the practitioner with guidelines and selected tools to measure and assess the nutritional status of individuals and populations. The equally important Section 8 provides guidelines and tools for planning meals for institutions and approaches to addressing issues of food quality and food safety. Both these chapters provide simple general information with an emphasis on low-income settings.

Section 9, a nutritional mosaic, addresses topics which can be considered to be only loosely related to community nutrition. It includes: the state of training of dietitians in Africa; nutrition misinformation (both naïve and deliberate), which is widespread across continents; the rapid pace of population growth; the very real dangers posed by climate change; biofuels (does their production do more harm than good?); the crisis in the world's fisheries; global problems of water shortages; foods made from genetically modified (GM) plants; and globalization. The aim of this section is to make you think and to show you that as a health professional all these global issues are also of vital importance to you as a nutritionist or dietitian. These are not problems that "others" have to deal with but problems that all health professionals need to embrace in order to find solutions.

Taking the book as a whole one sees a remarkable wealth of information and ideas. Trying to translate this book into practice is clearly an ambitious undertaking. Common wisdom expressed long ago by Hippocrates (c. 460–377 B.C.) stated: "If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health." This is the general foundation of the principles of health. Today, despite our better understanding, albeit still rudimentary, we still struggle – practitioners and the public alike – to select "the right amount of nourishment and exercise" to improve our health. The great challenge is the many and very complex determinants of health. This book will undoubtedly prove to be a significant contribution to the ever-elusive Hippocratic doctrine.

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# PART 1

## THE FOOD AND NUTRITION SITUATION IN DEVELOPING COUNTRIES

# CHAPTER 1

# A HUMAN RIGHTS-BASED APPROACH TO COMMUNITY AND PUBLIC NUTRITION

## Theoretical Underpinnings and Evolving Experiences

*Wenche Barth Eide and Eleni M. W. Maunder*

### *Outline*

- Human rights in community nutrition
- Nutrition, social justice, and human rights
- Protecting human rights in the context of economic and social development
- Economic, social, and cultural rights especially relevant to nutrition
- Implementation of rights at the country level

### *Objectives*

At the completion of this chapter you should be able to:

- Explain the origin of the concept of universal human rights
- Describe the Millennium Declaration and the Millennium Development Goals of the United Nations
- Understand the difference between a rights-based approach and a charity-based approach to nutritional problems
- Describe the UNICEF conceptual framework for the causes of malnutrition
- Explain your understanding of social injustice in relation to nutrition and health
- Explain the obligations of the state as a "duty-bearer"
- Describe the seven core principles of a human rights–based approach
- Describe the United Nations international human rights system
- Understand what is meant by a "right to food"
- Explain the terms *progressive realization* and *available resources* in relation to the right to food


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# 1. HUMAN RIGHTS AND COMMUNITY NUTRITION

## 1.1 The Concept of Human Rights

Human nutrition was, for many years, viewed within a medical framework. In development circles, however, the emphasis has recently shifted towards a more integrated approach to addressing problems of human nutrition – within the concept of human rights. This approach recognizes that human nutritional status is not determined simply by biological factors but also by social and political forces. While these forces can work to promote good nutritional status, they can also contribute to glaring social inequalities, with the result that certain population groups become especially vulnerable to economic and social changes that affect their food security and nutritional health. When adequate nutrition is understood to be a right, then one can reasonably say of the undernourished that one of their human rights has been violated.

Human rights are grounded in values and moral principles that are deemed to apply to all human beings. These rights have been enshrined in international law and, in some cases, in the laws of specific nations. All people have the same human rights, regardless of their skin colour, gender, age, language, religion, political affiliations, national or ethnic origin, innate physical and mental endowments, level of education, wealth, social class, and so on. The overriding goal of an approach based on human rights is to identify and protect those who may have been overlooked, if not more or less deliberately ignored, in development processes that in fact put their interests and needs at risk. As Judith Asher (2004, p. 2) explains in *The Right to Health,* "When health is not described simply in terms of *needs* but also in terms of *rights*, governments find it far more difficult to justify the withholding of basic provisions and services on account of alleged financial constraints or because of discriminatory priorities" (Asher, 2004, p. 2).

A clear difference exists between a rights-based approach and one based on charity. The latter sees the world's hungry and malnourished as passive recipients of handouts from the state or benevolent individuals or groups. Whereas charity depends on the moral will and compassion of the giver, who chooses to provide food to people who are hungry or who suffer from food insecurity, a rights-based approach regards hungry people as active citizens deserving of respect and dignity. A right-based approach is founded on the belief that hunger and malnutrition are largely the product of man-made injustices, sometimes compounded by random factors such as natural disasters. Such an approach holds that it would be immoral of a state and its citizens to stand by and do nothing when people are in danger of starvation. Such an approach therefore firmly establishes a legal obligation of states to address hunger and malnutrition.

## 1.2 Human Rights and the Legacy of the United Nations

Questions concerning the fundamental rights of human beings have been debated for centuries, but it was the United Nations (UN) that formulated the modern concept of universal human rights and made it a core element of international law. When the UN was founded, in 1945, the leaders of the world's nations hoped that the atrocities of the Second World War would never be repeated. They therefore joined hands to establish this new international organization, with the goal of fostering peace and protecting all populations against insecurity and injustice. The work of the UN is founded on the principles outlined in the Charter of the United Nations, to which all member nations are expected to adhere. Chapter I, Article 1, of the charter lays out the organization's overarching goals (see Box 1.1).

This first article sets as one purpose of the UN to encourage "respect for human rights and for fundamental freedoms for all." Peaceful relations among nations are unlikely to be achieved, however, if gaping disparities exist in economic and social circumstances of the world's people. Article 55, in Chapter IX ("International Economic and Social Cooperation"), accordingly recognizes that "conditions of stability and well-being," in which respect for human rights can flourish, are essential to international harmony (see Box 1.2). The creation of such conditions depends in part on solving the problems that contribute to the economic and social gaps among nations, including poverty, disease, and malnutrition.

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**Box 1.1:** Article 1 of the Charter of the United Nations

*The Purposes of the United Nations are:*

1. To maintain international peace and security, and to that end: to take effective collective measures for the prevention and removal of threats to the peace, and for the suppression of acts of aggression or other breaches of the peace, and to bring about by peaceful means, and in conformity with the principles of justice and international law, adjustment or settlement of international disputes or situations which might lead to a breach of the peace;
2. To develop friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples, and to take other appropriate measures to strengthen universal peace;
3. To achieve international cooperation in solving international problems of an economic, social, cultural, or humanitarian character, and in promoting and encouraging respect for human rights and for fundamental freedoms for all without distinction as to race, sex, language, or religion; and
4. To be a centre for harmonizing the actions of nations in the attainment of these common ends.

**Box 1.2:** Article 55 of the Charter of the United Nations

With a view to the creation of conditions of stability and well-being which are necessary for peaceful and friendly relations among nations based on respect for the principle of equal rights and self-determination of peoples, the United Nations shall promote:

a. higher standards of living, full employment, and conditions of economic and social progress and development;
b. solutions of international economic, social, health, and related problems; and international cultural and educational cooperation; and
c. universal respect for, and observance of, human rights and fundamental freedoms for all without distinction as to race, sex, language, or religion.

Human rights and fundamental freedoms needed to be formulated more specifically, however. Thus, in 1948, the UN General Assembly formulated the Universal Declaration on Human Rights (UDHR), which was adopted on December 10 – a day that has come to be known as Human Rights Day. Article 1 of the UDHR states: "All human beings are born free and equal in dignity and rights." In other words, human rights are innate. The UDHR contains general provisions for *civil, political, economic, social,* and *cultural rights*.

Starting in the early 1950s, however, the Cold War developed between capitalist nations and communist ones. The advent of the Cold War complicated the understanding of human rights as one integrated "package," as individual UN member states adopted differing approaches to safeguarding these rights, privileging some over others. The Eastern bloc – the Soviet Union and communist Eastern Europe – took the position that it was the responsibility of the state to feed and care for its people but placed little value on personal freedoms, such as free speech. In contrast, Western states, led by the United States, strongly promoted civil and political rights, while limiting the state's responsibility to secure the material well-being of its citizens. This divide prevailed until 1989, when the fall of the Berlin Wall precipitated changes that brought the Cold War to an end.

## 1.3 A Renewed Interest in Human Rights

The end of the Cold War made it possible to adopt a more unified perspective on human rights. In 1993, a World Conference on Human Rights was held in Vienna. It underlined that human rights are *universal, interrelated, interdependent,* and *indivisible*. Throughout the 1990s, interest in economic, social, and cultural

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rights, alongside civil and political rights, was growing, as was the understanding that these rights should be understood as an integrated whole.

Still, it took time to incorporate human rights into broader international debates and plans for economic and social development, including those rights particularly relevant to food security and nutrition. In 2000, at the turn of the millennium, the leaders of all UN member states gathered in New York for a "Millennium Summit," which resulted in the Millennium Declaration. In this document, the leaders of the world's nations agreed that, in addition to their responsibilities to their own populations, they had "a collective responsibility to uphold the principles of human dignity, equality and equity at the global level" and "a duty therefore to all the world's people, especially the most vulnerable and, in particular, the children of the world, to whom the future belongs" (I, 2).

The Millennium Declaration also listed certain fundamental values seen as essential for good international relations in the twenty-first century: *freedom, equality, solidarity, tolerance, respect for nature,* and *shared responsibility* (I, 6). In order to translate these shared values into actions, they identified the following key objectives of special significance:

- Peace, security, and disarmament
- Development and poverty eradication
- Protecting our common environment
- Human rights, democracy, and good governance
- Protecting the vulnerable
- Meeting the special needs of Africa
- Strengthening the United Nations

These objectives were to be pursued in an integrated manner so that they would mutually reinforce each other.

Under the objective "Development and poverty eradication," a series of development goals was listed, for the time being formulated in relatively broad terms. These goals included targets such as the reduction in the proportion of hungry people, of under-five mortality, and of maternal mortality. These goals were later refined and condensed into the eight Millennium Development Goals (MDGs), with specific targets set for 2015 (further described in section 2.6). But while these eight goals are widely used to promote and assess progress in different countries and the world, there is an unfortunate flaw in the way they were originally presented: they did not explicitly indicate *how* they were to be pursued, namely, in combination with the fourth objective, "Human rights, democracy, and good governance" (Alston, 2005). Many may have assumed that the link would automatically be recognized, but this is unfortunately not yet always the case. Many governments, as well as people in general, know relatively little about human rights, or they are not interested in them, or they may see them as running counter to their own political and economic interests. Nevertheless, from the end of the last century and into the new millennium, the world has witnessed a revitalized concern with human rights.

## 1.4 Human Rights and the Community

The term *community* has both a narrower and a wider meaning. The word is most often understood in its narrower sense, as referring to the locality in which an individual or a family lives and functions, such as a village. This sense of the term is important, because it suggests that a lot can be accomplished through alliances of people living and sharing the same conditions in a specific locality. There may, of course, be different interests *within* such a community, which can be a cause of conflict. Here, human rights should protect those weaker and sometimes marginalized groups.

But alliances among and/or on behalf of those sharing the same interests can stretch beyond circumscribed geographical areas. Thus we can think of a "community" in a more abstract manner – as a collection of groups who live in different localities but who have common goals that they wish to achieve. Examples would be a national, or even international, community of small-scale farmers, local fishermen, or women in city slums who have limited access to health care for themselves and their children. This understanding of

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community is useful in relation to the social inequalities that arise when certain groups lose out in the process of development. This chapter therefore gives a rather broad interpretation to the term *community*.

# 2. NUTRITION, SOCIAL JUSTICE, AND HUMAN RIGHTS

## 2.1 Shifting Perspectives on the Problem of Nutrition

Those who work in the area of community nutrition use several different terms to refer to their field: *community nutrition, public health nutrition,* and *public nutrition.* The distinction is to some extent historical, in that it reflects evolving perspectives on how best to approach the problem of undernourishment and other community health issues. The term used in this book, *community nutrition,* generally suggests a focus on specific interventions designed to help prevent disease and improve the health, nutrition, and well-being of individuals and groups within local communities. These communities may be defined by their setting, such as a village, school, or workplace), or they may consist of groups who have common health concerns, such as breast-feeding mothers. Community nutrition programmes are often sponsored by government agencies, but they may also involve international bodies such as the World Health Organization (WHO).

Closely allied with community nutrition is *public health nutrition.* Public health nutritionists are somewhat more likely to be employed in government departments and are commonly concerned with the application of public health principles (Hughes, 2003). As Beaglehole et al. (2004) point out, the concept of public health exists within an ethical framework, in that implicit in it is the recognition that individual choice is not free but is constantly constrained by environmental and socio-economic factors. This view of public health, they argue (2004, p. 2084), "affirms the positive obligations by governments and communities to protect and improve the health of all their citizens and is based on the assumption that all lives are of equal worth." Such a perspective forges a link between public health and human-rights approaches.

The term *public nutrition,* which came into use in the mid-1990s, is more explicitly connected to the notion of human rights. It encompasses both community nutrition and public health nutrition but shifts the emphasis to collective problem solving and the development of integrated policy, with the goal of realizing the human right to adequate food (Beaudry & Delisle, 2005). A public nutrition approach draws on governmental organizations in many sectors (health, agriculture, education, trade, transport, planning), along with the human and material resources available within a country, and directs them towards the improvement of the nutrition, health, and well-being of the public at large (Rogers & Schlossman, 1997). As Beaudry et al. (2004, p. 375) explain, "Public nutrition targets research, training and intervention. In line with health promotion, it focuses not only on an assessment of the problems and the analysis of their determinants, but also, and above all, on the concerted action required by civil society, the private sector and the government to solve them." Public nutrition thus involves collective action aimed at achieving sustained improvements in the nutritional status and overall health of the population. Such action requires formulating policies that address environmental issues, the need for agricultural development, social inequities, and substandard living conditions, while also promoting "the empowerment of individuals to adopt healthy food habits and to exercise better control over their health generally" (Beaudry et al., 2004, p. 375).

## 2.2 Recent Trends in Nutrition Policy

Over the past few decades, our understanding of the conditions necessary to the creation and maintenance of human nutritional health has likewise evolved. Nutrition now includes epidemiological studies of the prevalence and causes of malnutrition and ill health in various societies and population groups. Such studies provide the evidence base for interventions designed to improve nutritional status.

There has been a steadily growing awareness of the need to link economic, agricultural, and health issues with nutrition. Since the early 1990s, the important issues of food *availability* and food *access* have been widely studied and are now accepted as part of mainstream nutrition science and practice, with implications for food and nutrition policy. Interest in these areas developed during the 1990s in part through a series of global conferences organized by UN agencies, some of which were directly focused on food and nutrition. In 1992, the World Health Organization (WHO) and the Food and Agriculture Organization (FAO) jointly organized the International Conference on Nutrition, hosted by the FAO, in Rome (FAO, 1992). Then came

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the important "World Food Summit" in 1996, followed by the "World Food Summit: Five Years Later" in 2002, and a third "World Summit on Food Security" in 2009, also hosted by FAO in Rome (FAO, 1996, 2002a, 2002b, 2009a, 2009b). All were particularly significant regarding the further development of a human rights approach to food and food security.

## 2.3 The Global and National Food Security Situation

In 2013, the FAO estimated that 842 million people were undernourished (FAO, 2013, p. 8). Thus, around one in eight people in the world are likely to have suffered from chronic hunger, not having enough food for an active and healthy life. The vast majority of them live in developing regions. However, enough food exists to feed everyone in the world. In fact, notwithstanding disparities, most countries possess enough food to feed their population. In reality, most hunger is due to poverty and inequalities in food access.

Food security is not merely a matter of having enough food to supply energy. Food security is defined as having physical and economic access to food that is of sufficient quantity and nutritional quality to satisfy dietary needs (implying an adequate macro- and micronutrient intake) and that is safe and culturally acceptable (FAO, 1996). In other words, it is not enough simply to prevent undernutrition: people everywhere are entitled to a diet that will not cause obesity and associated chronic diseases, such as diabetes. Access to such a diet is often impossible for people living in poverty, as cheap foods are often energy dense but nutrient poor. Food security can only be achieved when individuals and households have the resources needed to obtain nutritionally adequate food. In an urban environment, this normally means having enough money to buy healthy foods; in a rural environment, it often means that people must have the agricultural resources to produce food, as well as money to purchase what they cannot grow themselves.

## 2.4 The Causes of Malnutrition: The UNICEF Conceptual Framework

Nutritional status and well-being depend on both dietary intake and overall health status. There are, however, many varied causes or determinants of malnutrition, as shown in the UNICEF conceptual framework (see Figure 1.1). Several important features of this framework should be noted. First, it is generic and thus can be used to analyse malnutrition in any context. That is, it does not apply only to specific situations. The framework includes a number of possible causes of malnutrition, and some, but not necessarily all, of these causes will apply in a given context. Second, information about the relative contribution of the varied causes of malnutrition in a specific context can be determined using this framework. Finally, the possible causes of malnutrition are presented in a hierarchy. This allows us to analyse the causes of malnutrition at different levels, as follows:

- The obvious *immediate* causes of inadequate food and nutrition intake and possible confounding infectious disease factors
- The *underlying* causes that can be clustered around food insecurity or inadequate access to food, inadequate care of the vulnerable, and inadequate control and prevention of disease, including adverse environmental sanitary conditions and inadequate health services
- The *basic* causes of malnutrition related to the resources available within a society and how they are used and controlled

Those who exercise power do not always use available resources – natural, financial, organizational, or human – in the best interests of those most in need of them. In practice, the distribution of resources is determined by prevailing economic, ideological, and political conditions. A change in the underlying and basic causes of malnutrition and hunger will therefore require redressing fundamental social, economic, and political inequities. In other words, nutrition should be seen as a problem area that may require solutions at a variety of levels – the individual, the household, the local community, and the broader society.

## 2.5 Social Injustice

Social injustice means that individuals or groups of people are treated very unequally: they do not have the same access to resources or opportunities, such as schooling, paid work, or good health care. The huge

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discrepancies in the average standard of living in different countries, as well as the discrepancies within countries, are of great concern, for two reasons. First, enormous numbers of people have an unacceptably low standard of living; this results in malnutrition, poor mental and physical development, ill health, and premature death. Second, it is now clear that in addition to the direct material deprivation suffered by those with a low standard of living, the presence of inequalities in society also leads to increased malnutrition, poor mental and physical health, and premature death. Globally and for practically all countries in the world there is enough food to satisfy people's energy requirements. Thus, the fact that there are nearly one billion people who are undernourished tells us about the extent of social injustice on a vast scale.

A human rights approach has the aim of eliminating social injustices. As we saw earlier in this chapter, Article 1 of the UDHR reads: "All human beings are born free and equal in dignity and rights."

The fulfilment of human rights and the elimination of social injustices, including hunger and malnutrition, would be ensured in a fair society, in terms of social and health policies and political and economic arrangements. In a report published in 2008, the WHO Commission on Social Determinants of Health called attention to existing inequities in global health and issued a call for change (see Box 1.3).

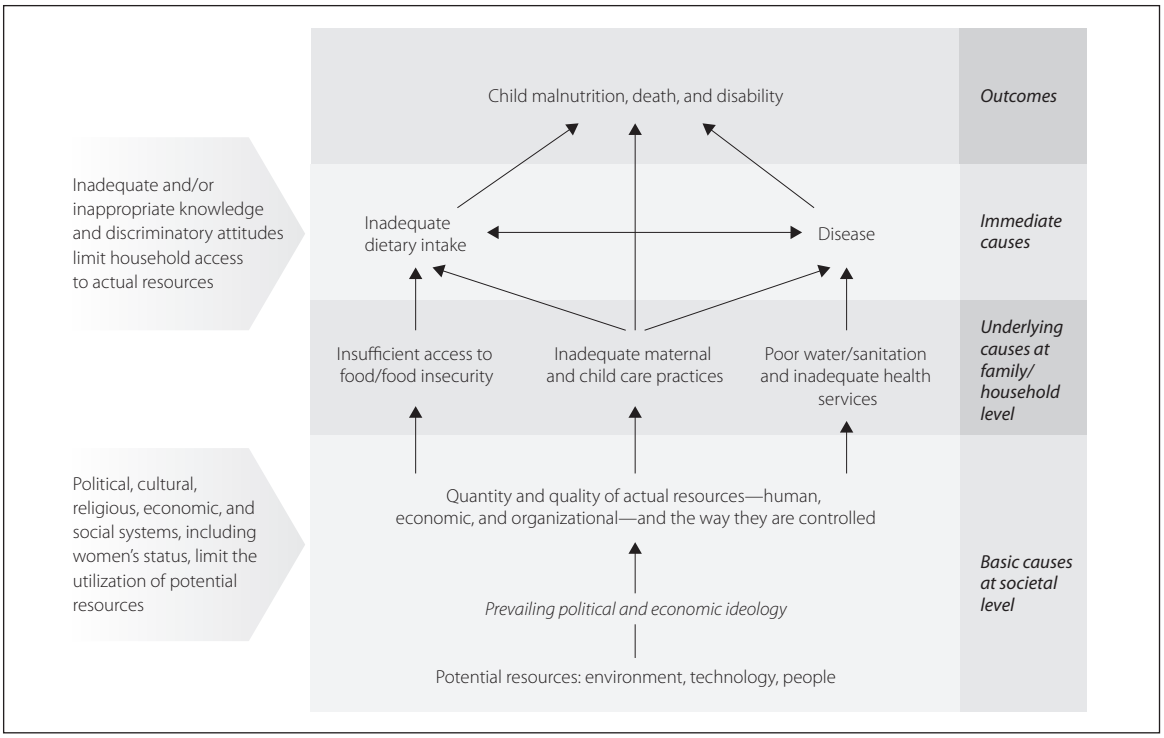


**Figure 1.1:** The UNICEF conceptual framework for understanding the causes of malnutrition. Adapted from *The State of the World's Children* (UNICEF, 1998).

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**Box 1.3:** A New Global Agenda for Health Equity

> Our children have dramatically different life chances depending on where they were born. In Japan or Sweden they can expect to live more than 80 years; in Brazil, 72 years; India, 63 years; and in one of several African countries, fewer than 50 years. And within countries, the differences in life chances are dramatic and are seen worldwide. The poorest of the poor have high levels of illness and premature mortality. But poor health is not confined to those worst off. In countries at all levels of income, health and illness follow a social gradient: the lower the socio-economic position, the worse the health.
>
> It does not have to be this way and it is not right that it should be like this. Where systematic differences in health are judged to be avoidable by reasonable action, they are, quite simply, unfair. It is this that we label health inequity. Putting right these inequities – the huge and remediable differences in health between and within countries – is a matter of social justice. Reducing health inequities is, for the Commission on Social Determinants of Health, an ethical imperative. Social injustice is killing people on a grand scale. (WHO Commission on Social Determinants of Health, 2008: Executive Summary)

## 2.6 The Millennium Development Goals (MDGs)

As explained above, as part of an effort to reduce social injustice, in the year 2000 the countries of the world agreed on the Millennium Declaration, out of which evolved the eight Millennium Development Goals (MDGs). These goals and their associated targets are shown in Box 1.4. As we suggested in section 1.3, the MDGs need to be promoted in the context of human rights, democracy, and good governance; this was the idea brought forward in the Millennium Declaration. It is therefore important that the principles of an approach based on human rights are applied in all efforts to reach the MDGs. Thequestion of human rights will be discussed below, in section 3. As students or as nutrition professionals, we can reflect on how the MDGs can be achieved as we read through the eight MDGs and their associated targets. We should also consider the extent to which success in reaching several of the MDGs depends on developments in nutrition programmes and services. Nutritionists and dietitians can actively use the MDGs to promote their causes and help politicians and planners see the direct links to good nutrition status.

The UN estimates that there have been significant advances towards meeting the MDGs, albeit with important setbacks in some areas. For example, regarding child mortality (MDG 4), annual deaths of children under 5 years of age fell to 8.8 million in 2008, down by 30% from 1990. Similarly with Goal 1 and its target to reduce hunger, children's nutrition has improved: the percentage of underweight children is estimated to have declined from 25% in 1990 to 16% in 2010. However, 104 million children are still undernourished. Stunting in children under 5 years old has decreased globally from 40% to 27% over the same period. In the UN Africa Region, unfortunately, the number of stunted children is projected to increase from 45 million in 1990 to 60 million in 2010.

**Box 1.4:** Millennium Development Goals

**Goal 1: Eradicate extreme poverty and hunger**

- Reduce by half the proportion of people living on less than a dollar a day
- Reduce by half the proportion of people who suffer from hunger

**Goal 2: Achieve universal primary education**

- Ensure that all boys and girls complete a full course of primary education

**Goal 3: Promote gender equality and empower women**

- Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015

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**Goal 4: Reduce child mortality**

- Reduce by two thirds the mortality rate among children under five

**Goal 5: Improve maternal health**

- Reduce by three quarters the maternal mortality ratio

**Goal 6: Combat HIV/AIDS, malaria, and other diseases**

- Halt and begin to reverse the spread of HIV/AIDS
- Halt and begin to reverse the incidence of malaria and other major diseases

**Goal 7: Ensure environmental sustainability**

- Integrate the principles of sustainable development into government policies and programmes
- Reverse loss of environmental resources
- Reduce by half the proportion of people without sustainable access to safe drinking water
- Achieve significant improvement in the lives of at least 100 million slum dwellers by 2020

**Goal 8: Develop a global partnership for development**

- Develop further an open, rule-based, predictable, and non-discriminatory trading and financial system
- Include a commitment to good governance, development, and poverty reduction – nationally and internationally
- Address the least developed countries' special needs
- Include tariff and quota-free access for their exports
- Enhance debt relief for heavily indebted poor countries
- Cancel official bilateral debt
- Give more generous official development assistance for countries committed to poverty reduction
- Address the special needs of landlocked and small island developing states
- Deal comprehensively with developing countries' debt problems through national and international measures
- Make debts sustainable in the long term
- Develop decentralized productive work for youth
- Cooperate with developing countries
- Provide access to affordable essential drugs in developing countries
- Cooperate with pharmaceutical companies
- Make available new technologies, especially information and communications technologies
- Cooperate with the private sector

NOTE: Since the MDGs were formulated, a proposal for a worldwide goal for the prevention and control of chronic diseases of lifestyle has been made (Strong et al., 2005); the target is a 2% reduction per year in death rates attributable to the major chronic diseases of lifestyle (heart disease, stroke, cancer, diabetes, and chronic respiratory diseases).

## 2.7 Nutrition Professionals: Exploring a Human Rights–Based Approach

The abolition of hunger and malnutrition should be a priority for the governments of all developing countries. From both a nutritional and a human rights perspective, it is important that the current substantial differences in living standards, nutrition, and health are significantly reduced. This will require the coordinated input of many sectors and departments and will be important in achieving the MDGs.

There is also a strong case for using an approach based on human rights in community nutrition. Human rights provide a specific perspective and opportunity that nutrition professionals need to be aware of when addressing nutritional problems (Maunder & Khoza, 2007). A rights-based approach to nutrition aims to ensure that the resources in a country are managed and utilized justly and equitably; this will help to secure

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adequate nutrition and health for all. This applies at both a community and household level. Such an approach may be pursued in the context of national constitutional rights, or, if they do not exist, of international human rights law – the majority of countries have now ratified the human rights conventions relevant to food and nutritional health.

Nutrition professionals need to have an understanding of their countries' obligations – constitutional or otherwise – for the achievement of human rights, as will be explained in section 3.2. More specifically they need to understand the meaning of a human rights perspective on nutrition and food security. Nutrition professionals need to work with government agencies and institutions, non-governmental organizations, and civil society in the development and implementation of programmes promoting the right to adequate food and other rights important in the promotion of good nutrition and health.

# 3. PROTECTING HUMAN RIGHTS IN THE CONTEXT OF ECONOMIC AND SOCIAL DEVELOPMENT

## 3.1 Human Rights as Goals and Means in Development

To understand what can be gained by applying a human rights approach to community nutrition, some basic information is first needed about the nature and meaning of human rights. Such information is not an end in itself; rather, it will open a window to a different way of thinking and working with national and human development as *the realization of human rights*. We may also think of the realization of human rights as *the condition for development*. Thus we can view human rights both as *goals* and also as *mean*s to national and human development.

## 3.2 Rights and Duties

When people have a right, there are always others who have a duty to help fulfil that right. Who, then, have rights and can thereby be named "right-holders," and who have duties and therefore become "duty-bearers"?

In the international legal system of human rights protection and promotion *the state* is the primary duty-bearer, with obligations towards all people under its jurisdiction to help them realize their human rights. This applies to states that have formally agreed to – or "ratified" – a human rights convention. But what is "the state"? First, there is the *state authority* proper, which is the government ministers or other politicians; their role as duty-bearers is to prepare laws that promote human rights as well as the policies for implementing them. In addition, there are many other duty-bearers on behalf of the state. They consist of institutions and individuals through whom the central or local government works to execute laws and implement policies and programmes: for example, by delivering various services according to state authority commitments. *Governance* is a term used to mean "the act of governing." *Good governance* has come to mean governing based on some clearly expressed values, which ought explicitly to include human rights as primary.

A community nutritionist or dietitian, who is an employee of a government-run district health station or clinic, has a duty to help realize human rights within their scope of work. To assess whether this actually happens must be done with an understanding of the often quite limited capacity of many institutions and their staff. For example, in nutrition within primary health care, the limitations may arise from broader shortcomings in the health delivery system, such as insufficient training and resources.

Community nutritionists can help clarify obligations of the state by gathering and analysing data that can be used to expose shortcomings and indicate better solutions to nutrition problems. Nutritional data are irrefutable as evidence of whether the rights to food, health, and care have actually been fulfilled, or whether efforts towards it are at least going in the right direction. Community nutritionists can also show respect for exposed people and groups by drawing them into analysing and working on their own situation and helping them clearly understand that they have rights that can be claimed.

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## 3.3 Where Do We Find Human Rights – and How Are They Used?

### *3.3.1 The meaning of human rights "instruments," binding and non-binding*

The word *instrument* has different meanings. In the present context it can be a certain law; in international law it is typically called a *convention* (or treaty), in national law it is the constitution or specific legislation, or official directives of various kinds set by the government.

Generally, an international instrument is either "binding" or "non-binding." A binding convention (or treaty) requires that (1) the state should incorporate its content into its own legislation and also implement it in practice, and (2) the state should periodically report on its implementation to special committees set up by the UN to monitor how this is followed up in various countries.

In human rights work, binding human rights conventions as well as numerous non-binding declarations have been issued over the years. A declaration is a statement from participants at a meeting of the UN or other organization expressing broad agreement on some issues of concern and how to address them. There may also be *codes of conduct* on how governments should behave, and there may be *guidelines* for more specific action. In neither case is there an explicit obligation to follow up, as is the case for a binding convention. These so-called "soft-law" human rights instruments can only guide governments already interested in trying to meet the human rights of everybody, and especially help vulnerable people and communities to act on their own situation.

### *3.3.2 "Signatures" versus "ratification" of binding human rights instruments*

At the time of formulation and initial adoption of a human rights convention (or treaty) by the UN General Assembly, a member state may sign the convention. This means the member state has the intention to later fully accept the convention by ratifying it. For that to happen, the convention must first go through the main legislative body in the home country, usually the parliament. Here there may be different political opinions about whether the country should ratify the convention. If it decides not to ratify, the country is not bound by the convention. If it decides to ratify, the country becomes a *State Party* to the convention. This move has important implications for how the government should govern that country in the best interests of its people. It will also be exposed to regular monitoring by specific committees set up for that purpose for each convention, called *human rights convention committees* or *human rights treaty bodies*. The country's own compulsory reports, as mentioned above, become one of several tools those committees have for such monitoring. At the same time, civil society organizations are invited to submit reports.

This system of ratification and monitoring is a potentially forceful means for human rights defenders in exposing what their governments do or not do in the interest of people's human rights of all kinds. All state and alternative reports, as well as the committees' concluding observations on each country, are freely available on the internet. Community nutritionists can be important actors in gathering and analysing information that can eventually be used by these committees, whether through formal or informal channels.

### *3.3.3 The key international human rights instruments*

An overview of key international human rights instruments is shown in Figure 1.2. The origin is the United Nations Charter, adopted at the birth of the organization in 1945, serving as its "constitution." The human rights parts (some cited in section 1) were further spelled out in the Universal Declaration of Human Rights in 1948, followed by two international conventions in 1966, the International Covenant on Civil and Political Rights (ICCPR) and the International Covenant on Economic, Social and Cultural Rights (ICESCR). Together the three are called the International Bill of Human Rights.

The overview includes the numbers of ratifications by UN Member States (as of November 2010) for each of the binding instruments. As regards the UDHR, it is established that any state that wants to be and is accepted as a member of the UN automatically thereby commits itself to adhere to both the UN Charter and the UDHR.

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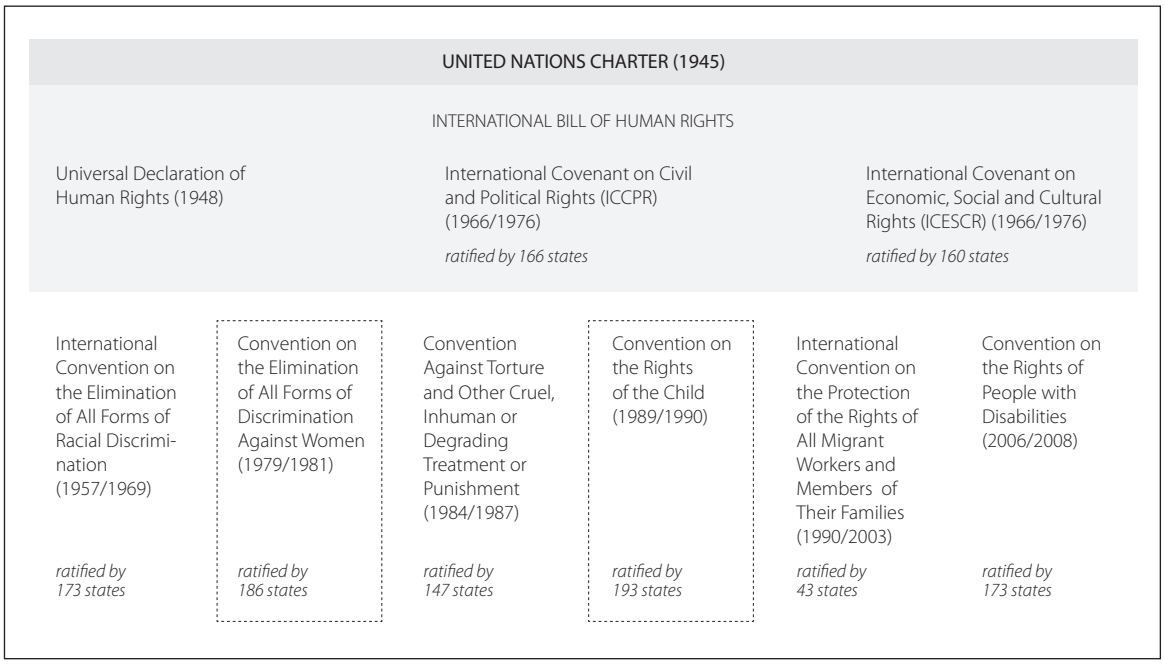


**Figure 1.2:** Overview of the key international human rights instruments. Numbers in parentheses are the date of adoption by the UN General Assembly and the date of entry into force. Boxes indicate those instruments especially relevant to nutrition.
*Source: Adapted from Eide and Kracht, 2005, with the number of ratifications updated as of 1 November 2010.*

### *3.3.4 Regional human rights instruments*

There are also regional human rights instruments that further underpin the international ones, but adapt and enrich them according to special circumstances in the regions. So far there are general human rights instruments (charters, conventions) in the African, Inter-American, and European regions, but not yet in the Asian region.

### *3.3.5 The nature and categories of obligations of a state*

In states that have ratified a human rights convention, the government must help ensure the rights of individuals and their families. How can this be generally expressed in terms of duties or obligations? In international human rights language, three categories of obligations have been identified for the state: to *respect,* to *protect,* and to *fulfil* a certain right, where *fulfil* has been divided into *facilitate* and *provide* (Eide A, 1987; CESCR, 1999). This categorization is particularly important in the case of economic, social, and cultural rights, and will be illustrated for the right to adequate food in section 4.

## 3.4 A Human Rights–Based Approach to Development Efforts

### *3.4.1 Basic needs and human rights*

A rights-based approach to development efforts focuses on the fact that the rights of access to certain goods and services are regarded as human rights. It implies, as we have seen, that the state has an obligation to respond to human needs and that people can claim and defend these rights. This differs from the "basic needs approach," which often views people as passive objects and recipients of protection and care. A rights-based approach, by contrast, recognizes people as active and participatory subjects. But rather than replacing a needs-based approach, a rights-based approach therefore adds value to it by empowering people – especially

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the most marginalized – to demand justice as a right rather than as charity, participate in policy formulation, and hold accountable those who have a duty to act (UNHCHR, 2006).

### *3.4.2 Process and outcome*

A basic needs approach can be implemented by merely aiming for a desired goal or outcome regardless of how that outcome is achieved. But a human rights–based approach also requires attention to a good process leading to that outcome. This may be critical for achieving the end result and for sustaining it. As described below, applying certain values drawn from core human rights principles in designing a project or programme or in organizing a particular service may go a long way to ensuring a process that is respectful of the felt needs and contributions of the groups in question, and that may therefore have a chance of being sustained after the external project or programme has ended.

### *3.4.3 Core principles of a right-based approach*

There are seven core principles of a rights-based approach. These are participation, accountability, non-discrimination, transparency, human dignity, empowerment, and the rule of law. As coined by the FAO, the first letter in each principle forms the acronym PANTHER. The principles are not mere rhetorical or inspirational values: they are preconditions for a meaningful and dignified human existence:

1. *Participation* underscores the importance of involving all players in decisions affecting their lives and the development of their own well-being. It is based on the notion, mentioned above, that people must not be treated as passive objects but as active participants in decisions affecting them. A rights-based approach emphasizes active, free, and meaningful participation of all affected segments of society. In the context of community nutrition this means people should be consulted when conducting surveys and gathering statistics. Furthermore, they should be involved in developing and implementing nutrition policies affecting their communities.
2. *Accountability* is a particularly important democratic and human rights principle. The state, as the primary duty-bearer, can be held accountable for its commitments and promises that are relevant to the realization of the right to food. A rights-based approach encourages the development of targets, indicators, and benchmarks to measure progress. These are essential preconditions to holding governments accountable. In keeping with human rights norms, they must be developed with participation of the community members.
3. *Non-discrimination* requires that the guaranteed right to food be essentialy the same for every person. People must therefore not be treated unequally, or discriminated against, on the basis of age, race, gender, sex, culture, or religion. In the context of nutrition, this can mean that people of certain cultural groups must not be deprived of their traditional ways of producing food.
4. *Transparency* is closely associated with accountability. It means making information publicly accessible and available. When nutrition-related policies are being developed, the state should consult with the public. People should also be provided with essential information about the decision-making process and who is accountable and responsible for what.
5. *Human dignity* is an essential principle of a rights-based approach. It refers to the absolute and inherent worth that people possess simply because they are human, not by virtue of any social status or particular powers. It is concerned with the dignified treatment of all. It discourages the notion of charity or handouts, because of the indignity this can entail for poor and marginalized groups. It encourages an environment in which people can obtain food through dignified work.
6. *Empowerment* is concerned with the ability of people to meaningfully participate in decisions affecting their lives. This means, for example, that people must be made aware of services they are entitled to and the associated responsibilities attached to receiving those services.
7. *The rule of law* deals with legal issues and redress mechanisms. It encourages the government and society to respect the rights of individuals. If people's rights are violated, there must be means of redress available, such as administrative mechanisms, "tribunals," or the courts. The rule of law also refers to the environment in which people are working, and it is a safeguard against arbitrary use of state authority and lawless acts of

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both individuals and organizations. For example, it is not possible for school feeding schemes to function well and achieve their objectives if there is theft of the food stocks.

Some of these principles, especially participation and transparency, have existed for decades in typical "development language." The specificity of human rights lies in the absolute and non-negotiable emphasis on the principles of human dignity, non-discrimination, accountability, and – by implication – respect for the rule of law. While human rights principles are derived from ethical and moral values, they have potentially a much stronger foundation in that these values have been transformed into legal principles and can be used to defend the rights of the most vulnerable groups in society and make it more likely that such groups will enjoy the fruits of economic and social development.

Finally, an approach based on human rights deviates from many conventional development approaches in that it (1) sets clear demands to governments to do what they have promised and (2) finds ways to hold a government accountable for its promises.

### 3.5 Claiming One's Rights: What Options Exist?

The realization of human rights depends on good governance at all levels of the state and requires that the people themselves or their representatives (in parliament, in local government) be listened to and enabled to participate in democratic decision-making. It means they must be able to voice their concerns, ideas, and demands via their own organizations, such as non-governmental organizations (NGOs) and community-based organizations (CBOs).

Politicians are expected to take these considerations into account, but whether they eventually do is another story. If they don't, then rights-holders should be able to claim their rights through so-called *remedial measures.* This could consist of bringing, for example, right-to-food violations before the courts. But there are also many other possible recourse mechanisms through which to claim one's rights and obtain reparation for violations. In a number of countries, such functions are exercised by national ombudsmen or human rights commissions.

## 4. ECONOMIC, SOCIAL, AND CULTURAL RIGHTS ESPECIALLY RELEVANT TO NUTRITION

### 4.1 From Causality to Normative Analyses and Aspirations

We have now presented some basic information regarding human rights. We shall now bring it all back to nutrition. How can human rights provide a new perspective on problems of hunger and malnutrition in all forms and contribute to their solution, given that the problems are often rooted in social inequalities and injustice?

The conceptual framework shown in Figure 1.1 depicted a range of immediate, underlying, and basic *causes* of malnutrition. We can talk about a similar range of *conditions* for achieving good nutrition, conditions that permit the realization of the rights to adequate food, to good health, and to adequate care. Human rights law obliges a government to ensure that the resources of the country (or province, district, or municipality) are controlled, managed, and utilized in a way that benefits the whole population. This requires policies and measures that guarantee the *basic* conditions for the realization of these rights, which in turn become the *underlying* conditions for an individual's adequate food intake and absence of disease – those *immediate* conditions for good nutritional status that all community nutritionists will strive to ensure.

A normative framework such as that shown in Figure 1.3 will suggest the factors that may affect the immediate as well as the underlying conditions for good nutrition. It will also suggest changes that are needed at several more basic levels – local, national, or international. Many of these changes are beyond the scope of what nutritionists and dietitians are able to accomplish on their own, but this framework will help them understand both the constraints and opportunities that influence their work. This in turn will help them make that work as effective as possible, preferably in collaboration with people employed in other sectors who carry out complementary analyses and action.

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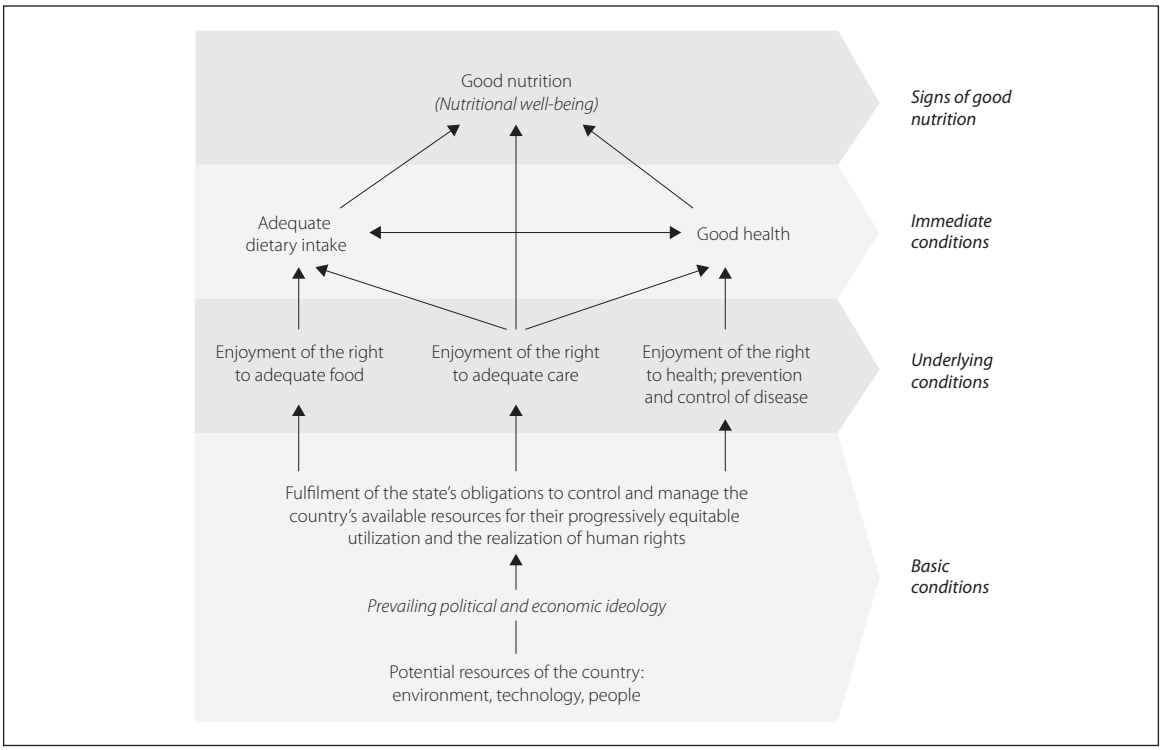


**Figure 1.3:** Normative framework depicting the conditions necessary for ensuring good nutrition at the national level, with specific reference to human rights.
*Source: Adapted from the UNICEF conceptual framework for understanding the causes of malnutrition shown in Figure 1.1.*

## 4.2 The Human Right to Adequate Food: Legal Provisions and Evolving Interpretations

Each of the three underlying conditions for good nutrition or nutritional well-being in Figure 1.3 is reflected in human rights law. Here we focus on the meaning of the right to food (the same kind of reasoning applies to the other two rights).

The state has an obligation to take reasonable measures to ensure the right to food. In common with other economic and social rights, the realization of the right to food is constrained by important notions such as "progressive realization" and "to the maximum of a country's available resources." Most states can normally only help realize the right progressively, over time. However, a plan should be made with clear targets as well as indicators and benchmarks for ascertaining progress. At the same time, the urgent needs of those in desperate circumstances must be addressed as far as possible on an urgent basis. Some states use the "available resources" constraints to justify why they cannot fulfil a right. Such an argument becomes unacceptable, however, when their budget clearly favours privileged groups in society at the expense of disadvantaged groups, such as children and women.

We are not talking here about people being given access to food on demand – the requirement is for the state to create environments conducive to people being able to feed themselves through their own labour, whether in production or other work that ensures sufficient revenue (Khoza, 2007). Or, in the words of the UN Special Rapporteur on the right to food, Olivier De Schutter (2010, p. 1):

> The right to food is not primarily the right to be fed after an emergency. It is the right, for all, to have legal frameworks and strategies in place that further the realization of the right to adequate food, as a human right recognized under international law. By directing the adoption of these policies, the right to food is a compass to ensure that policies are geared towards alleviating hunger and malnutrition.

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Having examined the situation in various countries, De Schutter also points to the importance for countries to give "concrete meaning to the right to food principles in their constitutions, laws, courts, institutions, policies and programmes, and for various food security topics, such as fishing, land, focus on vulnerable groups, and access to resources." And he concludes: "These processes, while much less visible than plain increase in food production, are key steps for lasting progress" (De Schutter, 2010, p. 1).

## 4.3 The Right to Food Guidelines

At the second World Food Summit in 2002, a decision was made to develop a practical tool for governments to use in taking action to help realize the right to food. The process led to the *Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security.* Adopted by the FAO Council in 2004 (FAO, 2005), these guidelines are now commonly known as the Right to Food Guidelines.

Nineteen of the Right to Food Guidelines cover a broad area of concerns and issues, with Guideline 10 dealing specifically with nutrition. However, all the others are also relevant to nutrition at different levels of societal organization, and all can be fitted into the normative framework described above. They provide measures that practitioners can choose from, according to their different professional domains and specialties. Besides Guideline 10, students and professionals in community nutrition will also find ample inspiration in many of the other guidelines, some dealing also with economic aspects, including the role of market forces. The Right to Food Guidelines are now frequently referred to and made use of in the international debate and action on the right to food. Combined with the Millennium Development Goals described earlier in this chapter, the Right to Food Guidelines will be useful in community nutrition with regard to most of the dimensions dealt with in this book.

## 4.4 Other Material of Use in a Human Rights–Based Approach to Community Nutrition

A lot of other material is helpful for the promotion of nutrition in the community, especially as regards its dietary dimensions. Here we briefly mention three organizations involved in using a human rights approach: the FAO, the WHO, and the Food First Information and Action Campaign (FIAN). Links that can provide useful material from these three sources are provided at the end of this chapter, in the "Additional "Resources" section.

The FAO is the most active UN agency in promoting and enriching the right to adequate food concept. In 2005, it established a Right to Food Unit – from 2009 called the Right to Food Team – to further promote the right to food, among other things through developing educational material and various tools for use in practical work.

The WHO has not as yet developed specific health-related aspects of nutrition in terms of human rights; however, the organization has an excellent Health and Human Rights Team whose role is to:

- strengthen the capacity of the WHO and its member states to integrate a human rights–based approach to health,
- advance the right to health in international law and international development processes, and
- advocate for health-related human rights.

The Food First Information and Action Campaign (FIAN) is the most significant non-governmental organization working solely with the right to food – or "The right to feed oneself," which is their slogan. FIAN has its headquarters in Heidelberg, Germany, and works in many countries, producing a wealth of interesting country-based information.

## 4.5 Other Rights of Immediate Relevance to Community Nutrition

Good nutrition involves more than having enough food and water of adequate quality. Achieving good nutrition is especially challenging in areas prone to infectious or chronic nutrition-related diseases where the

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sanitary environment and personal hygiene is poor, or in areas where income-earning activities of mothers compete with their time for caring for their young children. All this impacts both on the biological and psycho-social dimensions of an individual's nutritional status and general well-being.

But there are also other economic, social, and cultural rights with important direct impact on the food and feeding situation in a family. These include the right to adequate clothing, housing, and to the continuous improvement of living conditions. Each of these rights is within the concerns of a community nutritionist. Where conditions are unacceptably poor, community nutritionists can help draw awareness to this amongst politicians, international organizations, public planners and programmers, civil society groups, and the general population.

Finally, a range of other human rights may impact nutrition even more significantly, such as the right to work, right to social security, and right to free speech – to mention just a few. A broad, open mind allows a community nutritionist/dietitian to see his or her own work in the context of social, economic, cultural, civil, and political failures while also looking for opportunities by which conditions can be reported and hopefully addressed.

## 5. IMPLEMENTATION OF RIGHTS AT THE COUNTRY LEVEL

There is no blueprint for the realization of the right to adequate food and other nutrition-relevant rights at the national level. Nevertheless, as we have seen, the conceptual developments and refinements over recent years – of the right to food as well as economic, social, and cultural rights more generally – have served to identify a number of key principles that now make it easier to analyse and plan for a rights-based approach to community nutrition in any country. Common denominators are the different categories of obligations of states for economic, social, and cultural rights in general that were described in section 3, and those particular attributes of a right to adequate food that were described in section 4.

But each situation presents a more or less different picture and challenge according to context, just as the UNICEF conceptual framework indicates. For a country or a population group within it, the economic situation, the culture and customs, religion, the prevailing political ideology at any time, attitudes to gender, and other factors all set limits to and/or open opportunities or conditions for how far human rights, including the right to food, will be respected, protected, and fulfilled. Nutrition professionals need to work with human rights practitioners in promoting and protecting the right to food (Maunder & Khoza, 2007).

Since the mid-1990s there has been considerable and increasing interest in giving the right to food a more concrete and operational content. Whilst there is an international framework for the right to food and nutrition security in several international human rights instruments, the implementation at the national and global level is lacking, despite adequate food supplies. Progress has been made in some countries but this needs further development. Intersectoral and interdisciplinary work are required to ensure that legal frameworks, policy frameworks, programmes, the involvement of civil society, awareness, capacity building, and resource allocation will fulfil the rights to adequate food and nutritional health.

As a community nutritionist you can play a critical role in these endeavours. Keep that in mind when studying the rest of this book.

## DISCUSSION QUESTIONS AND EXERCISES

1. Identify which MDG and specific associated targets demand special attention to nutrition in order to be achieved.
2. Outline the international historical milestones of the human rights conventions and declarations relevant to the right to adequate food
3. What does it mean when a government signs and/or ratifies a human rights convention?
4. List the main principles of a rights-based approach and explain the meaning of each.
5. Does every person have the right to be fed by the state? Explain your answer.
6. Explain what is meant by "the right to food" in the context of your country.
7. Based on your observations and personal experiences, discuss how well the right to food is being realized in your country.

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8. Design a normative framework depicting the conditions needed to ensure good nutrition in the context of a household, with reference to the human rights involved. Use the normative framework in Figure 1.3 as a starting point.
9. Compare what your country's constitution has to say about human rights with the Universal Declaration of Human Rights.
10. Discuss the importance of capacity in relation to responsibilities.
11. Discuss whether you would consider community nutritionists employed by the government to be duty-bearers. If yes, what are the implications of this?
12. Use the matrix shown in Table 1.1 (below) to give examples of the obligations of the state with regard to the right to adequate food. You should be able to fill in at least some of the empty boxes from your own knowledge and experience. You can also discuss possible answers with colleagues and friends, who can contribute ideas and thereby help provide a "rich picture" of the constraints and opportunities that surround the right to food. You may also wish to consult the Right to Food Guidelines referred to in section 4.3, which can be downloaded from the FAO Right to Food home page, www.fao.org/righttofood. These guidelines (which are available in six languages) bring a wealth of ideas and suggestions for policies and measures that can be included in the matrix.

**Table 1.1:** The right to food matrix: an aid to conceptualization for analysis and planning.
*Source: Adapted from Oshaug et al., 1994.*

| | | FOOD SECURITY | | | | |
|---|---|---|---|---|---|---|
| NORMATIVE PRINCIPLES (food security attributes) | | Adequate food | | | Sustainable supply of adequate food | Stable access to adequate food |
| CATEGORIES OF STATE OBLIGATIONS | | Sufficient in quantity and nutritional quality | Safe for human consumption | Culturally acceptable | Environmentally and economically sustainable food systems | Physical and economic access to food that is within a household's means |
| RESPECT | | | | | | |
| PROTECT | | | | | | |
| FULFIL | Facilitate | | | | | |
| | Provide | | | | | |

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## ADDITIONAL RESOURCES

### United Nations

General website, information on the United Nations and the United Nations Charter: www.un.org

Charter of the United Nations: https://treaties.un.org/doc/publication/ctc/uncharter.pdf

United Nations Millennium Declaration: http://www.un.org/millennium/declaration/ares552e.htm

Millennium Development Goals: http://www.un.org/millenniumgoals/bkgd.shtml

### Office of the UN High Commissioner for Human Rights

General website: www.ohchr.org

*Frequently Asked Questions on a Human Rights–based Approach to Development Cooperation* of the UN Office of the High Commissioner for Human Rights: http://www.ohchr.org/Documents/Publications/FAQen.pdf

*General Comment No. 4 on the Right to Adequate Housing:* http://www.unhchr.ch/tbs/doc.nsf/0/4694d91a9378221c12563ed0053547e

*General Comment No. 12 on the Right to Adequate Food:* http://www.unhchr.ch/tbs/doc.nsf/0/3d02758c707031d58025677f003b73b9

*General Comment No. 14 on the Right to the Highest Attainable Standard of Health:* http://www.unhchr.ch/tbs/doc.nsf/(symbol)/E.C.12.2000.4.En

*General Comment No.15 on the Right to Water:* http://www.unhchr.ch/tbs/doc.nsf/0/a5458d1d1bbd713fc1256cc400389e94

### UN Special Rapporteur on the Right to Food

General website: www.srfood.org

The current SR on the right to food is Hilal Elver of Turkey; she is the third to fill this position since it was established in 2000. His website contains a wealth of information through his various reports to the UN Human Rights Council and the General Assembly, as well as speeches, documents, and briefing notes.

### Food and Agriculture Organization of the United Nations (FAO)

General website: www.fao.org

Right to food site: www.fao.org/righttofood

See especially the link to the Right to Food Guidelines (FAO, 2005). These are available in six languages. See also:

- Right to Food e-learning course: *A Primer to the Right to Adequate Food* (part of the e-learning curriculum "Right to Food in Practice"): http://www.fao.org/righttofood/knowledge-centre/distance-learning/a-primer-to-the-right-to-adequate-food/en/
- Right to Food – Making It Happen: Progress and Lessons Learned Through Implementation: http://www.fao.org/righttofood/publications/publications-detail/en/c/124301/
- The Right to Food Methodological Toolbox, which offers a series of downloadable publications, including a guide for conducting a right to food assessment, information about methods of monitoring, a guide to legislating for the right to food, and an outline for curriculum development: http://www.fao.org/righttofood/knowledge-centre/rtf-methodological-toolbox/en

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**World Health Organization (WHO)**

General website: http://www.who.int

Health and human rights site: http://www.who.int/topics/human_rights/en/

See especially links to Health and Human Rights Publication series: http://www.who.int/hhr/activities/publications/en/

This includes:

- *25 Questions & Answers on the Right to Health*, and
- *Human Rights, Health, and Poverty Reduction Strategies*, a tool for health policy-makers to design, implement, and monitor a poverty reduction strategy through a human rights–based approach.

**Foodfirst Information and Action Network (FIAN)**

This is the world's largest non-governmental organization working specifically on the right to food in its many dimensions. Its head office is in Heidelberg, Germany. There are national FIAN organizations in many countries.
General website: www.fian.org

**Books**

Eide WB & Kracht U, eds. *Food and Human Rights in Development.*

Volume I: *Legal and Institutional Dimensions and Selected Topics*, 2005.

Volume II: *Evolving Issues and Emerging Applications*, 2007.

These two volumes contain a large number of original contributions from human rights, development, and right to food experts working in various disciplines and sectors. The books can be ordered from the publisher, Intersentia (http://www.intersentia.com/).

Kent G. 2005. *Freedom from Want: The Right to Food as a Human Right.* Washington, D.C., Georgetown University Press. A PDF of the book is available online at http://press.georgetown.edu/sites/default/files/978-1-58901-055-0%20w%20CC%20license.pdf.

A wealth of other useful sources, many relating to the larger global issues of current concern, such as climate change, land grabbing, biofuel production, and food trade, can be found simply by searching the Web for "the right to food."

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# CHAPTER 2

# FOOD SECURITY, DIETARY DIVERSITY, AND BIODIVERSITY

## Food and Nutrition Security in Developing Countries

*Mieke Faber and Friede Wenhold*

### *Outline*

- Definition of the concepts of food security, dietary diversity, and biodiversity
- Different levels of food and nutrition security: global food availability, national food availability, household food security, and individual utilization
- Causes of food and nutrition insecurity
- Selected indicators of food and nutrition security
- Community-based actions to address food and nutrition insecurity

### *Objectives*

At the completion of this chapter you should be able to:

- Understand the relationship among the following core concepts:
  - Poverty
  - Food security (global, national, household, and individual)
  - Vulnerability to food insecurity
  - Food availability
  - Food access
  - Food utilization
  - Sustainability
  - Nutrition security
  - Dietary diversity
  - Biodiversity
- Discuss in depth the characteristics of the different levels of food and nutrition security
- Explain the risk factors for and causes of food insecurity at the global, national, household, and individual levels
- Describe indicators of food and nutrition insecurity
- Discuss community-based actions to address food and nutrition security

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# 1. INTRODUCTION

The concept of food and nutrition security has evolved over time. Formerly, the emphasis was purely on the physical availability of food at the global and national levels, but the focus has now shifted to the provision of nutritionally adequate food for individuals and the role of poverty reduction in sustained access to food.

The term "food security" originally focused solely on the availability of food. The underlying reasoning was that if governments ensure that enough food is available for feeding their populations, then hunger will disappear. However, this proved to be a false assumption. During the 1972–1974 food crisis, highly unstable food supplies and prices on the world market emerged as the main problem. This led to the realization that food availability at the national level did not automatically translate into food security at the household level. The concept of food security was thus broadened to include the need for households to have both physical and economic access to the national food supply. In addition, a distinction was made between chronic and transitory food insecurity, giving the concept of food security a temporal dimension. During the 1990s the concept of food utilization also became prominent, with the realization that food security must eventually be considered at the level of the individual. Furthermore, it was recognized that environmental hygiene, safe drinking water, and a sufficient supply of micronutrients were essential to "nutrition security" – that is, an individual's right of access to nutritionally adequate food. Twenty-first century thinking on food and nutrition security situates the goal of decreasing hunger and malnutrition in the context of sustainable development. Addressing food insecurity thus necessitates a holistic approach that includes the global reduction of poverty (FAO, 2008a; Frankenberger & McCaston, 1998; Weingärtner, 2009). This objective is articulated in the first of the eight Millennium Development Goals of the United Nations, described in section 2.6 of Chapter 1: "Eradicate extreme poverty and hunger."

# 2. DEFINING THE CONCEPTS

Food security is more than simply access to enough food to prevent death by starvation. The current understanding of food security accordingly emphasizes the quality of the diet – on the need for dietary diversity and for food that supplies the micronutrients necessary to create and sustain health. Poor people generally lack the resources to either produce or purchase adequate amounts of nutritious food. It therefore follows that *poverty* is the main cause of food insecurity.

## 2.1 Forms of Poverty

Because so many of the components of poverty are difficult to measure quantitatively, we tend to think of poverty purely in economic terms, as a lack of adequate wealth. For example, an individual who earns less than US$1 per day is defined as poor, as is a family whose combined income falls below the national poverty line (the minimum income needed by households to cover food and essential non-food expenses). But the concept includes other forms of deprivation. Poor people may, for example, have little or no access to education or to medical treatment when needed. They may lack political freedom or be rendered powerless by the social system within which they live. Any person who is unable to satisfy his or her basic needs is said to be in poverty.

*Food poverty* refers to a household's inability to access a nutritionally adequate diet. The food poverty line is based on the per capita cost of purchasing a food basket that provides a balanced diet sufficient to meet the average dietary energy requirements (ADER). A household that cannot afford to spend even this amount is regarded as poor. Critical food poverty refers to the proportion of the population whose income is below that required to access enough food to meet the *minimum* dietary energy requirements (MDER).

Poverty leads to malnutrition, and malnutrition reduces people's ability to learn, work, and care for themselves and their families. Thus, not only does poverty produce malnutrition, but a lack of adequate nutrition is itself an underlying cause of poverty.

## 2.2 Food Security

The Food and Agriculture Organization (FAO) of the United Nations defines *food security* as a condition that exists "when all people, at all times, have physical, social and economic access to sufficient, safe, and

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nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2008a). *Household food security* refers specifically to food security at the family level, with the focus falling on individual members of a household (FAO, 2009). Conversely, *food insecurity* can be defined as the "limited or uncertain availability of nutritionally adequate and safe foods" as well as the "limited or uncertain ability to acquire acceptable foods in socially acceptable ways" (Bickel et al., 2000). Although food insecurity may simply be caused by the unavailability of food, it may also result from insufficient purchasing power, a lack of the resources required for local food production, and/or the inappropriate distribution or inadequate use of food. Food insecurity may be a chronic condition, or it may reflect seasonal variations in food availability (for example, food shortages prior to the harvest season) or to transitory circumstances.

The four basic elements of food security are as follows (Riely et al., 1999; Weingärtner, 2009):

1. *Food availability* is achieved when sufficient quantities of food are consistently available. Although the term *availability* can refer to food supplies at the household level, it generally refers to food supplies at the regional or national level. National food availability depends on domestic food production, commercial imports and exports, food aid, and domestic food stocks.
2. *Access to food* presumes physical access and depends on the household's purchasing power and ability to secure foods from the market or from other sources, such as household gardens or in-kind transfers of food.
3. *Food utilization* refers an individual's ability to derive the greatest possible nutritional benefit from food. Food utilization is fundamentally a biological process, dependent not only on the intake of sufficient nutrients but on an individual's overall health status. But food utilization is also influenced by factors such as the quality and safety of food, its manner of preparation, hygiene and sanitation, an individual's food habits and preferences, the intra-household distribution of food, and good feeding and caring practices.
4. *Stability,* or *sustainability,* refers to the temporal dimension of food security – that is, to the capacity to maintain the conditions necessary to food security.

To achieve genuine food security, all four elements must be present. Access to food obviously presupposes that food is available, but availability does not guarantee access. In turn, food access is necessary but, in itself, insufficient to ensure adequate food utilization. For effective food utilization, households need a diet that provides sufficient energy and nutrients, as well as safe drinking water and adequate sanitation. In addition, knowledge within the household of food storage and processing techniques, basic principles of nutrition, proper child care, and illness management is crucial to food utilization (Riely et al., 1999; Weingärtner, 2009).

## 2.3 Vulnerability to Food Insecurity

Vulnerability refers to the risk of food insecurity and, by extension, malnourishment. It is determined not only by the degree to which an individual or group is exposed to factors that place them at risk of becoming food insecure but also by their degree of resilience – their relative ability to cope with events that create instability. Like food insecurity itself, vulnerability may be a temporary condition, arising from changes in the surrounding environment over which people have little or no control, such as a drought, an earthquake, or a war. But vulnerability is very often structural, in the sense that the risk of food insecurity is built into the circumstances of people's lives. Structural vulnerability results when people must live with conditions that place them at risk and that are either chronic or very slow to change – persistent difficulties in finding employment, for example, or the presence of debilitating health problems, such as HIV/AIDs. Such people are in a precarious position, which undermines their ability to cope with stress, that is, shifts in circumstances that threaten their already tenuous economic status or otherwise upset the balance of their lives. People who are food secure may be exposed to the same risks, but they are able to withstand them (FAO, 2002).

## 2.4 Nutrition Security

Nutrition security is a somewhat broader concept than food security. To achieve nutrition security, individuals need more than just access to sufficient, safe, and nutritious food. They must also have safe water and adequate sanitation; the ability to access health care services; and knowledge of sound household and community practices in child care, food storage and preparation, and hygiene (UNICEF, 1990).

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Nutrition insecurity can present as various forms of malnutrition. The term *malnutrition* refers to a range of conditions that result from deficiencies, excesses, or imbalances in the consumption of macro- and/or micronutrients. Although we usually associate malnutrition with a *lack* of nutrition (that is, undernutrition), it can also occur in tandem with *over*nutrition.

- *Undernutrition* reflects an inadequate food intake – one that is deficient in energy, protein, and/or vitamins and minerals – or poor biological utilization of the nutrients consumed, mostly as a result of frequent infections.
- *Overnutrition* reflects overall excess (eating too much) or an excess of certain food components such as saturated fats and added sugars (eating too many of the wrong things) in combination with low levels of physical activity, typically resulting in overweight and obesity. Although individuals suffering from overnutrition are almost always food secure, they are not necessarily nutrition secure.
- *Hidden hunger*, also known as micronutrient malnutrition, occurs when the diet is deficient in essential micronutrients, i.e., vitamins and minerals.

Infants and young children (under the age of 5) and women who are pregnant and lactating tend to be the most vulnerable to both food and nutrition insecurity. Other vulnerable groups include female-headed households, elderly people, people who have disabilities, individuals living with HIV/AIDS, and victims of events such as natural disasters or civil conflict (Riely et al., 1999; Millennium Project Task Force on Hunger, 2004).

## 2.5 Overlap of Food Insecurity and Nutrition Insecurity

Food insecurity and nutrition insecurity are closely linked, as Figure 2.1 illustrates. The outer oval represents a nutritionally insecure population, with the ovals within that oval representing specific subsets of that population – the food insecure, the hungry, the undernourished, and the overnourished. The way in which these ovals overlap illustrates the relationships among these various subsets.

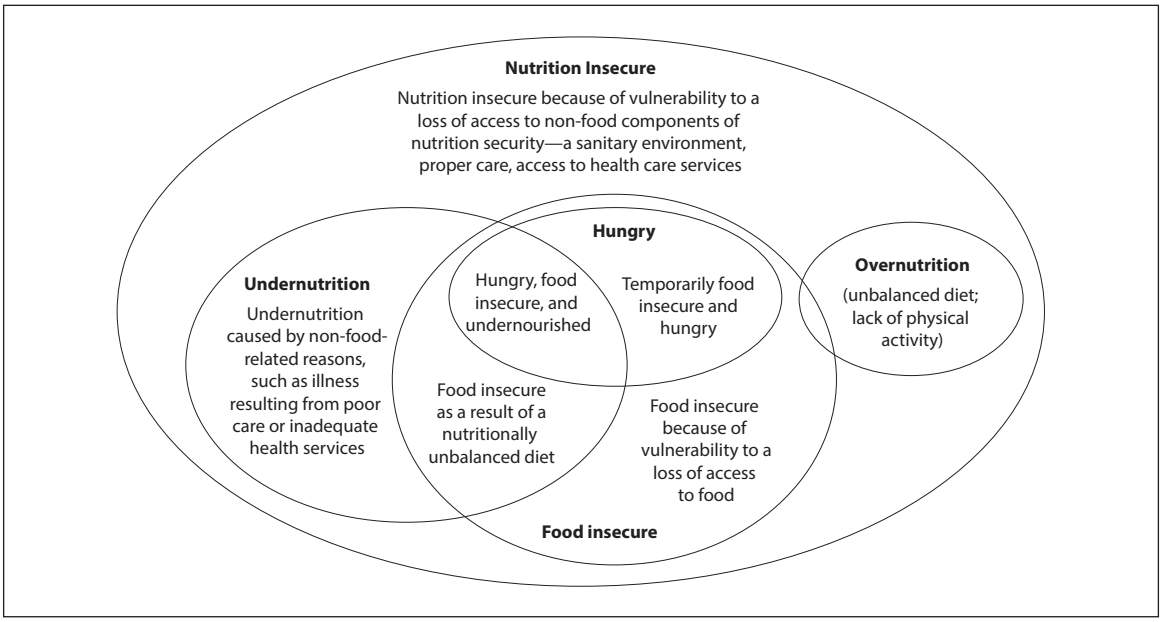


**Figure 2.1:** Overlapping concepts in the context of food and nutrition insecurity.
*Source: Benson, 2008.*

The "Hungry" oval refers to people who are involuntarily hungry, whether chronically or temporarily. As the figure indicates, all people who suffer from hunger are food insecure (whether chronically or temporarily), but

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not all food insecure people are hungry. In other words, hunger is a potential, but not a necessary, consequence of food insecurity (Bickel et al., 2000).

The overlap of the "Overnutrition" oval with the "Food insecure" oval reflects emerging evidence that obesity is in some cases a result of moderately food insecure households relying on inexpensive foods that tend to be high in fat and energy but poor in nutrients. Many poor people simply cannot afford to consume a balanced diet (Benson, 2008). Instead, people in lower socio-economic groups drift towards poor-quality, energy-dense foods because these foods are cheap (Kennedy et al., 2004). The result is a rise in obesity even in food insecure populations. (For more on the relationship between diet cost and diet quality, see Chapter 19 in this volume.)

Mason (2003) illustrated a positive association between child growth and household food security. However, while the inverse may also apply, poor child growth is not necessarily caused by food insecurity: it can be due to non-food-related factors as well. This is illustrated in Figure 2.1 by the section of the oval representing the undernourished population that does not overlap with the food insecure oval.

## 2.6 Dietary Diversity

*Dietary diversity* refers to the variety of foods and/or food groups in the diet. It can be assessed at various levels: national, household, and individual. At the household and individual level, dietary diversity scores are the sum of the different foods or food groups consumed over a specified time period (usually 24 hours).

At the household level, dietary diversity scores are useful indicators of the household's economic ability to access a variety of foods (Kennedy et al., 2011). For most countries, in both rural and urban settings a positive correlation exists between dietary diversity and household per capita income (Kennedy, 2004).

Consuming a variety of foods is needed to ensure a nutritionally adequate diet. Dietary diversity scores can thus be used at the individual level to reflect the nutritional quality of the diet (Steyn et al., 2006). Dietary variety should, however, not be equated with diet quality. For example, consuming a variety of foods that are high in energy may contribute to overweight and obesity. Poor households often cope with poverty by adopting monotonous diets that are based mainly on starchy staples with little or no animal products and few vegetables and fruit. Such diets may meet energy needs but tend to be low in micronutrients.

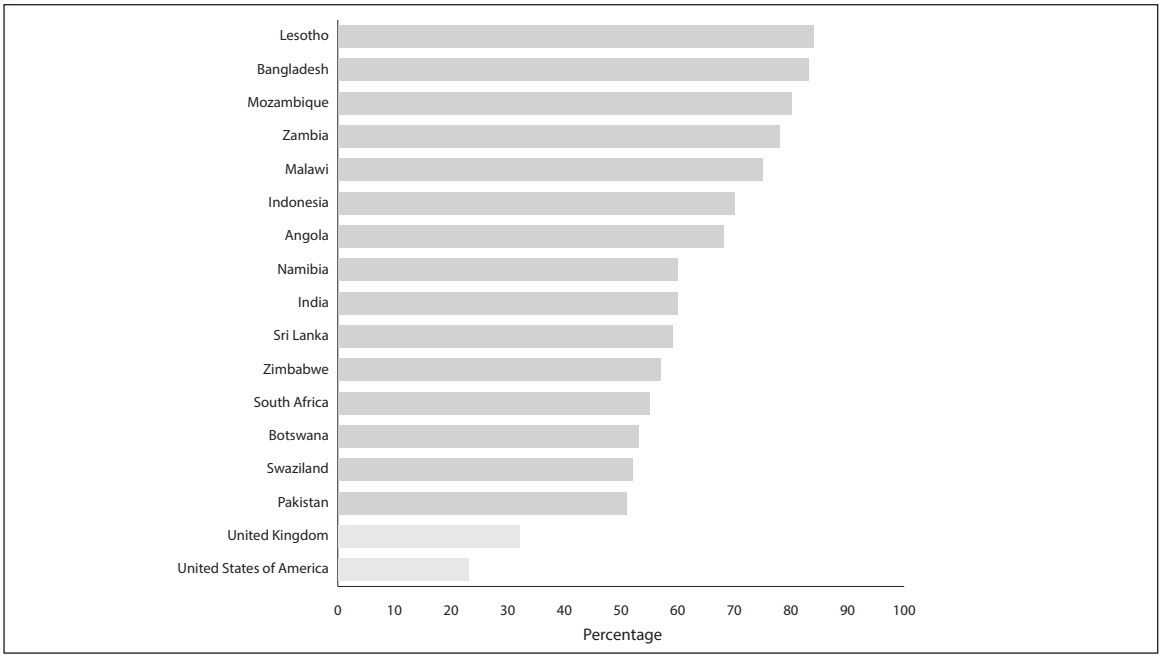


**Figure 2.2:** Percentage of total dietary energy supply derived from starchy foods for a selection of developing and industrialized countries (2003 to 2005).
*Source: FAO, 2010a.*

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The same can be true at the national level. Figure 2.2 compares the percentage of the dietary energy supply derived from starchy foods (cereals, roots, and tubers) in a number of developing countries and in two industrialized countries, the United Kingdom and the United States, The percentage of energy derived from starchy foods is significantly higher in developing countries – in all cases more than half the total, in contrast to roughly a quarter in the US and a third in the UK. When starchy foods exceed 70% to 75% of the total energy supply, there is cause for concern (FAO, 2001). People who live in countries where, on average, more than 80% of dietary energy comes from starchy foods (Lesotho and Bangladesh, for example) are therefore very vulnerable to micronutrient malnutrition.

Food insecurity and the "nutrition transition" (see Chapter 4) are characterized by a decrease in dietary diversity. Increasing the variety of foods across and within food groups is more or less universally recommended, and many countries publish food guidelines that emphasize the need for dietary diversity (see Chapter 14). All the same, achieving dietary variety can be difficult for lower-income people and may be outright impossible for the very poor.

### 2.7 Biodiversity

*Biological diversity*, or *biodiversity*, refers to the range of variation visible in all the forms of life of a region, from genes to species to ecosystems. The broader the range, the greater the biodiversity. The term *agrobiodiversity* applies the concept of biodiversity specifically to food production. It refers to "the cultivated plants and animals that form the raw material of agriculture, the wild foods and other products that are gathered by rural populations within traditional subsistence systems, as well as organisms such as pollinators and soil biota that are key to sustainable agroecosystems" (Johns & Eyzaguirre, 2006, p. 183).

Agrobiodiversity is of great value to the world as it means that a wide variety of strains of seeds for growing food crops are available. These can help farmers to increase crop yields. In addition, having a wide selection of strains available might be of especial value to help grow foods when the climate is changing. Unfortunately, a gradual decline in the use of indigenous and traditional foods has resulted in a concomitant decline in agrobiodiversity. One danger this problem presents is that many potentially strains of seeds may be lost. A closely related problem is that we now have a narrower food base. Of the thousands of plant species available to humans, maize, wheat, and rice now supply the bulk of energy needs. Whereas wealthier countries are able to import foods from all around the world, in developing countries the shrinking food base simply translates into a more restricted diet. Interventions focusing on the revitalization and mobilization of indigenous and traditional food systems and the reintroduction of indigenous foods into diets can potentially affect food and nutrition security (Johns & Eyzaguirre, 2006).

## 3. LEVELS OF FOOD AND NUTRITION SECURITY

An individual's nutrition security is the final step in a sequence of food production and distribution, from the availability of food globally and nationally to access to food at the household level. Figure 2.3 depicts the levels at which the concept of food security applies and what it entails at each of these levels.

### 3.1 Global Food Availability

*Global food availability* refers to the total amount of food that is produced globally. Currently, global food availability would be more than adequate to meet the *energy* needs of all the world's people, provided the food were equally distributed. The reality is, however, that vast numbers of people remain undernourished – some 925 million as of 2010, according to FAO estimates (see Figure 2.4). Undernourishment (food deprivation), defined as dietary energy consumption below the minimum energy requirement (see Box 2.1), is an indicator of food insecurity. The FAO's estimate for food deprivation is based on the food available to households, not the actual consumption by individuals. It also focuses on energy and provides limited information on the nutritional quality of the food.

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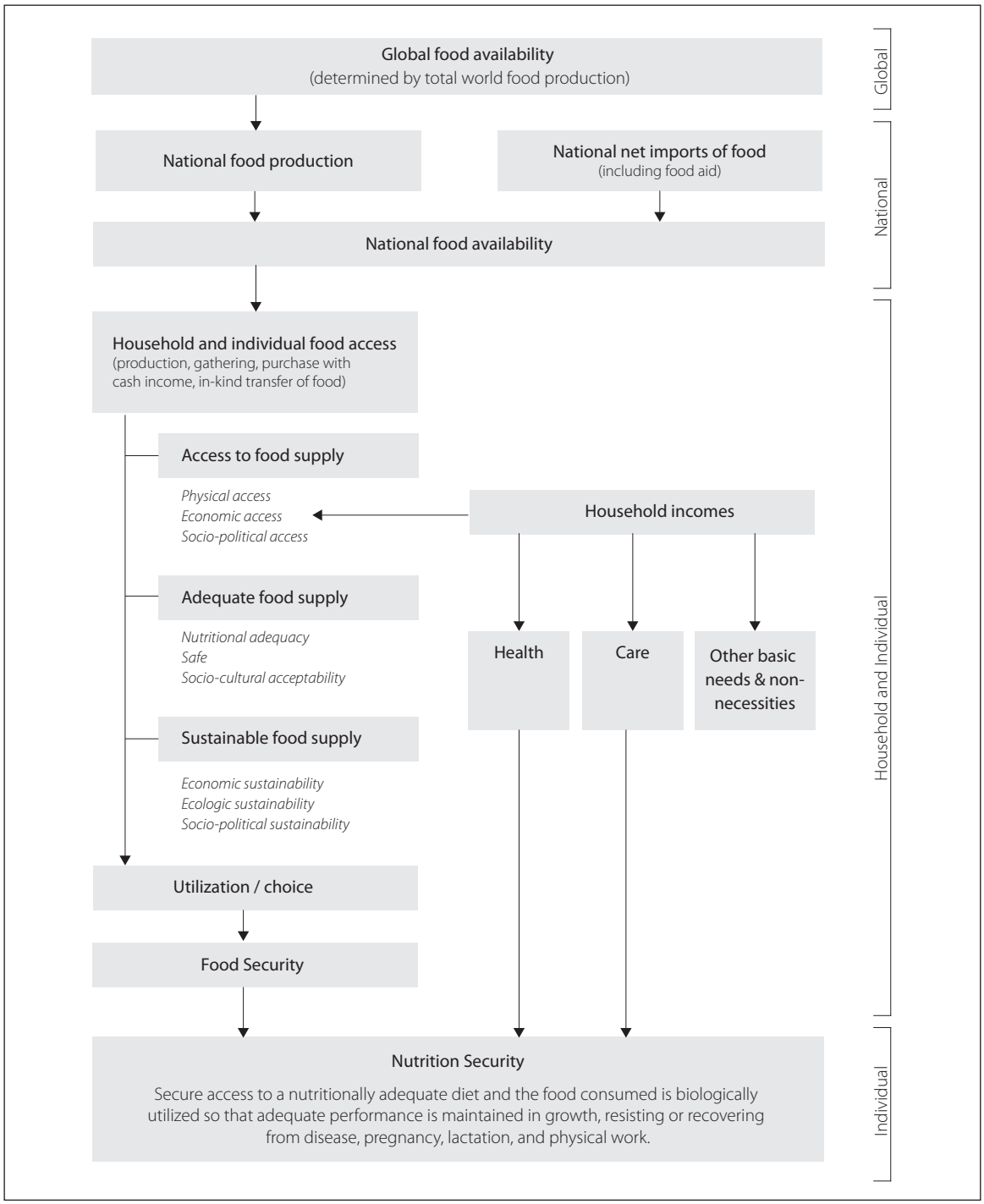


**Figure 2.3:** Conceptual framework of food security, from global availability to individual nutrition security.
*Source: Smith et al., 2000; Oshaug & Haddad, 2002.*

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**Box 2.1:** FAO Estimates of Undernourishment

The FAO uses three main parameters to estimate the number of undernourished people per country: (1) the average amount of food available for consumption per person as derived from food balance sheets, (2) the level of inequality in access to that food (obtained from household budget surveys), and (3) the energy requirements of an average person.

*Food balance sheets* contain information on the country's food supply (local production plus imports) and utilization, which includes human consumption, livestock feed, and exports, during a specific reference period. The per capita supply available for human consumption (as energy, protein, and fat) is calculated simply by dividing the total amount by the total population.

The *dietary energy supply* (DES) per person per day reflects the food available for human consumption. It provides an indication of the adequacy of the food supply in terms of energy requirements **(FAO, 2008d).**

The vast majority (98%) of the world's undernourished people live in developing countries. In absolute numbers, the region with the most undernourished people is Asia and the Pacific. However, Africa has the highest *proportion* of undernourished people, at 30% in 2010 (FAO, 2010e). South Asia has enough food, but close to 50% of the population lives in extreme poverty. In this region, food access is the major problem rather than food availability. In sub-Saharan Africa (SSA), poverty is widespread, suggesting severe food access problems, but at the same time food availability is also a major problem (Smith et al., 2000). Of the 47 countries that experienced a food crisis in 2007 that required emergency assistance, 27 were in Africa, while 10 were in Asia and the remaining 10 in other parts of the world (FAO, 2008b).

International targets have been set to reduce global food insecurity. The World Food Summit aims to halve the *number* of undernourished people between 1990–1992 and 2015. In contrast, the Millennium Development Goal is to halve the *proportion* of undernourished people between 1990 and 2015. However, because of rapid population growth, the absolute number of undernourished people could in fact increase. Between 1990–1992 and 2004–2006, for example, the proportion of undernourished people declined from 34% to 30% in SSA and from 25% to 23% in South Asia (see Figure 2.5). Yet, during this period, the actual number of undernourished people increased from 169 million to 212 million in SSA and from 286 million to 337 million in South Asia.

The globalization of food production and supply poses particular problems for developing countries, in the form of the nutrition transition, a topic discussed in Chapter 4. High-input, high-yield agriculture and long-distance transport increase the availability and affordability of foods rich in refined carbohydrates and edible oils. In addition, the globalization of culture and commerce fosters a Westernization of food systems and diets in developing countries. Modern food systems thus play an important role in the nutrition transition, resulting in the double burden of undernutrition and overnutrition within one and the same country (FAO, 2008b). Local production systems shift away from subsistence agriculture, and the orientation is increasingly towards markets for both the sale and the purchase of food (Johns & Sthapit, 2004). Global food security now depends on global food systems, which are geared towards large-scale commercial farming, the processing and packaging of food products, corporate concentration in retailing and distribution ( brand names, large supermarkets), and the growth of urban populations, which rely almost completely on purchased food (Ericksen, 2008).

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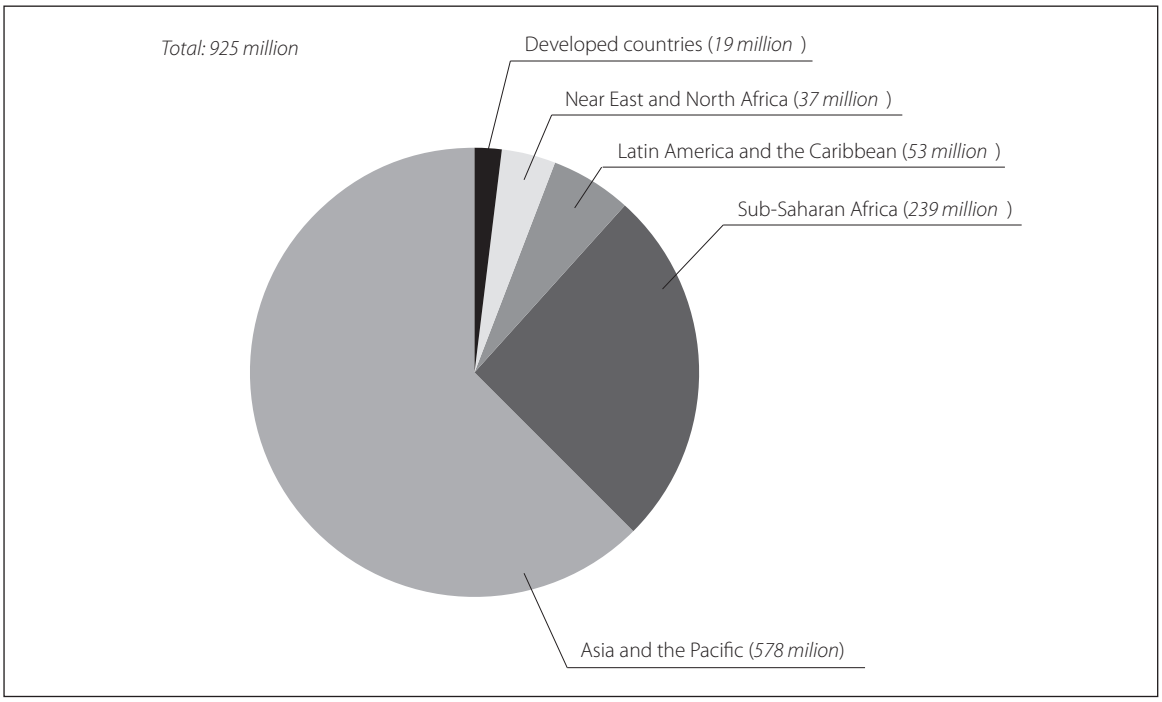


**Figure 2.4:** Undernourishment in 2010, by region (in millions).
*Source: FAO, 2010e.*

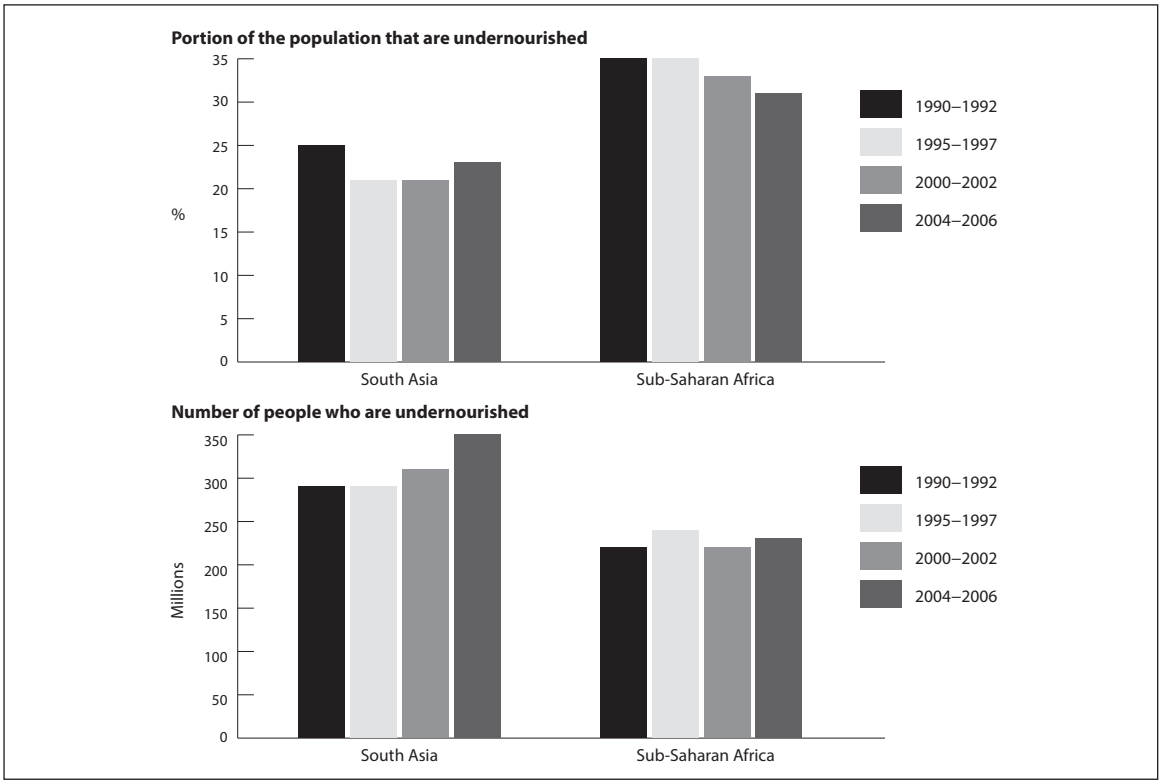


**Figure 2.5:** Food insecurity in South Asia and sub-Saharan Africa.
*Sources: FAO, 2010b, 2010c.*

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From the perspective of public health nutrition, it is imperative that we move beyond an emphasis solely on the availability of food energy, in the form of cereal production and global reserves sufficient to feed the world's people. We must also focus on the *distribution* of food among countries – that is, on national food availability – and on the nutritional *value* of this food.

## 3.2 National Food Availability

*National* (*domestic*) *food availability* refers to the amount of food available for consumption by a country's population. This supply of food consists of total agricultural production (cash crops, livestock, and food crops), net food imports (imports minus exports), food aid, and food stocks. Food availability at the national level can be obtained from food balance sheets compiled by the FAO per country. The per capita dietary energy supply reflects the adequacy of the national food supply relative to the nutritional requirements of the population (see Box 2.1).

In the regions most affected by food insecurity (notably SSA and South Asia), agriculture is a major component of household survival. Approximately half of the population in SSA live below the poverty line, and two-thirds derive their livelihood from the agricultural sector. Families in Africa generally lack access to information and modern technologies and, as a result, they must generally rely on relatively unsophisticated agricultural practices. In the face of modern population pressures, however, traditional agricultural techniques can prove insufficiently productive and may lead to the depletion of natural resources (World Bank/IFPRI, 2006).

A country is self-sufficient if it is able to produce 100% (or more) of its national food requirements. The food self-sufficiency ratio (SSR), which is usually calculated for specific food commodities, represents the percentage of the overall supply of a given commodity that is domestically produced. A SRR of 100% indicates that the country is self-sufficient with regard to a specific food commodity, whereas a figure below 100% indicates the need to import the shortfall. Few countries are entirely self-sufficient, and most countries achieve adequate food supplies (also known as food self-reliance) through a combination of domestic production and imports. Developing countries therefore need the capacity to generate foreign exchange to enable them to buy foods from the world market, which, in turn, needs to offer a reliable source of affordable food supplies (Konandreas, 2000).

## 3.3 Household Food Security

### *3.3.1 Access to food supply*

Sufficient amounts of food may be available at the national level, but people must have both physical and economic access to this food. Unless they are able to generate enough food on their own to provide a balanced diet, they must be able to reach a place where food is available. Once they reach a marketplace, they must have enough money (or the equivalent in food vouchers) to buy food. A household's ability to grow, gather, purchase, and store food is influenced by geographic location and by socio-economic status, and it can vary over time (Riely et al., 1999).

National food security is a prerequisite but no guarantee of household food security. South Africa is an example of a country that has sufficient food supplies at the national level yet a significant proportion of the population has inadequate access to food. High unemployment rates, an inadequate social welfare system, and high HIV infection rates all contribute to household food insecurity (du Toit et al., 2011).

*Physical access.* Households need physical access to a place where food is available. Households typically obtain food through

- producing their own crops or livestock for consumption,
- purchasing from markets,
- receiving food as a transfer from relatives, members of the community, the government, or foreign donors, and
- gathering in the wild (Riely et al., 1999).

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Physical availability of food relates to local production, agricultural productivity, and the ability of markets to deliver food to consumers and agricultural inputs to farmers. In developing countries, availability through local food production is often affected by low agricultural productivity, seasonality, and inadequate adoption of appropriate technologies. In addition, people's physical access to food is often restricted by inadequate infrastructure, such as roads, railways, and markets. Remote areas are particularly affected by difficulties in transportation and inadequacies in the food distribution markets (Millennium Project Task Force on Hunger, 2004).

*Economic access*. Regardless of the source of food, households must have the means to acquire appropriate foods. *Economic access* therefore refers to the affordability of food to the consumer. The majority of people worldwide, including those in low-income countries, obtain at least part of their food through markets. Households' ability to purchase food depends on the households' income and the price of food; factors that affect either food prices or household income influence people's ability to buy food. Low-income households are more vulnerable to higher food prices because they spend a higher share of their income on food. In some of the lowest-income countries, households may spend as much as 60% of income on food, versus 15% or less for households in high-income countries (FAO, 2008b).

From 2006 to 2008, a sharp increase in the fuel price resulted in sharp increases in food prices. This was followed by a global economic recession during which real wages and household incomes decreased, jobs were lost, credit was cut, and remittances dropped. As a result, between 2003–2005 and 2009, the number of undernourished people globally increased from 848 million to 1.02 billion (von Grebmer et al., 2009). The increasing demand for crops such as maize and sugar cane in the production of biofuel also contributed towards high food prices (FAO, 2008c). The number of undernourished people declined to 925 million in 2010 (FAO, 2010e).

**Box 2.2:** Households' Coping Strategies During Periods of Food Shortage

Households respond to a shock or a shortfall of food through consumption coping strategies and/or livelihood coping strategies. *Consumption coping strategies* refer to the immediate and short-term adjustment of food consumption, which can be reversed later. Generally, there are four types of consumption coping strategies:

- Dietary change: Households change their diet by eating cheaper and less preferred foods.
- Food seeking: Households attempt to increase the amount of food available through short-term, temporally non-sustainable strategies such as borrowing food, purchasing food on credit, begging for food, consuming wild foods, and consuming seed stocks intended for the next season.
- Household structure: Households reduce the number of people that they have to feed in the short term by sending some household members elsewhere.
- Rationing: Households attempt to manage the shortfall, e.g., by limiting portion sizes, reducing the number of meals, favouring certain household members over others, and not eating for whole days.

In contrast to the above, *livelihood strategies* include the longer-term alteration of income earning or food production patterns, and once-off responses such as selling assets. There are two types of assets: *liquid assets*, such as savings or jewellery, and *productive assets* are those important for generating income. Examples of livelihood strategies include the following:

- Re-allocating resources to reduce risk, e.g., during drought the household moves from crop production to non-farm wage employment
- Selling assets, which reduces future earning potential
- Relying more on loans or transfers, and less on current crop production and market purchases to meet immediate food needs
- Participating in income-generating activities, particularly by women
- Migrating to areas where there are more job opportunities, or back to the village or country of origin
- Borrowing from formal or informal markets, which reduces future earning potential and increases risks

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- Reducing expenditure on health, education, and durable and semi-durable goods so as to maintain expenditure on food, which may negatively affect health and development and thereby reduce future earning potential

*Sources: FAO, 2009; Maxwell et al., 2003; Maxwell & Frankenberger, 1992.*

*Socio-political access.* Various social and political factors affect household food security. Households in developing countries may, for example, have unequal access to food because of unequal social conditions and exclusionary practices. Social conflict can also threaten the food access of affected people.

In many developing countries, gender inequality contributes to hunger. In conditions of gender inequality, women and girls are more poorly nourished throughout the life cycle, show higher rates of mortality, have less access to health care, and are subject to greater household food insecurity (ACC/SCN, 2004). Lower literacy rates and access to education for women are associated with higher rates of hunger (von Grebmer et al., 2009). Reducing gender disparities in key areas, particularly in education and health, and empowering women are essential for reducing poverty and hunger (see Box 2.3).

**Box 2.3:** Three Pillars to Achieve Gender Equality and Women's Empowerment

**The International Fund for Agricultural Development (IFAD) defines the following three pillars of gender equality:**

**Economic empowerment:**
Improving women's access to income-earning opportunities and productive assets
**Decision-making:**
Increasing women's say in community affairs and strengthening women producers' organizations
**Well-being:**
Improving access of rural people, especially women, to basic services and infrastructure

*Source: IFAD, 2010.*

### *3.3.2 Access to an adequate food supply*

The quality of food is a complex characteristic that determines its value or acceptability to the consumer. Beside the nutritional value of food, quality includes safety, organoleptic characteristics (such as appearance, colour, texture, taste), and functional properties. Food should also be culturally acceptable to the consumer.

*Nutritional adequacy*. The concept of *nutritionally adequate food* is an important part of the current definition of household food security. The adequacy of the diet should be considered quantitatively and qualitatively. The quantity of food consumed should be sufficient to fulfil the energy requirements, while the quality of the diet should address macro- and micronutrient requirements. The diet should thus include a variety of foods that are adequate in energy, protein, and vitamins and minerals. Besides the cereal-based staple foods, the diet should contain legumes, vegetables, fruit, and food of animal origin. Poor people may, however, lack the ability to access a large variety of foods. The findings of a national survey done in South Africa showed that households with low dietary diversity were the most impoverished (Labadarios et al., 2011).

*Food safety*. Microbiologically unsafe food increases the risk of food-borne infections, leading to, for example, diarrhoea. Food should be free from possibly harmful contaminants, parasites, and toxins (see Chapter 24).

During the last few decades, the street food sector – ready-to-eat food prepared and/or sold by vendors or hawkers – has expanded rapidly and represents a significant part of food consumption for millions of low- and middle-income urban consumers in developing countries. This food sector also provides job opportunities for

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many people. Practising food hygiene at street level can be difficult in settings with low environmental and sanitary standards. Street foods are therefore a public health concern, especially regarding microbiological contamination. General guidelines for street foods are available (FAO/WHO, 1997).

*Socio-cultural acceptability.* Food and food practices reflect the social and cultural diversity of people and play a symbolic role in people's lives. *Food culture* is a set of behaviours related to food that characterize a particular social group or culture, that is passed on from one generation to the next. Social and cultural factors, religious beliefs, and food preferences and taboos within communities all affect households' access to food.

### *3.3.3 Access to a stable food supply*

*Stability,* or *sustainability,* refers to the time frame over which food security is considered. Food insecurity may be a short-term (transitory) experience, longer-term, or even lifelong (chronic) condition. Transitory food insecurity can be either cyclical (e.g., seasonal) or temporary (e.g., the result of a drought or flood) (Maxwell & Frankenberger, 1992; FAO, 2008a).

In many parts of the tropics, food security has a strong seasonal dimension, with hunger being highest during the growing season because (1) farmers are unable to grow enough food for year-round consumption, (2) farmers lack the knowledge, technology, and equipment needed to store food for the hungry season, and (3) farmers and their families are unable to find employment in the non-farming sector to supplement their income and buy food from the market (Millennium Project Task Force on Hunger, 2004). For example, in Dinajpur, an urban area of Bangladesh, households showed higher rates of food insecurity and malnutrition during the monsoon season because of (1) an increase in morbidity during the rainy season, (2) a decrease in food availability during the pre-harvest season, and (3) fluctuating demand for female labour and its impacts on caring practices (Hillbruner & Egan, 2008).

To achieve food and nutrition security, food supply needs to be stable throughout the year and, equally importantly, sustainable over time. A host of economic, social, and environmental factors affect food security, and there are complex interactions between these factors. The three Ps – poverty, people, planet – can be linked to the economic, social, and environmental aspects of sustainable development. Thus protecting and enhancing the natural environment, including the biodiversity it contains, in such a way that future generations can also enjoy and utilize it is part of creating sustainable food security.

An increase in the efficiency and productivity of food systems is believed to reduce hunger and improve nutrition. Yet aspects of food systems can pose threats to the social, economic, and environmental pillars of sustainability, and can therefore undermine sustainable food security (see Box 2.4). Sustainable systems are those that make the best use of environmental goods and services while not damaging these assets (Pretty, 2008).

## 3.4 Individual Utilization

If sufficient and nutritionally adequate food is available and accessible, the household has to decide what food to purchase, prepare, and consume. Choice is determined by knowledge, culture, food preferences, and habits, and it affects food safety and caring practices.

*Physiological access* relates to the body's ability to use nutrients for growth and development. Infection reduces the physiological access to ingested nutrients. A healthy physical environment, including safe drinking water and sanitary facilities, is critical to avoid diseases. In the absence of good care and a healthy and clean environment, availability of and access to food will not translate into nutrition security. Also, an understanding of proper health care, food preparation, and food storage processes is needed.

**Box 2.4:** The Green Revolution

The introduction of high-yield varieties of seeds and the increased use of fertilizers, pesticides, and irrigation are known collectively as the Green Revolution. In Asia cereal production doubled in Asia between 1970 and 1995, while cereal and energy availability per person increased by nearly 30%, and wheat and rice became cheaper.

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The Green Revolution resulted in a significant increase in the agricultural productivity needed to make India self-sufficient in food grains. The Green Revolution technologies were, however, either too expensive or inappropriate for most of Africa, and they had limited impact in sub-Saharan Africa because of poor infrastructure, high transport costs, limited investment in irrigation, and pricing and marketing strategies that penalized farmers.

Although the Green Revolution helped large numbers of people to escape poverty and hunger, it also caused environmental damage because of excessive and inappropriate use of fertilizers and pesticides, and inappropriate irrigation practices. It further relied on a few major cereal varieties, which lead to a loss of biodiversity on farms.

*Source: IFPRI, 2002.*

## 3.5 Relative Role of the Different Dimensions of Food and Nutrition Security

The relative contribution of the three determinants of food security – availability, accessibility, and utilization – varies over time across and within settings, in response to economic crises, civil disturbances, or natural disasters. Kiess et al. (2001) used the term *choice* instead of *utilization*, reasoning that when accessibility and availability are ensured, utilization primarily represents household and individual choices, for food, health care, and other opportunities. Kiess et al. (2001) illustrated the relative contribution of the three determinants of food security in different settings using the examples of Bangladesh and Indonesia (see Box 2.5).

**Box 2.5:** Determinants of Food and Nutrition Security

**Bangladesh**

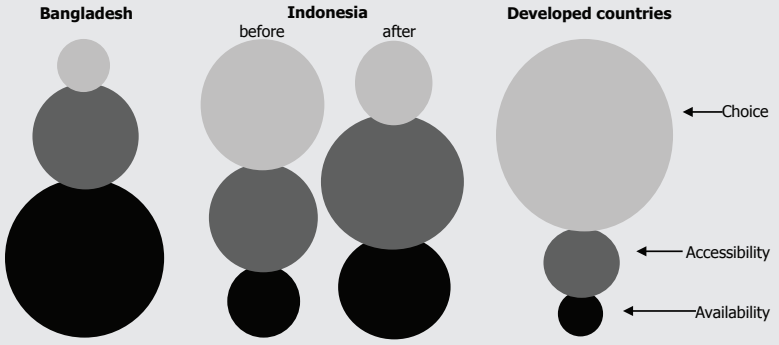
Availability of nutritionally adequate food, particularly foods of animal origin, fruits, and vegetables, is a major problem in rural areas. More than 35% of the Bangladeshi population fall below the poverty line. As a result, accessibility is also a major constraint for achieving food security. In this situation, food utilization (or food choice) is a minor determinant of food security.

**Indonesia**

Before the Asian economic crisis, availability and access to food were generally less important determinants of food security in Indonesia. The economic crisis in Indonesia in mid-1997 increased prices of food and other commodities and reduced employment opportunities. This lowered real income and purchasing power, making accessibility a more prominent determinant of food security.

**Developed countries**

Food availability and access is generally not a problem in developed countries, and food utilization (choice) is by far the biggest determinant.




*Source: Kiess et al., 2001.*

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# 4. CAUSES OF FOOD AND NUTRITION INSECURITY

People are food secure when their consumption of food is sufficient, secure (not vulnerable to shortfalls), and sustainable. Therefore, factors affecting the sufficiency, security, and sustainability of foods consumed will affect food and nutrition security. The causes of food and nutrition insecurity differ between regions, and this is illustrated by, for example, the contribution of the different components to the Global Hunger Index (GHI), which is used by the International Food Policy and Research Institute (IFPRI) to measure hunger in countries. The GHI includes three equally weighted hunger-related indicators: (1) the proportion of the population which is undernourished (reflecting food deprivation or hunger; see Box 2.2), (2) the prevalence of underweight in children under the age of five, which reflects childhood malnutrition, and (3) the under-five mortality rate, which is partially a reflection of the fatal synergy between inadequate dietary intake and unhealthy environments. The index ranks countries on a 100-point scale, ranging from 0 (no hunger) to 100 (worst-case scenario), though neither of these extremes is achieved in practice (von Grebmer et al., 2009).

Regions with the highest food insecurity scores are South Asia (GHI of 23.0) and SSA (GHI of 22.1). The causes of food insecurity in these two regions differ. In South Asia, the prevalence of underweight in children under the age of five dominates, reflecting the low nutritional, educational, and social status of women. In contrast, in SSA, low government effectiveness, conflict, political instability, and high rates of HIV/AIDS are reflected in the high child mortality and high proportion of undernourished people (von Grebmer et al., 2009).

The causes of food and nutrition insecurity all relate to either insufficient national food availability or insufficient access to food by households and individuals.

## 4.1 At the National Level

Several global risks can potentially impact the availability of food at the national level. These include high and volatile food prices, financial and economic shocks, climate change, and epidemic outbreaks of human disease and crop and livestock disease (von Braun, 2009). Access to food within a country is affected by a range of factors: the general social, economic, and political environment prevailing at national level; the presence of natural shocks or conflict; the quality of commercial and trade policies; the commitment of the political leadership to hunger reduction; and the prevalence of institutions that enable participation of women and marginal groups in decision-making processes that affect their future (Millennium Project Task Force on Hunger, 2004).

Shocks at the community level can be either natural disasters or man-made disasters. Natural disasters are either "slow onset" (e.g., drought) or "sudden onset" (e.g., floods, cyclones, hurricanes, earthquakes; see Box 2.6). Man-made disasters are generally related to political instability, civil war, and ethnic conflicts, or to socio-economic crises (FAO, 2008b).

**Box 2.6:** Food Security Implications of the 2010 Haiti Earthquake

Haiti is the poorest country in the western hemisphere. More than half of the population are undernourished and live on less than US$1 per day. On January 12, 2010, a powerful earthquake struck Haiti. Early predictions were that an estimated 210,000 people were killed, 200,000 injured, 2 million in need of food aid, and 1.1 million in acute need of emergency shelter.

The earthquake caused destruction of productive assets and infrastructure. This led to widespread unemployment, which affected food security because of loss of income and purchasing power. Household income was also affected by the death or injury of income providers. Damage to hospitals and health centres resulted in a shortage of health care, thereby reducing the income earning capacity for injured populations. Compounding this, those in need of health care needed to travel long distances for care; the high cost of this reduced those resources that would normally be devoted to food and agriculture.

Displacement of large numbers of people to rural and urban areas outside of the metropolitan area exerted additional pressure on available food, natural resources (e.g., firewood), and the degraded soil, particularly in areas that under normal circumstances already experienced chronic food insecurity.

*Sources: FAO, 2010d; USAID, 2010.*

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### 4.2 At the Household and Individual Level

Shocks at the household level include shocks in production (e.g., harvest failure), market (e.g., lost employment), or household expenditure (e.g., emergency medical costs resulting in less money available for food).

HIV/AIDS and food and nutrition security are becoming increasingly entwined in a vicious cycle. Food insecurity increases susceptibility to HIV exposure and infection, while HIV/AIDS exacerbates vulnerability to food and nutrition insecurity. SSA is the region most heavily affected by HIV/AIDS, with a total number of 22.4 million living with HIV in 2008. In this region, women are more vulnerable to HIV than men and account for approximately 60% of HIV infections (UNAIDS, 2009). Agriculture is the main source of livelihood for many people in SSA, with approximately 80% of subsistence farmers being women. Subsistence farmers in the region are particularly vulnerable to the impact of HIV/AIDS because the disease reduces the resources available for agriculture, specifically available labour, as a result of sickness, premature death, or caring for the ill. Additionally, less money is available and assets are sold because of medical and funeral costs. This reduces the household's ability to buy food. In addition, households affected by HIV often switch to a monocrop system (producing only one crop, rather than a variety of crops) or shift from labour-intensive crops, such as vegetables, to less labour-intensive crops, such as roots. As a result, the household has less access to a variety of nutritious foods. The negative impact of AIDS on food security also occurs by way of long-term processes embedded in social, economic, and cultural systems. The long-term effects of HIV/AIDS decrease the household's resilience to other shocks, thereby increasing the household's vulnerability to food insecurity (Gillespie, 2008).

## 5. SELECTED INDICATORS FOR FOOD AND NUTRITION SECURITY

Food security is a complex and multidimensional concept for which there is no single, direct measure. Multiple or composite indicators are needed. Which indicator(s) to use depends on the level of food security (global, national, household, individual; see Figure 2.3) as well as the dimension (availability, accessibility, utilization, sustainability) of interest. Food security indicators can be either process or outcome indicators (Maxwell & Frankenberger, 1992).

*Process indicators* reflect food supply and food access, and some degree of vulnerability. Indicators reflecting food supply generally provide information on agricultural production, access to natural resources, institutional development and market infrastructure, and exposure to regional conflict or its consequences. Socio-economic data reflect the household's access to food, although these indicators are location-specific (Maxwell & Frankenberger, 1992).

*Outcome indicators* are a proxy for food consumption, either directly or indirectly. Direct indicators of food consumption are, for example, food expenditure (household budget and consumption surveys), household perception of food security, and food frequency assessments. Indirect indicators include, for example, assessment of nutritional status. Nutritional status indicators do not always correlate directly with food availability and access because nutritional status is a result of several factors beyond food consumption (Maxwell & Frankenberger, 1992; Riely et al., 1999). Issues that need to be considered when selecting indicators for measuring food security, as well as for monitoring and evaluating food security programmes, are given in Box 2.7.

The Committee on World Food Security identified (1) core food security and nutrition status indicators for monitoring progress towards the World Food Summit goals on a global level, and (2) additional indicators relating to the food economy for monitoring the extent to which availability, stability, and access targets are being met (FAO, 2002). A short description for each of these indicators is given in Table 2.1.

Many of the indicators listed in Table 2.1 are collected at the national level and not directly relevant to the community nutritionist. However, awareness of and ability to interpret these indicators is important for understanding food and nutrition security of communities, households, and individuals. In Table 2.2, some indicators applicable to community-level assessment are given. The indicators of nutritional status listed in Table 2.1 can also be applied in communities.

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**Box 2.7:** Issues Surrounding the Selection of Food and Nutrition Security Indicators

***Relevance and information use***:
Indicators should be relevant to (1) local conditions and the food security context, and (2) when used to monitor and evaluate programmes, to the objectives, structure, and implementation plan of the specific programme. The indicators and the intended uses of the information should match.

***Accuracy***:
How close the defined variable is to, for example, the actual situation.

***Credibility***:
Indicators should be (1) universally understood and based on accepted practice and theory, (2) objective, (3) controllable, to minimize measurement errors, (4) precise (i.e., reliable, so repeated measurements under specified conditions should agree), and (5) of a defined and acceptable margin of error and confidence level.

***Resources/cost***:
Indicators must be feasible within resource constraints such as time, personnel, and logistics of data collection, processing, and analysis.

***Comparability***:
Comparisons between regions, programmes, or over time require that indicators are conceptually equivalent and are applied in the same way.

***Time sensitivity / timeliness***:
When used to evaluate programmes or show trends, indicators should be able to show change within the time frame of the programme.

*Sources: Maxwell & Frankenberger, 1992; Riely et al., 1999.*

**Table 2.1:** Selected indicators for food and nutrition security

| **1. Food Security and Nutritional Status Indicators (Core Indicators)** | |
|---|---|
| **1.1 Food consumption** | |
| Average per person dietary energy supply (DES)<br>(indicator of global, regional, and national food supply) | Food available for human consumption, expressed in energy (kcal/kJ) per person per day |
| Cereals, roots, and tubers as percentage of the DES<br>(provides information about the quality of the average diet of the population) | Share of cereals, roots, and tubers to the DES. A high percentage indicates a relatively poor diet in terms of diversity. When starchy staples exceed 70% to 75% of DES, there is cause for concern. |
| Percentage of population undernourished (indicator of national, regional, or global food insecurity) | The condition of people whose food consumption is continuously below requirements. The FAO measure of food deprivation refers to the number of people (or proportion of the population) whose DES consumption is below a predetermined and country-specific threshold (minimum energy requirements). |

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| | |
|---|---|
| **1.2 Health status** | |
| Life expectancy at birth<br>(indicator reflecting environmental and living conditions in a country, the health of its people, and the quality of health care) | The number of years a newborn infant would live if prevailing patterns of mortality at the time of birth were to stay the same during its lifespan. Life expectancy is lowest in countries with the highest prevalence of undernourishment. |
| Under-five mortality rate | The probability that a newborn baby will die before reaching age five, if current living conditions stay the same, expressed as per 1000 live births. |
| **1.3 Nutritional status**<br>[Nutritional status indicators reflect the consequences of prolonged food insecurity as well as the utilization dimension of food security, but do not consider the determinants of food insecurity as such.] | |
| Proportion of children under 5 years of age that are underweight, stunted, or wasted<br>(indicator of nutrition security) | Low weight-for-age (underweight)<br>Low height-for-age (stunting) – measure of chronic malnutrition indicating general deprivation and poverty; quality of the diet often a bigger problem than quantity consumed<br>Low weight-for-height (wasting) – measure of acute malnutrition due to an energy-deficient diet and/or chronic infections |
| Percentage of adults with body mass index (BMI) <18.5<br>(indicator of nutrition insecurity) | Low weight-for-height (underweight) – adults suffer from thinness as a result of inadequate energy intake and/or severe illness |
| **2. National Food Economy Indicators (Additional Indicators)** | |
| **2.1 Economic conditions** | |
| Gross national product (GNP) per capita | The market value of a country's final output of goods and services produced in one year divided by the total population |
| Growth in GNP per capita | The change in GNP per capita over a period, expressed as a percentage of GNP at the start of the period |
| GNP per capita at purchasing power parity | Purchasing power parity (PPP) is a measure of the relative purchasing power of currencies of different countries for the same types of goods and services. |
| **2.2 Food availability** | |
| Food production index by country | Based on the sum of price-weighted quantities, after deducting similarly weighted quantities of seed and feed |
| Volume of production, food use, trade, and stock changes for major food commodities, by commodity group and by country grouping | Obtained from food balance sheets |
| Ratio of the five major grain exporters' supplies to requirements | A measure of the ability of the five major grain exporters to meet the import demand for wheat and coarse grains; ratio of the sum of local production, imports, and opening stocks to the sum of their domestic utilization of grains plus exports |

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| | |
|---|---|
| **2.3 Food access** | |
| Gini coefficient of income distribution | A measure of income inequality, with a range from 0 (perfect equality) to 1 (perfect inequality). A low Gini coefficient indicates a more equal distribution, while a higher Gini coefficient indicates more unequal distribution. |
| People living below national poverty line | The poverty line is the minimum income needed by a household to cover food and non-food expenses. |
| People living on less than US$1 per day | Indicator of poverty (and therefore economic lack of access to food) |
| **2.4 Stability of food supplies and access** | |
| Index of variability of food production | Total country production of food crops that are considered edible and that contain nutrients |
| Food price index | Change in the cost to the average consumer of acquiring a fixed basket of food |
| Changes in cereal production in low-income food deficit countries (with and without China and India) | Aggregate cereal production of some 80 low-income food deficit countries (countries which are considered to be the most vulnerable to fluctuations in food supplies and international prices). This indicator can be heavily affected by production in China and India; two different indicators are therefore measured – one including China and India, and the other excluding China and India. |
| Export price movements for wheat, maize, and rice | Monitors the international price for the three major cereals |
| **2.5 Risks, hazards, and shocks** | |
| Number of countries facing food emergencies | Identifies “hunger hotspots.” A food emergency can be due to either natural or man-made disasters. thus the indicator also takes into account which countries are receiving food assistance. |

*Sources: Smith et al., 2000; Maxwell et al., 2003; Millennium Project Task Force on Hunger, 2004; FAO, 2001; FAO, 2008a.*

**Table 2.2:** Selected community indicators of food and nutrition security

| Indicator | Reference |
|---|---|
| Household dietary diversity score (HDDS) (*indicator of households’ economic ability to access a variety of food*) | Kennedy et al., 2011 |
| Individual dietary diversity score (*indicator of nutrient adequacy*) | Kennedy et al., 2011 |
| Household Food Insecurity Access Scale (HFIAS) (*indicator of households’ access to food*) | Coates et al., 2007 |
| Community Childhood Hunger Identification Project (CCHIP) hunger index | Frongillo et al., 1997 |
| Radimer/Cornell hunger scale | Frongillo et al., 1997 |
| Months of Adequate Household Food Provisioning (MAHFP) (*indicator of household’s access to food over seasons*) | Bilinsky & Swindale, 2010 |
| Coping strategy index (*indicator of households’ behaviour during periods of food shortage*) | Maxwell & Caldwell, 2008 |

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To eradicate hunger, we need to (1) target people and areas suffering from hunger, (2) identify the causes of hunger, and (3) take remedial action to improve the situation. The Food Insecurity and Vulnerability Information Mapping System (FIVIMS) initiative (see www.fivims.org) was launched after the 1996 World Food Summit in Rome to better inform decision-makers about food insecurity and vulnerability. The approach used to establish a national FIVIMS is flexible, and depends on the country's needs and priorities. The following important questions should be included in a national FIVIMS:

- Who are the food insecure and vulnerable people in the country?
- Where are they located?
- How many are they?
- How severe is their hunger?
- What are their livelihood systems?
- Why are they in this condition?
- What can be done about it? (FAO, 2002)

## 6. COMMUNITY-BASED ACTIONS TO ADDRESS FOOD AND NUTRITION INSECURITY

Policies at the national level, food aid programmes implemented during emergencies, and purely agricultural interventions are all important but are not discussed in this chapter.

This section focuses on community-based interventions or actions of interest to the community nutritionist. Interventions to strengthen food security must ensure the complementarities and synergies between food availability, access, and utilization. These interventions should therefore focus on actions to improve the households' physical, economic, social, and physiological access to food. Details on how to implement community-based interventions are discussed in Chapters 16 and 17.

Community-based interventions to improve household food availability and dietary diversity are considered sustainable solutions to address household food and nutrition insecurity in developing countries. In these interventions, household food availability is increased through local production, thereby increasing the household's access to diverse and micronutrient-rich foods. Such programmes can also lead to reduced household poverty, improved nutritional status of household members, and potentially empower women (see Box 2.8).

Food-based strategies at the community level generally focus on the production of nutritious food for household consumption. These strategies have the potential for income generation, provided that households produce a surplus and have easy access to markets at which to sell their produce (Low et al., 2007). Economically viable post-harvest products could further enhance market possibilities for locally produced crops (Low & van Jaarsveld, 2008).

To ensure that the gardening activities translate into improved dietary quality, home-gardening projects need to include a strong nutrition education and behaviour change component (Ruel, 2001) (see Chapter 15). Various entry points can be used for nutrition education and promotions. Community-based growth monitoring (see Box 2.9) and schools are examples.

School-based projects can be used to (1) promote consumption of fruits and vegetables, (2) teach learners how to establish and maintain home gardens, (3) introduce learners to food preparation and storage techniques, (4) provide nutrition information and thereby encourage learners to adopt more healthy dietary habits, and (5) stimulate the interest of learners in agriculture and nutrition (Bokeloh, 2009). The manual *Setting Up and Running a School Garden* is available at http://www.fao.org/docrep/009/a0218e/a0218e00.htm.

The best choice of intervention depends on the nature and the magnitude of the problem. A situation assessment prior to the intervention will indicate which elements of food insecurity are involved and who is affected. Analysis of the underlying causes of food and nutrition insecurity should be the core of any sustainable intervention that aims to prevent recurrence and does not create dependency.

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**Box 2.8:** Homestead Food Production Programme in Asia

The homestead food production programme has been implemented by Helen Keller International (HKI) in Bangladesh, Cambodia, Nepal, and the Philippines in partnership with local non-governmental and governmental organizations.

Village model farms (VMF) are established to serve as (1) training and demonstration centres on improved agricultural techniques, technologies, and poultry production activities and (2) production centres for agricultural inputs such as low-cost quality seeds, seedlings, saplings, and chicks. VMF owners provide support to participating households, typically about 20 households per VMF owner, and these households are divided into two smaller groups to facilitate collaboration among households.

Households are assisted in establishing home gardens (growing a variety of vegetables and fruit) and small animal husbandry, mainly poultry. Linkages with local health and agriculture structures are established to provide additional services to the households and to capacitate local partners to provide sustained technical assistance after the three-year project cycle.

Nutrition education sessions at the village level focus on healthy eating during pregnancy and lactation, and optimal feeding of infants and young children. Dietary diversity and consumption of micronutrient-rich foods are also addressed. Cooking demonstration sessions are held that use locally grown foods.

From 2003 to 2007, the programme was implemented among approximately 30,000 households. Evaluation of the programme revealed the following:

- Improved availability and consumption of vegetables, fruits, and animal foods (egg and liver) in participating households
- Reduction in the prevalence of anaemia among women and children in some of the countries
- Increase in household income as a result of the food production activities
- Improved involvement of women in decision-making

*Source: HKI, 2010.*

**Box 2.9:** Community-based Growth Monitoring: The Ndunakazi Project

In the Ndunakazi project in South Africa, community-based growth monitoring activities served as a platform for the promotion and implementation of a home-garden project that focused on provitamin A-rich crops.

Growth monitoring sessions were held in households. Demonstration gardens, which served as training centres for gardening activities, were established at each growth monitoring site. During the monthly growth monitoring sessions, promotion of household production and daily consumption of vegetables and fruits rich in provitamin A was achieved through

- education on vitamin A nutrition,
- cooking of locally produced provitamin A–rich vegetables, and
- demonstrations of the planting process in the demonstration garden.

Many of the mothers were not familiar with the provitamin A–rich vegetables, and the vegetables cooked on growth monitoring days were used to (1) introduce the mothers and children to these vegetables, (2) teach the mothers various ways of preparation, and (3) give mothers the opportunity to observe their children eat and enjoy it. The latter motivated the mothers to plant and prepare these vegetables at home.

*Sources: Faber et al., 2006; Faber et al., 2002.*

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## DISCUSSION AND REFLECTION QUESTIONS AND EXERCISES

1. Brainstorm and discuss factors that can put people in your country or community at risk of food insecurity. Group these factors into natural, economic, political, health, and technological risk factors. Can you also group these factors into national, community (household), and individual levels?
2. Consider this statement: "Different methods for assessing food security will give different results." Explain and discuss the implications of this for policy-makers, researchers, and community nutritionists.
3. Compile a list of resources and services available in your community that could be mobilized and/or accessed for addressing household food insecurity.
4. Discuss the roles and responsibilities of (a) the state, (b) community and public health nutrition practitioners, and (c) citizens in addressing food (in)security.
5. Reflect on the following statement: "Poverty drives ecological deterioration when desperate people overexploit their resource space, sacrificing the future to salvage the present."
6. Discuss the cartoon and its implications for food security.

7. Explain how a nuclear accident like the one in Fukushima, Japan, in 2011 is linked to food and nutrition security. Consider the different levels and the temporal aspects of food and nutrition security.

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# CHAPTER 3

# FOOD CULTURES

*Folake Samuel and Neelam Makhani*

## *Outline*

- Food culture
- Diets in Africa
- South Asian diets
- Globalization of food culture in developing countries

## *Objectives*

At the completion of this chapter you should be able to:

- Understand how culture affects the dietary habits of a society
- Know the different cultural outlooks about foods and their use in developing countries, particularly countries in Africa and South Asia
- Understand the term *globalization* with respect to food culture in developing countries


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# 1. FOOD CULTURE

*Food* refers to nutritious substances that when eaten sustain life and health. Dietary habits therefore play a key role in supporting life and well-being. *Culture*, on the other hand, refers to beliefs, attitudes, and practices accepted by the members of a particular group or society. Culture characterizes people in terms of language, customs, values, norms, rules, technologies, products, organizations, and institutions. Culture has also been described as a social identity associated with shared behaviour, a pattern that includes food habits, dress, language, family structure, and sometimes religious affiliation.

Food does not only have nutritional value, it also has cultural value. Culture largely determines the food we eat, while the foods available in the environment are themselves an important building block of culture and tradition of the people. Food culture involves the ways in which humans use food, including how food is obtained and stored, how it is prepared, how it is served and to whom, how it is consumed, and how people celebrate special occasions with special foods. Food culture arises out of the place of a people's origin and whether they still live there or not. It is also shaped by several other factors: resources (climate, land, soil, water, and fuel); belief and information (religion, education and literacy, communication); ethnicity (indigenous or immigrant); technology (hunting, gathering, agricultural, horticultural, aquacultural, fishing, food processing and storage, transport, cooking); colonization; and by health status and health care (Wahlqvist & Lee, 2007).

Many have observed that culturally based food habits are often tightly held onto, and are therefore difficult to change through adoption, acculturation, and assimilation. Assimilation occurs when an individual or a group of persons drop the original cultural identity of food to fully merge into a new one. This may occur when they move to another society with different cultural norms and food culture.

# 2. ASPECTS OF FOOD CULTURE

For human beings, daily food intake is an intricate phenomenon that arises from the need to satisfy hunger (for survival and well-being) but also to meet social needs. In this latter respect, human beings differ from animals. Moreover, humans not only gather or hunt food, but they also cultivate plants and raise livestock. They cook food, use utensils for eating, create rules for behaviour ("table manners"), and use food in social and religious rituals (Kittler & Sucher, 2007). As described by Fox (2003), eating is a profoundly social urge:

> Food is almost always shared; people eat together; mealtimes are events when the whole family or settlement or village comes together. Food is also an occasion for sharing, for distributing and giving, for the expression of altruism, whether from parents to children, children to in-laws, or anyone to visitors and strangers. Food is the most important thing a mother gives a child; it is the substance of her own body, and in most parts of the world mother's milk is still the only safe food for infants. Thus food becomes not just a symbol of, but the reality of, love and security.

## 2.1 Social Aspects of Eating

Food is also eaten for meeting the need for a sense of belonging: the use of food shows that an individual belongs to a group. As humans crave to fit into society, it follows naturally that people often adopt a dietary practice to demonstrate a sense of belonging. For example, people of the African diaspora may choose to eat African foods on certain occasions or at parties as an expression of ethnic identity. Food can be linked to status, and this is plainly seen when people's dietary habits change as they move up the socio-economic ladder. They tend to go beyond mere consumption of basic staple items for survival to the purchase and intake of more expensive and indeed exotic forms of diet that are prestigious and can adequately "match" their status. Foods that are considered within their own culture as "food for the poor" are consciously excluded from the daily diet as these could "taint" their achieved social position. In general, eating with particular people connotes social equality with those people – many societies regulate who can dine together as a means of establishing class (Kittler & Sucher, 2007). Moreover, a gendered dimension is seen in some cultures where women and children eat apart from men.

## 2.2 Conservatism of Cuisine

Another aspect of the culture-food interaction is the concept of "conservatism of cuisine." Although what

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people eat is based in part on what has traditionally been available to them, food habits are also culturally defined. Thus, some food items, although edible and nutritious, remain taboo among certain population groups. In essence, what determines consumption of a particular food is not only its availability (and our ability to purchase it) but, importantly, its cultural acceptability.

The Food and Agricultural Organization (FAO) defines food security as a state in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life. As the inclusion of the term *food preferences* in this definition indicates, food security has a dimension beyond the physiological. Food preferences, while sometimes purely idiosyncratic, are strongly determined by culture and tradition: what is considered acceptable as food is dictated to a large extent by cultural norms. This explains why people are often reluctant to try foods that are unfamiliar to them – why they tend to be conservative in their choice of cuisine.

## 2.3 Food Taboos

A food taboo refers to the act of abstaining from certain foods by reason of culture or religion. Food taboos dictate what may or may not be eaten, and by whom, at what periods certain foods may or may not be eaten, and which foods can or cannot be eaten together. Cultural guidelines may also exist regarding how a particular crop is to be harvested or how a certain type of animal is to be slaughtered, cooked, and served. Many Jewish households keep kosher, for example, in accordance with the *kashrut,* or dietary law. Or, to take another example, in most Western cultures, the idea of eating dog or horse meat is repugnant, as is the thought of eating insects, which are considered a delicacy in some cultures.

Food taboos can also be tied to the reproductive cycle. Pregnant women, for example, may be allowed to eat certain foods but not others. Cultural values and beliefs can also affect infant feeding practices, including the practice of breast-feeding, in ways that may have either a positive or negative impact on a child's nutritional status. For example, in some cultures, mothers are told that a child with diarrhoea should abstain from food in order to "cleanse" the belly. Another widely held belief in some cultures is that colostrum is "dirty" and should be discarded, and a baby should therefore not be suckled until the "white milk" appears.

## 2.4 Etiquette

Proper etiquette for serving and eating food also shows great variation between different cultures. In many cultures, only the right hand may be used for eating, because the other hand (the left) is, culturally, not suitable, as it is designated for sanitation purposes. While meals must be eaten silently in some cultures, in others mealtimes are looked forward to as a period for family discussion and interaction. In considering all these possibilities, it should be accepted that there are no absolute right or wrong food habits, as conclusions can only be made within the perspective of one's own culture – provided that the food habits in question are of nutritional benefit to the consumers.

## 2.5 Religious Aspects

Food plays different, important roles in many religious faiths and practices. These roles are usually rigid and tenaciously held by the adherents of the faiths. Then again, these roles may vary within a faith or philosophy. For instance, most Buddhists are vegetarians so as to avoid killing animals. Some Buddhists avoid meat and dairy products, while others only shun beef. Many Hindus are vegetarian but this is not obligatory. Muslims follow a list of foods that are allowed (*halal*, Arabic for "permitted" or "lawful") and those that are prohibited (*haram*), such as pork and alcohol. *Rastafarians follow the Ital diet (where Ital is derived from vital), which means a natural and sane way of life. Ital is largely a vegan or vegetarian diet, though some people consume* limited types of meat in accordance with the dietary laws of the Old Testament. Christian practices vary by denomination and sect. While Catholic and Orthodox Christians observe several feast and fast days during the year, most Protestants observe only Easter and Christmas as feast days and don't follow ritualized fasting. Some Christians do not drink alcohol, including many members of various Protestant churches. Seventh Day Adventists avoid both caffeinated and alcoholic beverages, and they are vegetarians.

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### 2.6 Symbolic Aspects

Aside from faith-related food taboos, religious symbolism of foods occupies a significant position in indigenous societies. An example of religious symbolism has been documented in Ghana, where *Oto*, a sacred dish made from hard-boiled eggs, mashed yam, and palm oil, is commonly served as part of several ceremonies (Osseo-Asare, 2003). Such Ghanaian ceremonies include the naming ceremony for a new baby (an ”outdooring”), the purification of the mother after birth, at puberty ceremonies for girls, at festivals associated with twins (whom the Akan and Ga people consider sacred), and at special occasions after the birth of the third, seventh, or tenth child of the same sex (based on numbers that are sacred in the Akan and Ga cultures).

Palm wine and cola nuts are important symbolic foods throughout West Africa. In Nigeria, for example, palm wine is of paramount importance at most social functions (Okafor, 1979). It is used in pouring libations, offering prayers, and heralding events. Cola nuts are regarded as important symbols of welcome and hospitality. Among the Igbo of Southern Nigeria, all discussions, prayers, and ceremonies begin with the breaking of cola nuts, and without cola, these occasions are not regarded as serious (Okigbo, 1980).

## 3. DIETS IN AFRICA

We now turn our attention to the diets followed in Africa. It is the second largest continent in the world and has a vast array of geographic, ethnic, and cultural diversity. This diversity includes widely varying dietary habits. Here are a few examples of the foods that are eaten: Injera, an Ethiopian flat bread; Tajine, a Moroccan lamb or poultry stew; pounded yam and egusi soup, a Nigerian tuber and vegetable dish; Sukuma wiki, a Kenyan vegetable dish; and Bobotie, a South African meatloaf. However, each region of Africa has its distinct cuisines.

### 3.1 Northern Africa

Much of the diet of Northern Africa is based on grains, which are used to prepare flat breads and porridges. Couscous (made from hard wheat and millet) is often the main dish at lunch, which is the primary meal. This may be accompanied by vegetables and meat from a variety of domesticated and wild animals. Legumes, such as broad beans (fava beans), lentils, yellow peas, and black-eyed peas, are also important staples. Cooking with olive oil, onions, and garlic is common. Notable spices include cumin, caraway, clove, and cinnamon, while the fruits consumed include oranges, lemons, pears, and mandrakes. Alcoholic drinks are forbidden in many places, as the cuisine largely reflects the Islamic traditions of the region. Mint tea and coffee are very popular non-alcoholic beverages in this region.

### 3.2 West Africa

Food staples in West Africa vary widely, ranging from rice, which is common from Mauritania to Liberia and across to the Sahel, to root crops, primarily varieties of yam and cassava, which are common along the coast from Côte d’Ivoire to Nigeria and Cameroon. The staple is eaten with soups made from legumes, green leafy vegetables, other vegetables, meat, fish, or other foods from animal sources, with palm or vegetable oil. The soups of West Africa tend to be generously flavoured with peppers and other condiments and spices to add taste and variety. As observed by Osseo-Asare (2003), the “sacred” combination of pepper, onions, and tomatoes, otherwise known as “the ingredients,” form a “holy trinity” (a term also used in New Orleans cooking), providing in the appropriate amounts, the base for endless varieties of soups, stews, sauces, and gravies in the region.

### 3.3 Central and East Africa

In Central and Eastern Africa, the abundant green bananas and plantain are used as the base of the main dish. This may be eaten with a relish made from pumpkin, cowpea, or cassava leaves, with the addition of groundnut sauce or red palm oil (Oniang’o et al., 2003). Other main staples include potatoes, rice, and a maize meal that is cooked up into a thick porridge. Beef, goat, chicken, or sheep are the most common meats.

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### 3.4 Southern Africa

The traditional meal in the Southern African region is centred on a staple crop, usually rice or maize, served with a stew. The most common dish made from cornmeal is called mealie meal, pap, or nshima, depending on the country. It is usually eaten with stew poured over it; the stew may include a boiled vegetable, such as cabbage, spinach, carrots, or turnips. Chicken and beef are widely eaten. A great variety of fruits are available in the southern part of the continent. Within this region, South Africa is of special interest because it is a mixture of several cultures. South Africans of Dutch, other European and Asian Indian descent have diets similar to those eaten in their countries of origin. This is one reason why the country appears to be farther along than the rest of Africa in adopting a Westernized diet and lifestyle.

### 3.5 The Changing Face of Diets in Africa

Many African countries have in the past three generations experienced extensive changes in food supplies and household diets (Oniang'o et al., 2003). Exotic, non-traditional foods now dominate many urban areas. Even in rural areas, the range of traditional domestic foodstuffs has been considerably reduced, partly because of increased cost of production and processing, and also because of long and laborious domestic preparation methods. Shifts in the traditional eating patterns, new forms of cooking, and new sources of food have emerged, coupled with shifts towards higher levels of women's participation in the workforce and subsequent changes in domestic roles and culinary practices.

## 4. THE SOUTH ASIAN DIET

South Asians are of Indian, Sri Lankan, Bangladeshi, and Pakistani origin. Their food and cultural practices, although similar to each other in many ways, vary from region to region, reflecting the varied religious beliefs of the different peoples. Geographical location has also had an important influence. For example, the majority of people living in India are Hindus and tend to be vegetarians. Non-Hindu people living in Sri Lanka and Bangladesh choose fish more frequently. Each cultural group has its own eating habits; however, they all share similar food choices.

The most common staples used in the South Asian diet are rice (*chawal*) and flour (*atta*). Rice is either used plain or it may include spices to make pilaf. Wheat and corn flour is used to make a variety of flat breads. These may be made into *roti, naan*, *puri,* or *paratha*. A griddle (*tawa*) is used to cook *roti*, and other breads like *puri* and *paratha* are fried in vegetable oil.

A variety of legumes (dried peas and beans) and lentils are used in South Asian cooking. Lentils are used to make *daals*, which have a soup-like consistency. Some common legumes and lentils include red lentils (*masoor*), black bean (*urad*), chickpeas (*channa*), pigeon pea (*tuvar*), and green gram (*mung*). These may either be used whole or split in curries, or processed into flour. Lentil flour is used to coat vegetables before frying. Chickpea flour is a very common ingredient as a batter mix for deep-fried snacks.

Meat choices used in South Asian cooking include beef, goat, and lamb. Use of beef is very minimal because of the religious (Hindu) belief that the cow is a sacred animal. Muslims use beef or lamb but don`t use pork. Use of *halal* meat is a mainstay among the Muslims. Fish is used among communities that are non-Hindu and/or living in the coastal areas. Meat is used in curries or as a filling in snacks.

Snack foods are very common in South Asian eating. They are either used as appetizers or in the evening as a snack with tea. A very popular snack food is *samosa*. A variety of fillings is used to make this finger food, including potatoes, mixed vegetables, minced meat, cheese (*paneer*), and curried chickpeas.

South Asians consume cow's milk on a daily basis. It is used to make yogurt, buttermilk, and desserts. In India, the cow is considered a sacred animal because it provides milk. Buffalo milk is also used in India. Coconut milk is used in many south Indian dishes to cook rice, meat, and vegetables.

Vegetables are an indispensable ingredient in South Asian cooking. They can be part of an appetizer, snack, soup, or main or side dish. They are also used to make different pickles (*achaar*). Some common vegetables include potato, green peas, eggplants, and okra. Vegetables may be used at all meals. They are typically cooked with oil and different spices to make them into curries.

Many fruits are used by South Asians either at a meal or as a snack. Mangoes are very common and eaten

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either fresh or pickled. They are also used in a variety of desserts and in drinks. Other common fruits used include papaya, grapes, and guava.

Most South Asian curries are cooked in vegetable oil, which traditionally is used liberally in cooking. In north and west India, peanut oil is most popular, while in east India, mustard oil is commonly used. Coconut oil is used widely in southern India and along the coastal regions. Another fat used in many recipes is *ghee* (clarified butter). It is made from cows` milk. Foods are deep-fried either in oil or *ghee* in traditional South Asian cooking. Animal fat is never used in the cultures of the region, mainly because of religious practices.

Indian cuisine is characterized by the use of a variety of herbs and spices. Commonly used spices include chilli pepper, black mustard seed (*rai*), cumin (*jeera*), coriander (*dhania*), turmeric (*haldi*), fenugreek (*methi*), garlic (*lasan*), ginger (*adrak*), and asafoetida (*hing*). A popular spice mix is *garam masala*, which is a powder that typically includes dried spices such as cardamom, cinnamon, and cloves. This spice mix varies from region to region.

Tea (*chai*) is used very commonly by South Asians. It is usually consumed at breakfast and with snacks. The process of making tea involves boiling water with tea leaves. Spices such as cardamom, cinnamon, and/or cloves are added to the tea mix as it boils. Sugar is also added, followed by the addition of fresh milk. Besides tea, some cold beverages, such as lemonade (*Nimbu Pani*), buttermilk (*lassi*), and coconut water, are used.

South Asian cuisine includes numerous desserts, such as *gulab jamun, kheer,* and *ras malai,* which are generally eaten in small quantities. *Gulab jamun* consists of dried milk dumplings, deep fried and soaked in sugar and rose water syrup. *Kheer* is a creamy rice pudding flavoured with cardamom, saffron, and nuts. *Ras malai* are dumplings made from Indian cheese (*paneer*) that are soaked in sweetened milk. Such desserts, which are intensely sweet, are mainly consumed on special occasions or as part of religious celebrations.

Eating habits among South Asians tend to be similar in many ways. The meal pattern usually consists of three meals and an evening snack. Many families gather in the evening to have tea and a snack. The main meal is eaten much later into the evening (8–9 pm). Breakfast foods include tea and some sort of flat bread. Many families have pickles (*achaar*) and/or chutneys with flat bread. Foods eaten at lunch and dinner tend to be very similar. Both meals include rice, flat bread, two or three kinds of vegetable curries, lentils (*daal*), and plain yogurt and/or buttermilk (*lassi*). If meat is used, then a meat curry will also be present. Condiments include a variety of pickles and chutneys. Traditionally, meals are eaten either on the floor or on very low stools. Food is usually eaten with the right hand. A small piece of the flat bread is used to scoop the vegetable curry for eating. Cutlery is not used commonly.

Fasting is practised by many South Asian religious groups. Muslims fast during the Holy Month of Ramadhan, each day from sunrise to sunset. During this fast neither food nor water is taken. Among Hindus, fasting may either be on a certain day of the week or month, and some foods and water are allowed during the day. This type of fasting includes one main meal during the day.

## 5. THE GLOBALIZATION OF FOOD CULTURE IN DEVELOPING COUNTRIES

In the past, colonialism influenced the food culture in many countries as the colonialists brought new foods and cultures to indigenous people where they established their colonies, and in return, took new foods and cultures back home. However, the dietary habits and nutrition environment in contemporary times are being influenced by globalization and other socio-economic factors that are changing the traditional pattern of indigenous diets all over the world. The different cultural perspectives to food are gradually being eroded, while entirely new ones or amalgams of the traditional and new are being formed. There is rapid diffusion of food culture from one region of the world to another, and people are quickly adopting new food patterns. These changes are being hastened by modernization, urbanization, economic development, and market globalization, and have been implicated in the development of nutrition-related, chronic diseases of lifestyle among populations in which these changes are occurring. This trend is referred to as the "nutrition transition" and is described in Chapter 4.

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We need to improve our understanding of changes in food culture and dietary patterns in developing countries. Studies are needed on both community and national scales to assess and understand these changes in the consumption of food among different socio-economic classes of the populace. In line with this, a dearth of information on traditional African food habits is of concern to nutrition experts, as this knowledge is necessary to gain an understanding of how traditional dietary patterns could potentially reverse current trends in chronic diseases of lifestyle and improve the health status of indigenous populations throughout Africa, and perhaps in the wider world (Raschke et al., 2007).

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# CHAPTER 4

# THE NUTRITION TRANSITION IN DEVELOPING COUNTRIES

*H. H. Esté Vorster and Lesley T. Bourne*

## *Outline*

- Meaning of the nutrition transition
- Factors that influence the nutrition transition
- Dietary changes during the nutrition transition
- The double burden of disease
- Biological responses to diet
- The double danger of early undernutrition
- The formulation of public health policy
- Monitoring, measuring, and assessing the nutrition transition

## *Outline*

At the completion of this chapter you should be able to:

- Explain what is meant by the nutrition transition
- Describe the stages of the nutrition transition
- Describe the key dietary changes at the different stages of the nutrition transition
- Discuss how investigating the nutrition transition helps us to better understand the emergence of nutrition-related chronic diseases of lifestyle
- Suggest programmes that need to be implemented to counter the emergence of nutrition-related chronic diseases of lifestyle

## *Abbreviations*

| | |
|---|---|
| CDL | Chronic diseases of lifestyle |
| NR-CDL | Nutrition-related, chronic diseases of lifestyle |

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# 1. INTRODUCTION

The *nutrition transition* is defined as changes in dietary patterns and nutrient intakes of individuals, families, groups of people, or whole populations when their food environment and other circumstances change. It is usually accompanied by an *epidemiological transition*, which is a shift from a pattern of high prevalence of malnutrition-related infectious diseases to one of increases of the nutrition-related, chronic diseases of lifestyle (NR-CDL). The environmental or circumstantial changes usually associated with the nutrition transition are urbanization, modernization (when people adopt modern "Westernized" lifestyles), and acculturation (when people forsake traditional cultures to adopt new lifestyles and beliefs). We live in a changing world, and the way we respond to these changes will influence our health. Moreover, changes in our external environment are intricately interlinked and often unavoidable.

In this chapter, the forces responsible for the changes in the food "environment," how people respond to these changes, and how the changes in eating patterns and nutrient intake influence health and well-being are explored. Because access to affordable, nutritious, and safe foods is a human rights issue, the chapter will also focus on the role and responsibilities of the different sectors in ensuring an environment in which healthy and safe food choices are possible and affordable. This includes recommendations for appropriate policies and programmes to steer the present nutrition transition in low- and middle-income countries into a positive direction.

# 2. A CONCEPTUAL FRAMEWORK TO UNDERSTAND THE NUTRITION TRANSITION

## 2.1 Factors that Influence the Nutrition Transition

Figure 4.1 illustrates a framework for understanding the complex, interlinked causes of the nutrition transition. To steer the nutrition transition in a positive health direction, it is necessary to understand all the factors influencing our food choices and our responses to changing diets.

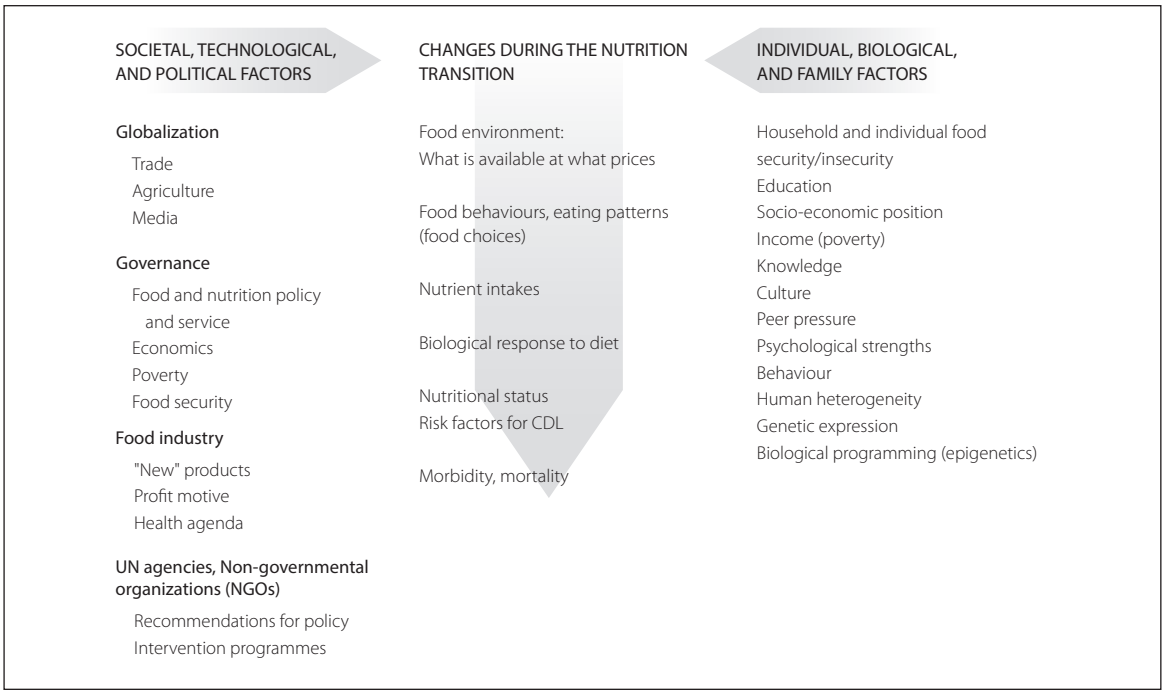


**Figure 4.1:** Factors influencing the causes and consequences of the nutrition transition.

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## 2.2 The Nutrition Transition and the Food Environment

The five historical patterns and changes during the nutrition transition have been described as follows by Cabellero & Popkin (2002) and by Popkin (2002, 2012).

1. **Collecting of food**. Hunter-gatherers ate a diet high in carbohydrate and fibre, and low in fat.
2. **Famine.** At this stage there were periods of acute scarcity of food and little dietary variety. These changes are related to a shift towards settlements and the adoption of a lifestyle based on farming. At first, foods mainly consisted of crops, but later also included livestock and poultry.
3. **Receding famine.** As farming developed, there was increased consumption of fruit and vegetables and less reliance on staple foods. The consumption of fruit, vegetables, and animal protein increased, while starchy staples become less important in the diet.
4. **Nutrition-related chronic diseases of lifestyle (CDL).** This period is characterized by an increased availability of inexpensive, ultra-processed, energy-dense foods high in fat, cholesterol, and refined carbohydrates. This is also referred to as a "Western" diet.
5. **Behavioural change.** Here we see the emergence of a "new," prudent, healthy dietary pattern based on scientific knowledge of the relationships between diet and health, as well as the benefits of increased physical activity.

Modern technology has created a world that is becoming "smaller": globalization of countries, markets, economies, multinational companies, and individuals (see Friedman, 2005), accompanied by international trade agreements, changes in agriculture (e.g., development of genetically modified foods), the influence of the food industry (developing and marketing of new products), and the media (promoting specific products), have collectively created a food environment in which a huge variety of good-tasting, palatable "healthy" and "unhealthy" foods are available, often during all seasons.

Unfortunately, social inequality – due to widespread poverty, wars, dictatorships, bad governance, and unfair trade policies – has resulted in a situation in developing countries where poor people are not benefiting from globalization (see Chapter 27). Moreover, many are concerned that globalization and overconsumption are threatening the environment and the ability to provide healthy and safe food for future generations. The food industry, largely responsible for the marketing of high-fat, sweet, "good-tasting," or palatable convenience foods, products, drinks, and snacks, is at present endeavouring to include a health agenda in the development of new functional food products. However, their motives, ethics, and contribution to "fairness, equity and a better future" for all are often questioned (Monteiro et al., 2010).

Different populations are at different stages of the nutrition transition. Indeed, different groups of people in the same population can be at different stages. In developing low- and middle-income countries, we see a situation where poverty and underdevelopment in rural areas often gives rise to hunger. This places some groups in the patterns of *famine* and *receding famine.* Yet at the same time, urbanization in the same countries has resulted in the pattern of CDL in many individuals and groups. In developed countries, there is promising evidence that some individuals and groups are moving towards the *behavioural change* pattern during which a more prudent and healthier diet is adopted. The major objective of food-based dietary guidelines (FBDGs) is to promote a prudent, balanced diet that places all people within a population in this behavioural change stage or pattern (Vorster, 2001).

Figure 4.1 also shows that food behaviours or our dietary choices in this changing food environment are influenced by psychological strengths, knowledge of healthy diets, education, food culture, and what we can afford. These factors should therefore be addressed in planning intervention policies and programmes to improve the diet of individuals and populations.

## 2.3 Dietary Changes During the Nutrition Transition

We now examine more closely the dietary changes typically seen during the nutrition transition in developing countries (Popkin, 2002). Similar patterns are seen around the world. Urbanization, as well as modernization of lifestyles in both urban and rural areas, has resulted in a dietary pattern characterized by increased intake of total and saturated fat, refined carbohydrates and added sugar, and of total and animal-derived protein.

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Conversely, there is a decreased intake of total carbohydrate, plant protein, and fibre. In many instances the recommended micronutrient intakes are not met, resulting in a "hidden hunger" where apparently healthy, even overweight and obese people, eating a Westernized diet, suffer from some micronutrient deficiencies. The end result of these changes is the Western diet, characterized by a high intake of fat (>30% of total energy), saturated fat (>7% of total energy), and salt (>6 grams/day), but a low intake of dietary fibre (<20 grams/day) and phytochemicals, combined with an energy intake that exceeds energy needs (as dictated by physical activity). A dominating feature of this diet is "overnutrition" due to an excessive supply of macronutrients.

As an example of a developing country, nutrient intake changes observed in South Africans over the past fifty years are described here. These data illustrate the dietary changes typically seen during the nutrition transition. In order to show trends in per capita consumption, food balance sheets for the years 1962 and 2001 are presented in Figure 4.2 (FAO, 2004). This shows the amounts of energy from the different macronutrients as well as total energy available for the South African population. While food balance sheets present total amounts of food available, they do not reflect the variations between the different socio-demographic subgroups. As has been seen in both international and local studies, over the 40-year period the available protein and fat supplies have increased. While this suggests that overall food security has improved, the trend in the macronutrient profile of available foods is in the direction that is likely to increase the risk of chronic diseases. Meanwhile, the per capita available energy supply has increased by about 12%. This is especially significant as changes to lifestyles, such as greater availability of buses and cars, meant that people had less need to engage in physical activity.

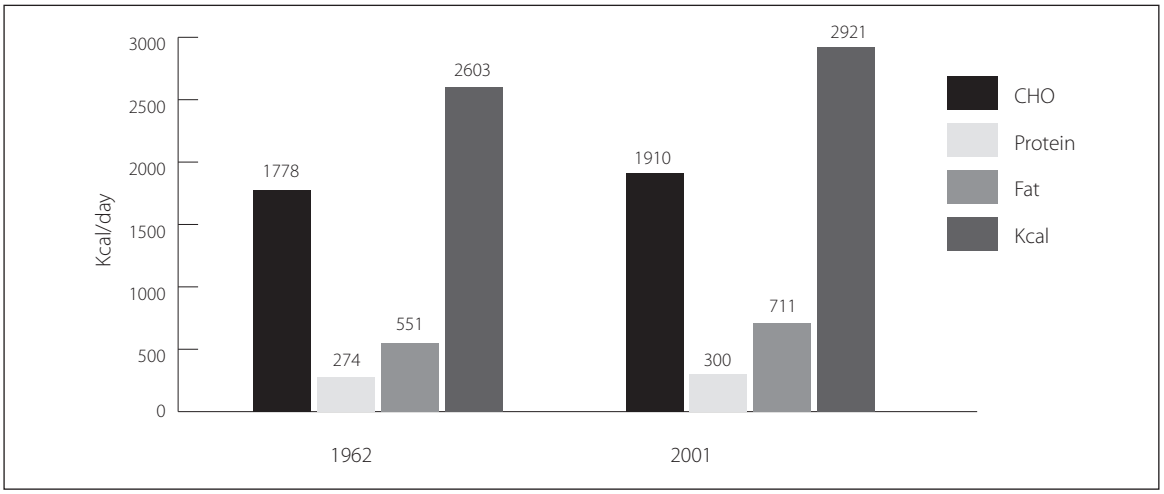


**Figure 4.2:** Trends in dietary energy supplies of South Africans, 1962 and 2001.
*Source: Steyn NP et al., 2006, using FAO (2004) food balance sheets.*

Similar trends were identified in black adults, aged 19 to 44 years, living in Cape Town (Bourne, 1996). The data were stratified by the percentage of life spent in an urban environment. Figure 4.3 shows that with increased urban exposure, reported intake of carbohydrate as a percentage of total energy decreased from 68% to 58%, while fat increased from 23% to 30%. Protein intake was relatively stable; however, a higher proportion of it was from animal sources. Total fibre intakes decreased from 20.7 to 16.7 grams per day (not shown in the figure). These shifts reflect the adoption of an increasingly Western diet.

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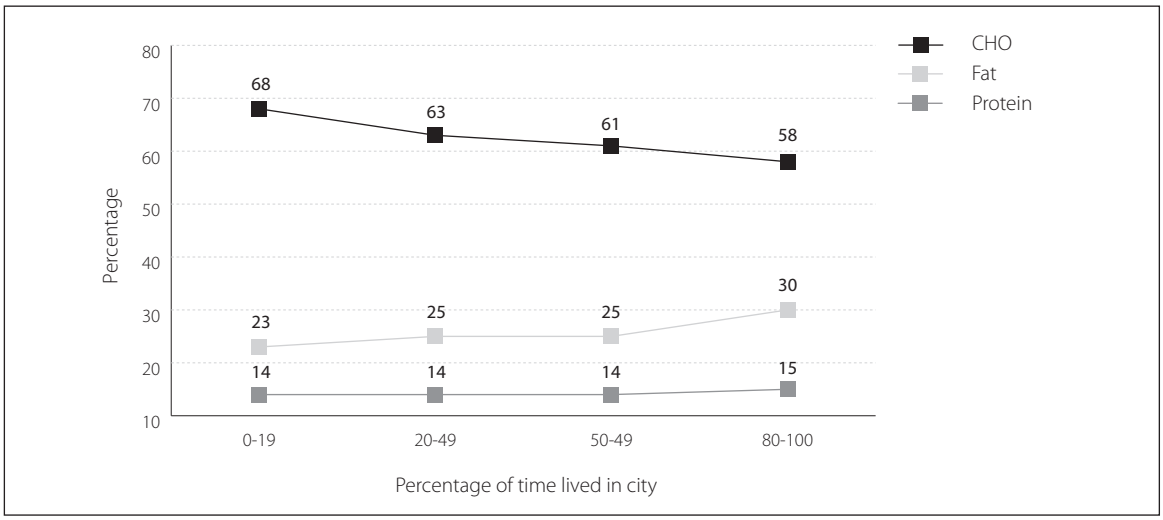


**Figure 4.3:** Impact of urban environment on diet.
*Source: Bourne, 1996.*

There are important differences within the various South African population groups. Figure 4.4 compares the macronutrient intake of adult white urban males (aged 15 to 64 years), black urban males (aged 19 to 44 years), and black rural males (aged 20 to 65 years). The figure indicates that the white population consumes a Western diet (Wolmarans et al., 1988), while the rural black population follow a traditional dietary pattern (Steyn et al., 2001). By contrast, the urban black population has an intermediate diet (Bourne, 1996). The mixed-ancestry population (Steyn et al., 1985) and Indian population group (Wolmarans et al., 1999) consume diets that are culturally distinctive but reflect Western macronutrient profiles, placing people in these groups at risk of chronic diseases and in the NR-CDL stage of the nutrition transition.

## 3. THE NUTRITION TRANSITION AND HEALTH

The Western diet, through various mechanisms, increases the risk of nutrition-related CDL. Therefore, eating a typically Western diet results in an increased risk of obesity, hypertension, ischaemic heart disease, stroke, the metabolic syndrome, type 2 diabetes, and some types of cancer.

### 3.1 The Double (or Dual) Burden of Disease

In low- and middle-income countries, in recent years, there has been a great deal of urbanization and economic development. Following this, the nutrition transition has been rapid and intense. The result is that CDL, especially obesity, hypertension, cardiovascular disease, and type 2 diabetes, emerged in the higher socio-economic groups before the battle against undernutrition and infectious disease in the lower socio-economic groups had been won. This co-existence of CDL (in adults) and infectious diseases (mostly in children) is known as the *double burden of disease*. A particular feature of this is that the onset of CDL in the adult population occurs at a younger age than in developed populations who experienced the nutrition transition many years ago. Also, the consequences and mortality from CDL are more pronounced in populations who are presently experiencing the double burden. A possible explanation is that in countries experiencing the double burden, undernutrition induces early foetal and infant programming, which then confers an extra vulnerability for CDL in later life when these "programmed" individuals are exposed to a Western diet.

In many low-income countries, the HIV/AIDS pandemic added another dimension on top of the double burden of disease; this is therefore a "triple burden of disease." Tragically, it is often countries with limited resources that have to cope with this.

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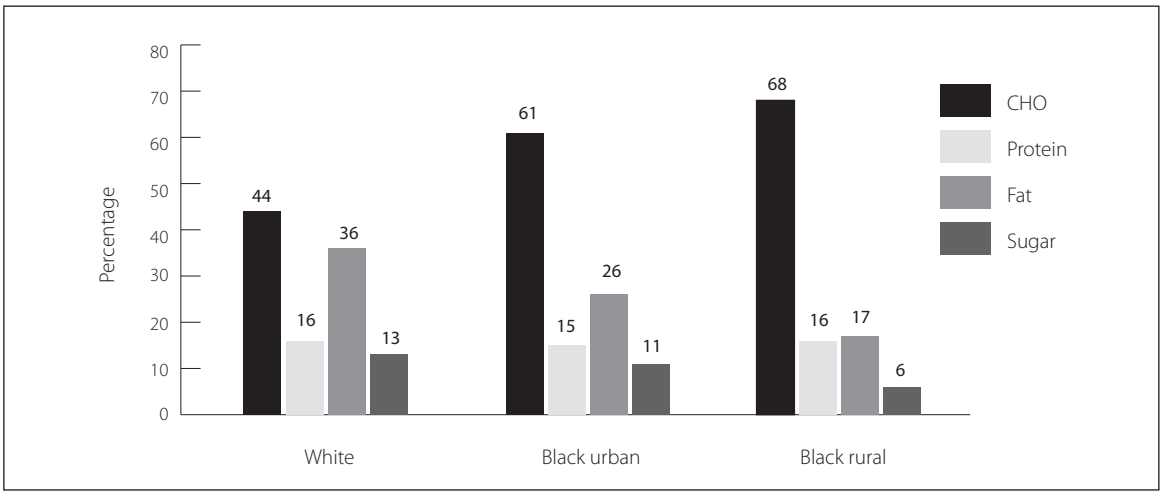


**Figure 4.4:** Macronutrient distribution as percentage of total daily energy.
*Sources: Wolmarans et al., 1989, for white population; Bourne, 1996, for urban-dwelling black population; Steyn et al., 2001, for rural black population.*

## 3.2 Biological Responses to Diet

The way people biologically respond to a changing diet as they move from a rural, traditional diet to a Western one has been the subject of intense research.

As noted above there is evidence that individuals who were previously exposed to undernutrition during foetal life or infancy have an increased vulnerability to CDL when they eat Western diets as adults. This "early origins of adult disease" hypothesis (Barker, 1992, 2012) is now better – but not totally – understood and accepted. It appears that as a result of this undernutrition during early life, biological processes are somehow reprogrammed so that many years later, in adult life, the person is especially vulnerable to the effects of overnutrition.

The variation in biological responses to the nutrition transition, both within and between populations, helps explain the variation in the prevalence of the resultant CDL. The possible reasons for these differences are summarized in Box 4.1. It is important to realize that despite these differences in response to dietary changes, we have no reason to question the established relationships between nutrition and health. For prevention of CDL, an optimal diet should be promoted at the population level. This optimal nutrient composition – with balanced intake of energy and macronutrients, and adequate intake of micronutrients – can be achieved with many different traditional and culturally acceptable foods.

## 3.3 The Double Danger of Early Undernutrition

Early undernutrition poses a double danger to human health. First, as discussed above, there is the danger of increased risk of CDL during adulthood. Second, babies and infants who are nutritionally compromised have a greater risk for physical and mental (cognitive) underdevelopment (Grantham-McGregor et al., 1999). This is often termed "decreased human capital." Adults who grow up in such a situation are unable to "build a better life" and escape poverty. The consequence of this is an intergenerational poverty-malnutrition cycle. These serious negative consequences of early undernutrition have profound implications for nutrition policy and programmes.

This emphasizes the importance of:

- good or optimal nutrition of women in their reproductive years and during pregnancy to prevent low-birth-weight babies
- good nutrition during infancy and childhood to prevent stunting
- adherence to a healthy, balanced, optimal, and prudent diet during adulthood to prevent CDL

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**Box 4.1:** Possible Explanations of Differences in CDL Prevalence and Type

| Suggested mechanism | Example |
|---|---|
| 1. Genetic differences between individuals (and populations) regarding risk factors for specific CDL | 1. Familial hypercholesterolaemia due to a founder effect: increased ischaemic heart disease |
| 2. Genetic differences in response to specific nutrients and dietary changes | 2. Salt sensitivity → hypertension; obesity, diabetes, and insulin resistant genes |
| 3. Time span of the nutrition transition | 3. Foetal and infant programming for adult disease more pronounced if the transition is rapid, over one or two generations |
| 4. Food environment: Types of foods and nutrients available influence nutritional status. | 4. The presence of *trans*-fatty acids because of changes in manufacturing of margarine |
| 5. Cultural and environmental influences on coping mechanisms (may be a modulator, not a determinant, of response to diet) | 5. Passive versus active coping and changes during acculturation will determine, for example, "resistance" to hypertension. Effects on response to diet not known. |

# 4. THE FORMULATION OF PUBLIC HEALTH POLICY

Chapter 13 expands on the relationship between specific foods, dietary components, and their relationship with CDL. Based on this we can formulate recommendations for the optimal diet to prevent CDL. The goal is to steer the nutrition transition into a positive direction. There are many different food combinations or diets that can lead to an optimal nutrient intake. There are ample opportunities, therefore, to promote diets that are traditional, culturally acceptable, available, and affordable.

This section focuses on those factors in the food environment that are potentially modifiable. Based on this, we suggest policies and programmes that can potentially reduce the negative effects of the nutrition transition. Several of the topics looked at here are explored in more depth in later chapters.

## 4.1 A Double Burden of Nutrition-related Diseases

Many developing countries are experiencing a double burden of morbidity and mortality from both infectious diseases related to undernutrition as well as CDL related to overnutrition (Steyn K et al., 2006). Tragically, this situation is further exacerbated by the HIV/AIDS pandemic and the high prevalence of other infectious diseases, such as tuberculosis and malaria (Bradshaw et al., 2006). These rapid and complex changes in the food environment have created a complex situation, including: the co-existence of macronutrient overnutrition and micronutrient undernutrition in the same individual; the presence of overweight and obese mothers and caregivers in households with stunted children (Doak et al., 2002; Steyn NP et al., 2006); and the inequity in the nutritional status of different population groups.

This complex situation creates many challenges to the development of policies and programmes. These need to take into account and confront those factors which are responsible for the movement from receding famine to CDL. One major factor is poverty, which leads to a reliance on inexpensive staple foods that are energy dense but have a poor content of micronutrients (MacIntyre et al., 2002).

But to eradicate hunger and move away from undernutrition all proximal and distal contributing factors – such as food insecurity and poverty, lack of access to health services, disease, unhygienic environments, and lack of education – should be addressed in holistic, integrated programmes involving all relevant sectors of governance. Particular attention must be given to the intergenerational vicious cycle between undernutrition and poverty. This should be addressed by programmes that simultaneously tackle the causes and consequences of undernutrition and poverty. Programmes and policies should address these problems and promote appropriate behavioural change in a culturally sensitive manner.

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## 4.2 Food and Nutrition Rights and Responsibilities

The fundamental human right of access to affordable, safe, and nutritious food is embedded in the constitution of many countries (see Chapter 1). This right, as well as the signing of many international agreements to alleviate poverty and hunger (ACC/SCN, 2000), place a responsibility on governments to ensure food and nutrition security at a household level. Governments, through appropriate policies and programmes, must ensure a food environment in which healthy, prudent dietary choices are possible and affordable. Individuals have the responsibility to make these healthier choices but can only do so if they are educated and empowered with the information and knowledge about the relationship between diet and health.

## 4.3 The Role of the Food Industry and Related Sectors

The food industry is often accused of creating an environment in which healthy choices are not promoted. For example, marketing and advertising of products such as sugar-rich beverages and fat-rich snack foods for children are thought to contribute to childhood obesity, a growing international health problem (Proctor, 2007). Also, some food production and packaging processes, aiming to reach "upmarket," sophisticated consumers, are not always compatible with protection and conservation of our physical environment and the world's natural resources. There is evidence of a voluntary movement in some multinational food companies to produce and market healthier foods and products, although the motive and effectiveness of this is often questioned. Local, national, regional, and international governance could and should do much more to ensure sustainable, affordable, and healthier food environments. This may require regulatory approaches that counteract the heavy marketing of convenient ready-to-eat foods that are high in fat, sugar, and salt to promote a pattern of optimal intakes, referred to as the *behaviour change* phase (or stage) of the nutrition transition.

## 4.4 Culture and Traditional Foods

Migration and Westernization of peoples in developing countries have been characterized by an explosion of CDL, often at a relatively early age (Popkin, 2002). Promotion of the consumption of traditional foods and retention of cultural eating patterns are known to partially prevent this transition. However, there are several barriers to this solution, including availability of these traditional foods.

One way to promote increased consumption of traditional foods is to commercialize their production and marketing. Modernization and Westernization are characterized by a transition in taste and access to convenience foods. A huge educational effort is therefore needed to convince people in transition that their traditional food cultures are compatible with palatable diets, good health, and low risk of CDL.

## 4.5 Some Examples of Programmes: A Glance at South Africa

Some governments, such as that of South Africa (through the Department of Health), have already introduced important policies and programmes to address the double burden of disease. The food-based dietary guidelines are an important user-friendly tool for promoting optimal nutrition, while the Integrated Nutrition Programme focuses on dealing with the development and consequences of undernutrition. Feeding schemes have been introduced in schools attended by nutritionally vulnerable children. Additionally, micronutrient fortification of wheat flour and maize and iodization of salt have been introduced, while at primary-health facilities, supplementation with vitamin A and iron have been enforced. Breast-feeding initiatives have been strengthened by increasing the number of hospitals that are officially designated as "baby friendly." These programmes and policies focus on all stages of the life cycle in various ways. However, the promotion of physical activity, particularly at schools, remains a huge challenge.

The South Africa Department of Health has also developed policies and strategies to prevent and treat CDL in the country (Kotzenberg, 2006), supporting the recommendations of the World Health Organization (WHO/FAO, 2003; Yach & Hawkes, 2004) and the approach of the South African Medical Research Council (Steyn K et al., 2006) to follow an integrated model in which diet, physical activity, and other lifestyle and behaviour changes are addressed holistically. These factors should form part of any intervention activity aimed at minimizing the negative effects of the nutrition transition in Africa.

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## DISCUSSION QUESTIONS AND EXERCISES

Consider the nutrition situation in your country or community, but only if you live in a developing country and you have reliable nutrition data available to you. Alternately, use the data presented here on South Africa. This chapter broadly characterized the five stages of the nutrition transition.

1. Discuss and identify ranges of macronutrient intakes as percentage of energy that are associated with the following stages:
   a. Receding famine
   b. Nutrition-related chronic diseases of lifestyle (NR-CDL)
   c. Behaviour change
2. Discuss and list dietary recommendations that will allow a population to proceed from receding famine and from NR-CDL stages to the optimal, behaviour change stage.
3. Discuss and list other lifestyle changes needed to put the majority of the population at the last, optimal stage of the nutrition transition.
4. Discuss and list additional interventions that could be implemented by appropriate government departments to optimize nutritional status and prevent NR-CDL.

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## ADDITIONAL RESOURCES

Food and Agricultural Organization (FAO) website on nutrition transition: http://www.fao.org/Focus/E/obesity/obes2.htm.

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# PART 2

## LIFECYCLE NUTRITION

# CHAPTER 5

# NUTRITION DURING THE FIRST THOUSAND DAYS OF LIFE

## Part I: Pregnancy and Lactation

*Lisanne M. du Plessis and Celeste E. Naude*

### *Outline*

- Methods for determining the nutritional status of pregnant and lactating women
- Nutritional risks during pregnancy and lactation
- Nutritional needs of pregnant and lactating women
- Nutrition interventions during pregnancy and lactation
- Health care during pregnancy
- Benefits of breast-feeding for maternal health
- Rights of mothers and infants regarding breast-feeding
- The ten steps to successful breast-feeding

### *Objectives*

At the completion of this chapter you should be able to:

- Describe the methods for assessing the nutritional status of pregnant and lactating women
- Discuss nutrition-related health problems of pregnant and lactating women
- Know the nutritional needs of pregnant and lactating women
- Discuss nutritional interventions in pregnancy and lactation that have been proven to be successful
- State the recommendations for health care during pregnancy
- Describe the relationship between breast-feeding and maternal health
- Know the rights of mothers and infants regarding breast-feeding
- Name the ten steps to successful breast-feeding


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# 1. INTRODUCTION

Maternal and child health is a basic, non-negotiable human right. The International Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) of 1989 declares in Article 12(2) that the state should "ensure to women appropriate services in connection with pregnancy, confinement, and the post-natal period, granting free services where necessary, as well as adequate nutrition during pregnancy and lactation" (United Nations, 1979). Numerous treaties, policies, and programmes have been developed over time to address maternal and child health. However, despite commitments throughout the developing world, mothers and children still die at high rates from conditions that could be prevented (Bhutta et al., 2008).

Women between the ages of 15 and 49 represent what is often referred to as the "women of childbearing age" group. Maternal health refers to the period in a woman's life that involves pregnancy, childbirth, and post-natal care (Shung King et al., 2006). Good nutrition during these first thousand days – that is, from the start of a woman's pregnancy to her child's second birthday – is vitally important to the health of both mother and child. As 1000 Days, an organization dedicated to improving nutrition during this critical period, points out, "better nutrition can have a lifelong impact on a child's future and help break the cycle of poverty" (http://www.thousanddays.org/about).

Pregnancy is one of the most dangerous periods in the life of a woman. Teenage pregnancies are of particular concern since adolescent girls who fall pregnant may not yet have reached their full growth potential (Ronsmans et al., 2008).

Maternal mortality ratio (MMR), expressed as the number of maternal deaths per 100,000 live births per annum, traditionally refers to the rate of deaths in women as a result of childbearing, during the pregnancy, or within 42 days of delivery or termination of pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes (Ronsmans et al., 2008). MMR is an indicator of socio-economic status and health care in society. The values for MMR cover a wide range in developing countries, varying from 55 (per 100,000 live births) in eastern Asia to 920 in sub-Saharan Africa (Ronsmans et al., 2008). New estimates show that the leading causes of maternal deaths are haemorrhage and hypertension, which together account for more than half of maternal deaths. Indirect causes, which include deaths due to conditions such as malaria, HIV/AIDS, and cardiac diseases, account for about one fifth of maternal deaths (WHO/UNICEF, 2010).

Maternal and child undernutrition remain persistent and destructive conditions in low-income and middle-income countries (Black et al., 2008). Undernutrition affects mortality and ill-health along the entire continuum of care from pre-pregnancy to early childhood (WHO/UNICEF, 2010). When undernourished girls and women have children of their own, the consequences of inadequate nutrient intake are passed on to the following generation (Figure 5.1). It is thus clear that the prevention of maternal and young child undernutrition is a long-term investment that will benefit the current generation as well as their children (Bhutta et al., 2008).

# 2. PREGNANCY

## 2.1 Assessment of Nutritional Status

Nutritional assessment should be incorporated routinely into the medical care of pregnant women. (For general information on assessing nutritional status, see Chapter 22.) The assessment should be comprehensive and should include the so-called "ABCD" approach: Anthropometry, Biochemistry, Clinical signs, and Dietary intake. At the same time, it should be tailored to the setting and available resources. Assessments done early in pregnancy should be used to evaluate the nutritional status of the woman and to predict how well she can cope with the physiological demands of pregnancy. Unfortunately, this is usually neglected despite clear evidence in developing countries that pregnancy and lactation represent a major nutritional drain on the mother (WHO Expert Committee, 1995). Challenges for complete and detailed assessments are late seeking of antenatal care and resource poor environments, including lack of equipment and trained health-care workers.

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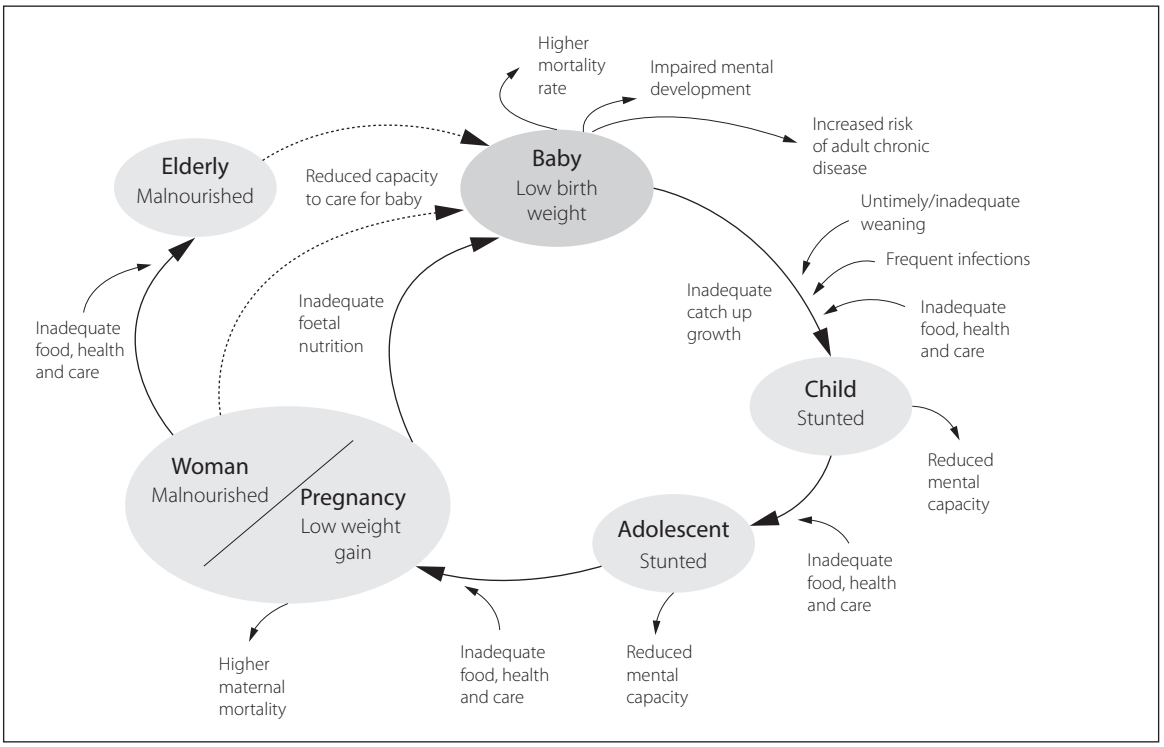


**Figure 5.1:** The malnutrition poverty cycle.
*Source: ACC/SCN, 2000, p. 1.*

### *2.1.1 Anthropometry*

*Weight and weight gain.* Body weight measured at various times during pregnancy has been widely used to assess maternal health status. Since body weight changes rapidly during pregnancy, gestational weight adjustments are routinely monitored in prenatal care worldwide. BMI is not an accurate indicator in pregnancy, but a very low pre-pregnancy BMI is a fairly reliable indicator of severe wasting of both fat and lean tissue (WHO Expert Committee, 1995).

Unfortunately, there is no guideline for weight gain for pregnant women from developing countries. In 2009, the Institute of Medicine (IOM, 2009) published new recommendations for total and rate of weight gain during pregnancy by pre-pregnancy BMI. These are based on US data; their application as recommendations for gestational weight gain for developing countries is therefore limited.

*Height.* Measuring a woman's height provides a proxy indicator of childhood growth and skeletal pelvic structure, and it is a good predictor of the risk of cephalopelvic disproportion and obstructed labour, which is a major cause of death in developing countries. Women of short stature (140 to 150 cm) are also at risk for intrauterine growth restriction (IUGR), low birth weight (LBW), infants who are small for gestation age (SGA), and preterm delivery (WHO Expert Committee, 1995).

*Mid-upper arm circumference.* A woman's mid-upper arm circumference (MUAC) reflects past and current nutritional status, but is less responsive than weight to short-term changes in health and nutrition conditions. It is relatively stable throughout pregnancy, even when measured relatively late in pregnancy, and it may be more reflective than weight of pre-pregnancy conditions (WHO Expert Committee, 1995). Wasting in pregnant women can be defined as a MUAC <22 cm (Kruger, 2005).

*Skin-fold thickness and calf circumference.* These measures are not considered reliable. Increased skin-fold thickness on the arms, legs, or back may not reflect an increase in total body fat of a pregnant woman. Measurements of the lower body, specifically leg circumferences, may be increased because of normal oedema, particularly during late pregnancy (WHO Expert Committee, 1995).

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*Symphysis fundus height.* Symphysis fundus (SF) height has long been used to measure the size of the pregnant uterus (i.e., interuterine growth rate). A review of studies concluded that SF height is of variable value as a predictor for IUGR (Jacobsen, 1992). However, in late pregnancy it has been used successfully to predict complications of delivery and problems with the newborn (WHO Expert Committee, 1995).

### *2.1.2 Biochemistry*

The physiological and metabolic changes of pregnancy cause changes in maternal biochemical and haematological parameters. These indicators should therefore be interpreted with care in pregnancy (Knight et al., 1994).

WHO estimates that more than half of pregnant women in developing countries may be anaemic, defined as haemoglobin below 11 g/dL (WHO, 1992). See also Section 2.2.2.

Proteinuria refers to abnormally high levels of proteins in the urine. During pregnancy, urinary protein excretion in excess of 300 mg in 24 hours (about 1+ on a urine dipstick) is regarded as abnormal. Proteinuria that occurs during the first 20 weeks of gestation (or prior to pregnancy altogether) may signal the presence of underlying kidney disease (Airoldi & Weinstein, 2007).

### *2.1.3 Clinical signs*

In pregnancy the same clinical evaluation will be done as for any woman, but specific attention should be given to signs of vitamin deficiencies, especially for vitamin A (night blindness), iron (pallor, bleeding gums), and iodine (goitre), which have proven to be problematic in many developing countries. General signs of malnutrition and fluid retention should also be investigated.

### *2.1.4 Dietary intake and physical activity*

Women of reproductive age have unique nutrition requirements (FAO, 2001). Energy requirements increase during pregnancy, largely as a result of foetal growth and increased maternal body weight (Brown, 2005). Energy metabolism may be altered in more than one way, and women who seem to enter pregnancy in similar nutritional states have varying responses. Additional energy needs of pregnant women have been found to range from 210 to 570 kcal (882 to 2394 kJ) per day (King, 2000). This additional energy requirement is also dependant on the level of physical activity (Brown, 2005). Women in developing countries often have high levels of physical activity, including physical labour in the fields, fetching fuel, and hauling water, in addition to domestic caring practices. These high levels of physical activity are not offset by increases in energy intake; the resulting imbalance is often reflected in low weight gain and impaired foetal growth (King, 2000). Additionally, energy metabolism and foetal growth is dependant on the pre-pregnancy energy status of the mother and the quality of her living conditions (King et al., 1994). (Appendix III provides the Dietary Reference Intakes [DRIs].)

In pregnancy, attention should be paid and questions should be formulated to ask specifically about nutrition-related health problems and risks, including: heartburn, constipation, nausea, pica (consumption of substances with little or no nutrients), and food safety (ADA, 2003). Relevant nutritional advice and practical guidelines should be formulated to address these issues.

Further investigations and assessments should be performed if gestational diabetes, pregnancy-induced hypertension, and/or HIV are suspected, and management should be tailored accordingly.

The ABCD approach is a useful one, but the environment, availability of population-specific cut-off points, and resources will determine what is feasible to measure. A framework has been proposed that identifies the critical points for action during pregnancy to improve birth outcomes. Women with short stature (<145 cm), low body weight (<45 kg), and/or low MUAC (<22 cm) are considered to be at risk of adverse pregnancy outcomes. Weekly weight gains from the second trimester should range from 0.3 kg for overweight women to 0.5 kg or more for underweight women. Genetic background, age, general health, HIV, educational status, cigarette smoking, past nutritional status, parity, multiple pregnancies, climate, socio-economic conditions, and the availability of health services (Kruger, 2005) should be considered when evaluating the nutritional status of a pregnant women.

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## 2.2 Nutritional Risks During Pregnancy

### *2.2.1 Undernutrition*

Maternal nutritional status at the onset of pregnancy can affect not only the health and development of the foetus but also maternal health (ADA, 2002). Indeed, maternal undernutrition during gestation reduces placental and foetal growth in animals and humans (Guoyao, 2004). A poor nutritional status increases the risk of miscarriage, stillbirth, neonatal malformations, and of infants born with significantly reduced birth weights and lengths. Low pre-pregnancy weight is a predictor of intrauterine growth restriction (IUGR) (Black et al., 2008). Nutritional status prior to conception is therefore as important as during pregnancy (Brown, 2005).

It was previously believed that the needs of the foetus were met at the expense of the mother's stores and requirements. Emerging evidence suggests that development of the growing baby can be suboptimal if certain nutrients are unavailable during specific responsive periods of development (Zeisel, 2009). Available nutrients are utilized first for maternal needs and physiological changes, next for placental health and development, and lastly for foetal growth and needs. Foetal growth is compromised more than maternal health in periods of inadequate intake (Velzing-Aarts et al., 1999; King, 2003). Thus, an adequate availability of nutrients during gestation is probably the single most important environmental factor influencing pregnancy outcome (King, 2003; Zeisel, 2009).

Improvements in maternal nutrition and health can increase birth weight, survival, and growth of children, and subsequent size and function – including health, productivity, and mental performance – in adult life (Allen & Gillespie, 2001).

### *2.2.2 Low birth weight, intrauterine growth restriction, and preterm birth*

The average duration of gestation is 40 weeks. Before 37 weeks (259 days) the foetus is considered preterm, and after 42 weeks it is considered post-term (Rolfes et al., 1990).

The constituents of low birth weight (LBW) are IUGR and preterm birth (Kramer, 2003). There are two processes that establish birth weight, namely duration of gestation and foetal growth rate. Therefore, being born too early (preterm birth) and being born small for gestational age (SGA) can both result in a LBW (<2500 grams) (Kramer, 2003). Infants with LBW have perinatal mortality rates that are 5 to 30 times greater than those of infants with normal birth weights (Jackson et al., 2003).

Preterm infants are at increased risk of death, short- and long-term pulmonary, ophthalmologic, and neurologic morbidity, and delayed psychomotor development (Kramer, 2003).

IUGR refers to foetal growth that has been constrained; it therefore characterizes a newborn that has growth impairment (ACC/SCN, 2000). This is associated with an elevated risk of sudden infant death syndrome (SIDS), increased perinatal morbidity and mortality, increased mortality and childhood morbidity, as well as a higher tendency towards neurologic impairment and poor cognitive development in childhood. IUGR infants tend to have small but lasting deficits in growth (Gülmezoglu et al., 1997; Kramer, 2003). There is growing evidence that impaired foetal growth is related to an increased risk of chronic disease in adulthood (Guoyao, 2004).

It is estimated that one-third of LBW infants in developed countries are born preterm (<37 weeks gestation). Most LBW infants in developing countries are born term, but have experienced IUGR, which may start early in pregnancy (Ramakrishnan, 2004).

Being born LBW has an intense unfavourable effect on the health and development of the neonate. It is a risk factor for stunting, which starts in the womb and will worsen if the diet and health status is not optimal during post-natal development (Allen & Gillespie, 2001). The causes of preterm birth and IUGR differ. For IUGR the most important factors are low energy intake and resultant low gestational weight gain, low preconception body mass index (BMI <18.5), short stature, maternal infections, abnormal placental blood flow, foetal infections, primiparity, pregnancy-induced hypertension, cigarette smoking, and malaria (for primiparae). Prematurity, regardless of degree, is associated with genetic factors; lower than average maternal age, height, and weight (low preconception BMI); small weight gain in pregnancy; poor prenatal care; lack of social or family support; inadequate spacing of births; multiple births; pregnancy-induced hypertension; placental insufficiency; uterine abnormalities; infections in pregnancy; premature rupture of membranes; history of previous preterm birth; heavy work during pregnancy; and cigarette smoking (Kramer, 2003; Allen & Gillespie, 2001; Illingworth, 1991).

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### *2.2.3 Micronutrient malnutrition*

Chronic maternal undernutrition may be associated with deficiencies of micronutrients that influence foetal growth, including folate, iron, zinc, and vitamins A, C, and D (Moore et al., 2004; Rao et al., 2001; Barker, 2001). Micronutrient intake during pregnancy is also associated with various birth outcomes, suggesting that different micronutrients play important roles in improving foetal growth (Rao et al., 2001). For some of these micronutrients, supplementation has been shown to be beneficial, but for others sufficient research is still lacking. Women in low-income countries often have an inadequate intake of various micronutrients because of predominantly cereal-based diets with limited consumption of animal products, fruit, vegetables, and fortified foods (Mahomed & Gülmezoglu, 1997).

*Anaemia*. Anaemia during pregnancy is very common in developing countries (WHO, 1992). Iron nutrition is covered in detail in Chapter 9.

Causes of anaemia include nutritional deficiencies (particularly iron, vitamin $B_{12}$, and folate), genetic factors, and infections. The effects of dietary deficiencies can be exacerbated by factors of poor socio-economic conditions (Mamabolo et al., 2004). Iron-deficiency anaemia is the most widespread nutritional problem among women. Anaemia during pregnancy in developing countries may be only partly due to iron deficiency since malaria, HIV infection, vitamin A deficiency, and intestinal parasites may be equally important causes (Ronsmans et al., 2008).

Iron supplementation of around 60 mg elemental iron daily in pregnancy improves maternal iron status during pregnancy and immediately after delivery in both industrialized and developing countries (Ronsmans et al., 2008).

*Folate.* Poor folate intake during pregnancy is associated with anaemia and reduced foetal growth (Shabert, 2004). Inadequate availability of folate between 21 and 37 days after conception can interrupt normal cell differentiation and cause neural tube defects, such as spina bifida (Eskes, 1998).

*Iodine.* Iodine deficiency in early pregnancy can lead to hypothyroidism in the offspring, a widespread problem in parts of the developing world (Cao et al., 1994). The incidence of infant hypothyroidism has been found to decrease by more than 70% when at-risk women in developing countries are given iodine supplements before or in the first half of pregnancy. This intervention also leads to improved psychomotor development of the infants and a reduced frequency of infant deaths (Mahomed & Gülmezoglu, 1997). The vital importance of adequate iodine is covered again in Chapter 9.

*Vitamin A*. Vitamin A deficiency causes night blindness in pregnant women and may increase the risk of maternal mortality. Four pathways have been suggested by which supplementation with vitamin A (or its precursors) may improve the maternal health status during pregnancy, namely (1) vitamin A may enhance maternal immunity and thereby decrease the risk of bacterial and viral infections during pregnancy, (2) it may improve the mother's haematological status, (3) it may enhance the implantation and development of the placenta, and (4) vitamin A deficiency has been associated with pregnancy-induced hypertension. The most convincing potential mechanism of action of vitamin A and its precursors is through the first two of these pathways (Ronsmans et al., 2008).

Vitamin A deficiency can affect iron metabolism and thereby contribute to low haemoglobin. This may occur when deficiencies of both nutrients coexist and particularly in environments that favour frequent infections. Maximum haemoglobin response occurs when iron and vitamin A deficiencies are corrected together (Ronsmans et al., 2008).

The Cochrane Review of vitamin A supplementation during pregnancy concluded that, despite positive findings from two developing countries, further trials are needed to provide evidence of a beneficial effect on maternal mortality and morbidity and to clarify the mechanism behind any such effect (Kennedy et al., 2000).

High-dose vitamin A is contra-indicated in pregnancy because of its terratogenic effect. Supplementation during the post-partum period (6 to 8 weeks) increases vitamin A in breast milk and improves maternal immunity (Rice, 2007). Vitamin A nutrition is discussed again in Chapter 9.

*Calcium.* Reviews of calcium supplementation trials during pregnancy provide strong support for this intervention as a means of preventing pregnancy-induced hypertension and pre-eclampsia in communities with low calcium intake. Supplementation with one to two grams of calcium daily is associated with a 42% reduction in risk of hypertension, with or without proteinuria, and a 65% reduction in risk of pre-eclampsia (Ronsmans et al., 2008).

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*Vitamin D.* There is a disturbingly high prevalence of hypovitaminosis D amongst pregnant women in many populations around the world; this is an area of growing concern. Inadequate vitamin D status during gestation may have adverse effects on maternal pregnancy as well as foetal and post-natal growth and development. Therefore, an increasing number of experts are advocating that recommended vitamin D intakes in pregnancy should be revised. The optimal circulating 25(OH)D concentration throughout pregnancy is still debated, but it is evident that prior levels used to establish intake recommendations were too conservative. In light of existing evidence, public health intervention to reduce the prevalence of hypovitaminosis D in pregnant women worldwide is urgently needed (Dror & Allen, 2010). The topic of vitamin D is revisited in Chapter 13.

### *2.2.4 Multiple pregnancies*

A woman who is pregnant with more than one foetus poses considerable risks for both the mother and the foetuses, with the risk increasing as the number of foetuses increases (Brown & Carlson, 2000). Adequate prenatal nutrition improves the chance that the infants will achieve a higher birth weight when born closer to term (Klein, 2005).

### *2.2.5 Closely spaced pregnancies*

Women who have short interpregnancy intervals (<18 months) may not have sufficient time to replace nutrients used during the previous pregnancy and are at risk of having an inadequate supply of nutrients to meet the needs of the subsequent pregnancy, especially in poor communities. Women with closely spaced pregnancies are at increased risk for delivering preterm, LBW, or SGA infants (King, 2003).

### *2.2.6 Overnutrition*

Overnutrition is a growing health problem globally. Obesity often coexists with undernutrition in developing countries and is a complex condition, with serious social and psychological dimensions, affecting virtually all ages and socio-economic groups (WHO, 2013).

The reproductive risks of overnutrition or obesity include infertility or difficulty with conception, gestational diabetes, hypertension (pregnancy-induced), premature birth, and increased rates of caesarean section, as well as a birth weight of greater than 4000 grams (Shabert, 2004).

Early identification by means of nutritional screening, dietary treatment, and monitoring of obese pregnant women as part of standard prenatal care may affect outcomes for the mother and infant.

### *2.2.7 Alcohol*

Alcohol should be avoided during pregnancy since it can lead to foetal alcohol syndrome (FAS), which is the most common preventable cause of mental retardation in the world. Other symptoms can include growth retardation, abnormal facial features, and an increased frequency of major birth defects. Children born with FAS never recover. A milder form of FAS is known as foetal alcohol effects (FAE). Children with FAE may be short or have only minor facial abnormalities, or develop learning disabilities, behavioural problems, or motor impairments.

FAS-affected children are frequently born to mothers who abused alcohol while they were unaware that they were pregnant. The type of alcoholic beverage is not important; the quantity of alcohol is the critical factor.

Alcohol use during pregnancy is a complex problem that is inseparable from other factors such as a woman's mental health, her socio-economic status, power relations between her and her partner, and the attitudes of her family and community towards drinking. It is now generally accepted that any woman who is or may become pregnant should abstain from alcohol consumption (Carlo, 2007).

### *2.2.8 Other harmful substances*

Food-borne illness during pregnancy can have severe consequences, including spontaneous abortion and

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stillbirth and it may also cause blindness, mental retardation, and seizures. Raised progesterone levels during pregnancy decrease a pregnant woman's ability to resist infectious disease, thus making her more susceptible to food-borne illness (ADA, 2003). To prevent food-borne infection, pregnant women should avoid raw fish and shellfish, unpasteurized cheese, raw or undercooked meat, unpasteurized milk (Brown, 2005), and unwashed surfaces of fruit and vegetables (Soto, 2002).

Other harmful substances to be avoided during pregnancy include contaminants in food, cigarette smoking, and heavy metals such as mercury, lead, and cadmium (Shabert, 2004). The use of all other pharmacological agents, drugs, herbal and natural remedies, and over-the-counter medications should be discussed with a doctor or pharmacist before use, because these may be harmful to the foetus.

# 3. NUTRITION AND HEALTH CARE FOR PREGNANT WOMEN

## 3.1 Nutrition Interventions for Pregnant Women

The period from the start of pregnancy up to the age of 24 months, the so-called "first 1000 days of life," presents a critical window of opportunity for nutrition interventions. Bhutta et al. (2008) reviewed interventions that affect maternal and child undernutrition and nutrition-related outcomes. Table 5.1 summarizes the evidence for the effectiveness of these interventions.

**Table 5.1:** Interventions that affect maternal and child undernutrition

| Sufficient evidence for implementation in all 36 countries | Evidence for implementation in specific, situational contexts |
|---|---|
| Maternal and birth outcomes | |
| - Iron folate supplementation<br>- Maternal supplements of multiple micronutrients<br>- Maternal iodine through iodisation of salt<br>- Maternal calcium supplementation<br>- Interventions to reduce tobacco consumption or indoor air pollution | - Maternal supplements of balanced energy and protein<br>- Maternal iodine supplements<br>- Maternal deworming in pregnancy<br>- Intermittent preventive treatment for malaria<br>- Insecticide-treated bednets |
| Newborn babies | |
| - Promotion of breastfeeding (individual and group counselling) | - Neonatal vitamin A supplementation<br>- Delayed cord clamping |
| Infants and children | |
| - Promotion of breastfeeding (individual and group counselling)<br>- Behaviour change communication for improved complementary feeding*<br>- Zinc supplementation<br>- Zinc in management of diarrhoea<br>- Vitamin A fortification or supplementation<br>- Universal salt iodisation<br>- Handwashing or hygiene interventions<br>- Treatment of severe acute malnutrition | - Conditional cash transfer programmes (with nutritional education)<br>- Deworming<br>- Iron fortification and supplementation programmes<br>- Insecticide-treated bednets |
| *Additional food supplements in food-insecure populations | |

*Source: Bhutta et al., 2008.*

Interventions for maternal nutrition that have been shown to be effective include iron and folate supplements, multiple micronutrients, calcium, and balanced intake of energy and protein (Bhutta et al., 2008). Some of the supporting evidence for this was discussed above.

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Dietary supplements that provide more energy were found to improve *birth weight* substantially, whereas protein supplements did not. In other words, what is most needed is more food. Women with the lowest weight and the lowest energy intakes are most likely to benefit. Findings on the impact of the timing of supplements (e.g., second versus third trimester) have been inconclusive. Continued supplementation of women through lactation and the next pregnancy may bring about an even greater improvement in the birth weight of her next child (Allen & Gillespie, 2001).

Although supplementation with micronutrients during pregnancy improves maternal anaemia, reduces maternal mortality, prevents birth defects, reduces preterm delivery, and improves the quality of breast milk, there is little evidence that micronutrient supplements improve birth weight. Non-nutritional interventions that can improve birth weight include reduced maternal physical activity, malarial prophylaxes, cessation of cigarette smoking (Allen & Gillespie, 2001), antimicrobial treatment, antiparasitic treatment, bed nets treated with insecticide, and social marketing regarding birth spacing and timing of marriage (in which increased age is preferred) (Alderman et al., 2004).

Dietary diversification strategies, including home gardening, livestock rearing, and dietary modifications, hold promise and are culturally relevant in addressing maternal and child undernutrition. Few of these interventions have, however, been implemented to a sufficient extent and evaluated sufficiently (Bhutta et al., 2008).

## 3.2 Health Care During Pregnancy

The WHO has proposed a minimum of four antenatal visits, scheduled at specific times during the pregnancy, to accomplish the essential level of antenatal care recommended (see Box 5.1). This is only a minimum requirement and more visits may be necessary depending on the woman's condition and needs (WHO, 1996).

**Box 5.1:** WHO Recommendations Regarding Antenatal Visits by Pregnant Women

First visit by the end of the fourth month (16 weeks): To screen and treat anaemia, screen and treat syphilis, screen for risk factors and medical conditions that can best be addressed in early pregnancy, initiate prophylaxis where required (e.g., anaemia, malaria), and begin to develop the individualized birth plan

Second visit in the sixth or seventh month (24 to 28 weeks)

Third visit in the eighth month (32 weeks): To screen for pre-eclampsia, multiple gestation, anaemia, and to further develop the individualized birth plan

Fourth visit in the ninth month (36 weeks): To identify foetal lie/presentation, and to update the individualized birth plan

*Source: WHO, 1996.*

The WHO suggests that these four goal-orientated antenatal care visits may achieve similar health outcomes than more rigorous schedules. All guidelines recommend a first visit at or before 16 weeks gestation (WHO, 1996). This is substantially earlier than most women seek antenatal care in sub-Saharan Africa (SSA).

A pregnancy education week held each year in February and the world breast-feeding week in August are two strategies on the WHO health calendar that aim to create community awareness through quality information and education on the topics of safe pregnancy and the importance of breast-feeding. Information is available at the following websites:

WHO, Health topics: Pregnancy http://www.who.int/topics/pregnancy/en/

WHO, Health topics: Breastfeeding http://www.who.int/topics/breastfeeding/en/

World Alliance for Breastfeeting Action http://www.waba.org.my/

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Another WHO initiative is Making Pregnancy Safer (MPS). This proposes a way to make pregnancy and childbirth safer for women and their newborns in order to speed up the reduction of maternal and perinatal mortality and morbidity. The major focus is the developing world, as that is where 98% of such deaths occur. For information about the programme, see http://www.who.int/making_pregnancy_safer/en.

Studies have shown that maternal and neonatal deaths commonly occur within the first 3 to 7 days after delivery. When discharged following delivery, mothers should visit a clinic within this period (Beksinka et al., 2006).

### 3.3 Millennium Development Goals and Maternal Health

Among recent efforts to eradicate poverty and address the world's most pressing heath issues are the Millennium Development Goals (MDGs) of the United Nations (see http://www.un.org/millenniumgoals/). These are discussed more fully in Chapter 1. Four of the eight goals relate directly and the others indirectly to women and children. Goal 5 is specifically dedicated to maternal health, with set targets and indicators to improve maternal health (see Box 5.2).

**Box 5.2:** Recommended Targets and Indicators for Millennium Development Goal 4

| **Goal** | - Reduce child mortality |
|---|---|
| Targets | - Reduce by two-thirds the mortality rate among children under five |
| Indicators | - Under-five mortality rate<br>- Infant mortality rate<br>- Proportion of one-year-old children immunized against measles |

*Source: United Nations, 2007*

In 2010, the WHO published a report that detailed progress towards achieving the MDGs (WHO, 2012). This report revealed that maternal mortality in Africa fell by 42% between 1990 and 2010. However, many countries on the continent saw no progress. Efforts should therefore be stepped up significantly to achieve this goal.

## 4. LACTATION

In this section we look at lactation from the perspective of meeting the mother's nutritional challenges. Later in the chapter we examine breast-feeding in terms of optimal feeding of the infant.

### 4.1. Assessment of Nutritional Status

The nutritional demands on the mother of lactation are high, and nutritional assessment should be incorporated routinely into the medical care of breast-feeding women. The ABCD approach is once again valuable, but should always be tailored to the setting and available resources. The nutritional status of the lactating mother depends on many factors, including past nutritional status, weight gain during pregnancy, immediate post-partum weight loss, duration and intensity of lactation, dietary intake, and physical activity (WHO Expert Committee, 1995).

#### *4.1.1. Anthropometry*

Owing to a lack of reference data, anthropometric measurements cannot be used effectively to assess the nutritional status of a lactating woman. Possible indicators that may become available when more research has been done include maternal body weight and skinfold thickness changes over a short period of time, maternal calf circumference, and poor infant growth during exclusive breast-feeding (WHO Expert Committee, 1995).

BMI may be a useful indicator of post-partum nutritional status. An estimated cut-off for BMI of 20.3

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at one month post-partum for women with a height of 150 cm has been suggested. BMI may be expected to gradually decrease throughout the first 6 months of lactation, at which point the non-pregnant, non-lactating value of 18.5 can be used as a cut-off for identifying women at risk (WHO Expert Committee, 1995).

### *4.1.2 Biochemical values*

As before, because of a lack of research regarding biochemical values in lactating women, these values should be interpreted with caution.

### *4.1.3 Clinical signs*

During lactation the same clinical evaluation can be done as for any woman, but specific attention should again be paid to signs of vitamin deficiencies, as in pregnancy, especially regarding vitamin A (night blindness), iron (anaemia, bleeding gums), and iodine (goitre). General signs of malnutrition and fluid retention should also be investigated.

## 4.2 Nutritional Risks During Lactation

### *4.2.1 Dietary intake and lifestyle factors*

A breast-feeding woman needs more energy from carbohydrates, fats, essential fatty acids, and protein as well as additional vitamins and minerals (FAO, 2001; Sharbaugh et al., 2005; Shabert, 2004). Most breast-feeding women need to increase not only their energy intake, but also all the nutrients that make up their diet, in order to satisfy the additional requirements for milk synthesis. However, the increase will be minimal for some women, depending on their BMI and the amount of weight gained during pregnancy. The recommended dietary allowance for energy during lactation (in addition to the RDA for non-pregnant females) is 330 kcal (1386 kJ) for the first 6 months post-partum and 400 kcal (1680 kJ) for the second 6 months (Shabert, 2004). Overweight or obese mothers may not need to add the extra energy.

During lactation, questions should be asked specifically about possible nutrition-related health problems and risks that lactating women may face, including the use of alcohol, tobacco, and other potentially harmful substances. The consumption of alcohol during breast-feeding is not as detrimental as during pregnancy, but alcohol consumed by the mother can enter her breast milk and could therefore pass to the infant. (For a discussion, see La Leche League International, "What About Alcohol and Breastfeeding?" (http://www.llli.org/faq/alcohol.html.) Although modest alcohol intake on the part of a breast-feeding mother is unlikely to harm her child, excessive consumption should be avoided. Too much alcohol may displace much-needed nutrients in the lactating mother's diet, and money spent on alcohol decreases the money available for food.

### *4.2.2 Undernutrition*

Maternal nutritional status and diet can directly impact breast-feeding. The composition of the milk is usually not compromised in the short term. However, over a longer period, an inadequate intake of protein, other nutrients, and energy can cause a decreased volume of milk production and possibly cause breast-feeding malnutrition, or "failure to thrive," in the infant (Sharbaugh et al., 2005).

Prolonged breast-feeding often results in maternal folate deficiency. Pregnancy and lactation are often linked to this deficiency that, in turn, is a common cause of megaloblastic anaemia. This is especially important in women from deprived socio-economic backgrounds who have suboptimal diets, closely spaced pregnancies, and long periods of continuous breast-feeding (Ingram et al., 1999).

### *4.2.3 Overnutrition*

Maternal obesity can adversely affect initiation and continuation of breast-feeding. Excessive weight gain during pregnancy and its complications, such as complicated delivery, gestational diabetes, caesarean birth, macrosomia (birth weight >4000 grams), may also contribute to difficulty in initiation of breast-feeding. Latching (attachment of baby's mouth to mother's breast) and positioning of the infant could also be

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problematic for the obese mother. Rasmussen & Kjolhede (2004) found that overweight or obese women had a lower prolactin response to infant suckling, which can compromise milk production and lead to early cessation of breast-feeding. Overweight or obese mothers should be identified in order to receive specialized care to prevent early lactation failure.

## 4.3 Breast-feeding and Maternal Health

Breast-feeding contributes to the health and well-being of mothers, including hormonal, physical, and psychosocial benefits (Brown, 2002; Kramer et al., 2001). Frequent breast-feeding helps to delay the return of fertility of the mother and thus helps to space children (Brown, 2002; Kramer et al, 2001; UNICEF et al., 2010). Furthermore, early contact between mother and infant increases the mother's self-confidence and bonding with her baby (Savage King, 1992) and reduces the risk of ovarian and breast cancer (Brown, 2002; Kramer et al., 2001).

Breast-feeding has several other health benefits for the mother. It may reduce the risk of post-partum haemorrhage (Savage King, 1992), a condition indicated as a leading cause of death of women. It enhances fat loss in the early post-partum weeks (Kramer et al., 1993; Kjos et al., 1993) and helps the mother to lose weight if continued beyond 6 months (Dewey et al., 1993). Breast-feeding also improves blood glucose control and increases high-density lipoprotein cholesterol levels in women with gestational diabetes (Dewey et al., 1993). More recently, breast-feeding has also been associated with a reduced risk of the mother developing type 2 diabetes (Stuebe et al., 2005).

As breast-feeding is both a safe and economical way of feeding, it therefore improves family and national resources (Kramer et al., 2001). Additionally, as breast-feeding requires no packaging and produces no waste, it is environmentally friendly (Kramer et al, 2001; Baumslag & Michels, 1995).

Contra-indications to breast-feeding are uncommon. Medical contra-indications include: a number of over-the-counter and prescription drugs; recreational drugs; certain metabolic disorders; and HIV/AIDS under certain circumstances (see Section 5.5).

Inconsistent information and a perceived lack of support from health professionals are barriers to initiating and continuing breast-feeding. Other barriers include insufficient maternity leave, facilities at work not supportive of breast-feeding, negative emotions about breast-feeding, embarrassment about breast-feeding in public, not knowing the volume of milk the infant is receiving, fathers feeling left out from the feeding of the baby, and lack of support from family and friends (Brown, 2002; Savage King, 1992).

## 4.4 Nutrition Interventions and Programmes for Lactating Mothers

### *4.4.1 Breast-feeding as a right*

It is clear from human rights law that the mother has a right to breast-feed if this is her choice. Some also hold that the infant has the right to be breast-fed. However, this imposes a corresponding duty on the mother, which she may be unable to perform for a variety of reasons that are beyond her control. A mother is therefore entitled to expect that the people and institutions that surround her, including the government, will work to protect, respect, and fulfil her rights so as to enable her to practise breast-feeding (see Box 5.3).

With regard to facilitating women's ability to breast-feed, it is useful to think in terms of nested "rings of responsibilities" belonging to a range of actors who encircle the mother at different degrees of distance (Kent, 2000). The actors may include her family, her local community, her employer (if she has one), and hospitals and health services, as well as the state authorities in charge of policies pertaining to breast-feeding. Helsing (2005) suggests that we may think of mothers as having a "conditioned moral duty" to breast-feed their infants. In this view, society as a whole must join mothers in fulfilling their breast-feeding goals. Policies should spell out the necessary action to be taken. A combination of relevant binding human rights instruments and other conventions, as well as a series of voluntary codes and agreements, have the potential to firmly protect the human rights and choices of mothers and babies, thus safeguarding their right to an equal chance of getting a good start in life.

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**Box 5.3:** The Obligations of Governments Regarding Breast-Feeding

**To respect:**

- Mother's and baby's right to practise breast-feeding
- The practical womanly wisdom and skills in lactation management inherited through the millennia and conveyed through extended networks of families and supportive networks

**To protect:**

- Mothers and babies from factors hindering or constraining the practice of breast-feeding
- Mothers and health workers from misleading information about breast-feeding and human milk
- Mothers' confidence in their own ability to breast-feed and health workers' confidence in their ability to assist

**To fulfil (facilitate):**

- The initiation and maintenance of breast-feeding
- The practice of breast-feeding for women who are in paid employment
- The practice of breast-feeding in emergency situations, by priority provision of food for mothers rather than cow's (or other) milk for babies

*Source: Helsing, 2005.*

### *4.4.2 The Baby Friendly Hospital Initiative (BFHI)*

In 1991, the WHO and the United Nations Children's Fund (UNICEF) launched the Baby-Friendly Hospital Initiative (BFHI), a global effort aimed at ensuring that maternity services of all sorts support efforts of mothers to practise exclusive breast-feeding of their infants from birth. (For further information, see http://www.who.int/nutrition/topics/bfhi/en/.) In order to be designated a "baby-friendly" facility, a hospital or other maternity service must have implemented the "Ten Steps to Successful Breast-Feeding" (see Box 5.4).

In 2009, when the BFHI guidelines were reviewed, three new criteria were added, the third of which is optional: (1) compliance with the WHO's International Code of Marketing of Breast-Milk Substitutes (WHO, 1981); (2) provisions for mother-friendly care; and (3) the ability to provide information and referrals regarding HIV and infant feeding. (For further discussion, see WHO/UNICEF, 2009, section 1.3.)

### *4.4.3 Breast-feeding support groups*

Step 10 of the ten steps to successful breast-feeding listed in Box 5.4 specifically encourages the establishment of breast-feeding support groups. One organization that offers peer-counselling programmes that provide this kind of support to mothers is La Leche League International (http://www.llli.org). The value of such support, in which mothers offer advice and encouragement to other mothers or mothers-to-be, should not be underestimated. It can contribute to prolonged breast-feeding, and it can also intensify the efforts to promote and protect the right to breast-feeding on a global scale.

Box 5.4: The Ten Steps to Successful Breast-Feeding

1. Have a written breast-feeding policy that is routinely communicated to all health-care staff.
2. Train all health-care staff in skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breast-feeding.

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4. Place babies in skin-to-skin contact with their mothers immediately following birth for at least an hour. Encourage mothers to recognize when their babies are ready to breast-feed and offer help if needed.
5. Show mothers how to breast-feed, and how to maintain lactation even if they should be separated from their infants.
6. Give newborn infants no food and drink other than breast milk, unless medically indicated.
7. Practise rooming-in. Allow mothers and infants to remain together – 24 hours a day.
8. Encourage breast-feeding on demand.
9. Give no artificial teats or pacifiers (also called dummies or soothers) to breast-feeding infants.
10. Foster the establishment of breast-feeding support groups and refer mothers to them on discharge from the hospital or clinic.

*Source: WHO/UNICEF, 2009, section 1.3.*

## 5. HIV AND INFANT FEEDING PRACTICES

As the third of the three additional BFHI criteria suggests, the World Health Organization (WHO) is cognizant of new evidence regarding HIV and infact feeding. In collaboration with several United Nations agencies, including UNICEF, the WHO recently released a revised set of key principles and recommendations, *Guidelines on HIV and Infant Feeding2010* (WHO, 2010a). These are intended to provide information to national and provincial health services and to assist them in formulating their infant feeding recommendations for HIV-positive mothers.

National or provincial health authorities must first decide whether they will primarily counsel and support mothers known to be infected with HIV to

- breast-feed and receive antiretroviral (ARV) interventions
  *or to*
- avoid all breast-feeding.

Pregnant women and mothers who are known to be infected with the HIV virus should be informed of the infant-feeding strategy recommended by the national or provincial authority. Such strategies will improve the chances that infants exposed to HIV will not be infected with the virus, while also improving the health of HIV-infected mothers. All pregnant women and mothers should have access to skilled counselling and support so that they receive reliable information about appropriate infant-feeding practices and about ARV interventions that can promote the HIV-free survival of infants.

Mothers whose HIV status is unknown can receive the same counselling as mothers who are known to be uninfected: to exclusively breast-feed their infants for the first 6 months of life and then introduce complementary foods while continuing breast-feeding for at least another 24 months. However, mothers whose status is unknown should be offered HIV testing. Mothers who are not infected with HIV should be counselled about ways to prevent HIV infection and about the services that are available to help them to remain uninfected, such as services that distribute free condoms (WHO, 2010a).

The issue of drug treatment for HIV-infected women in relation to breast-feeding is discussed more fully in Chapter 10.

## DISCUSSION QUESTIONS AND EXERCISES

1. A 22-year-old pregnant woman with pre-pregnancy weight of 43 kg and height of 1.6 m presents to the clinic. She smells of cigarette smoke but says that she does not smoke. How would you handle this case?
2. Imagine you are a manager of a national nutrition programme. With specific reference to your country setting, describe how you would incorporate the interventions that have been shown to be effective for maternal

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undernutrition and nutrition-related outcomes. Base your answer on the UNICEF conceptual framework for understanding the causes of malnutrition described in section 2.4 of Chapter 1, and refer to the malnutrition poverty cycle, illustrated in Figure 5.1 above.

3. You are a lecturer in community nutrition at a university in a developing country. You have been invited to give a presentation to a group of visiting gynaecologists and obstetricians, most of them from quite affluent countries. The topic is the recent addition of new criteria to the WHO's Baby-Friendly Hospital Initiative. Discuss how you will describe these new criteria and explain to the doctors why they are important. In addition, explain what actions have been carried out in your country to implement the BFHI and what still needs to be done.

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The following websites also provide a wealth of up-to-date information:

La Leche League International: http://www.llli.org/
1,000 Days: http://www.thousanddays.org/

WHO, Maternal, Newborn, Child and Adolescent Health:

http://www.who.int/maternal_child_adolescent/en/

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# CHAPTER 6

# NUTRITION DURING THE FIRST THOUSAND DAYS OF LIFE

## Part II: Infant Feeding and Development

*Lisanne M. du Plessis, Celeste E. Naude, and Rina Swart*

### *Outline*

- Normal patterns of growth and development of infants and young children
- Assessment of the growth and development of infants and young children
- Problems of underweight, stunting, wasting, and overweight
- Other nutrition-related problems of young children: worm infestations, oral health
- Nutritional benefits of breast-feeding for the infant
- Complementary feeding
- Appropriate feeding practices for pre-school children
- Malnutrition in infants and young children
- Issues of breast-feeding for mothers who are HIV-positive
- Nutritional needs of infants and young children
- Nutrition interventions and programmes for infants and young children

### *Objectives*

At the completion of this chapter you should be able to:

- Describe the normal pattern of growth and development of infants and young children
- Describe how to assess the growth and development of infants and young children
- Describe the problems of underweight, stunting, wasting, and overweight in terms of anthropometry
- Describe the nutritional advantages of breast-feeding for the infant
- Describe good complementary feeding practices
- Discuss the appropriate recommendations for breast-feeding if the mother is HIV-positive
- Discuss the nutritional requirements of infants and young children
- Discuss nutrition interventions and programmes for infants and young children
- Describe the appropriate feeding practices for pre-school children
- Discuss the consequences (morbidity and mortality) of malnutrition in infants and young children
- Discuss other factors that impact the nutritional status of young children:
    - Worm infestations
    - Oral health


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# 1. MALNUTRITION AMONG INFANTS AND YOUNG CHILDREN

Every year, more than 10 million children die before they reach the age of 5. Almost 4 million of them die within the first 4 weeks of life. Most of these 4 million deaths occur in developing countries, predominantly in South Asia and sub-Saharan Africa (Black et al., 2003).

Five categories of immediate determinants of the child survival rate have been proposed (Mosley & Chen, 2003; Hill, 2003):

- Maternal factors (age, parity, birth interval)
- Environmental contamination (air, food/water/fingers, skin/soil, inanimate objects, insect vectors)
- Nutrient deficiencies (energy, protein, micronutrients)
- Injury (accidental/intentional)
- Personal illness control (personal prevention measures, medical treatment)

The World Health Report 2005 stated that more than half of the deaths in children younger than 5 years can be attributed to undernutrition (see Figure 6.1).

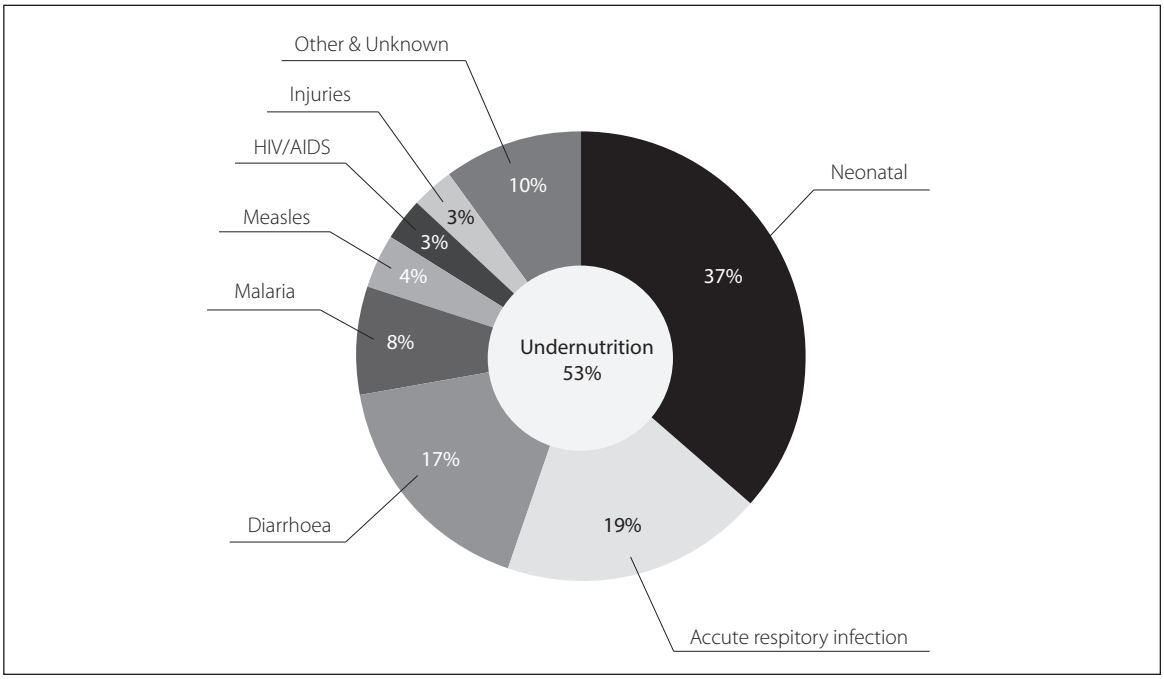


**Figure 6.1:** Contribution of malnutrition to mortality in children under 5 years of age.
*Source: WHO, 2005b.*

Many children are permanently disabled by the physical and mental effects of inadequate dietary intake in the earliest months of life. It was documented in 2008 that for children younger than 5 years, stunting, severe wasting, and intrauterine growth restriction (IUGR) together caused about 2.2 million deaths and were responsible for 21% of the total number of lost disability-adjusted life-years (DALYs). Vitamin A and zinc deficiencies were estimated to be responsible for 0.6 million and 0.4 million deaths, respectively, and a combined 9% of global childhood DALYs. Deficiencies of iron and iodine lead to fewer child deaths, and combined were liable for about 0.2% of global childhood DALYs.

As the above figures indicate, infant and young child feeding practices directly affect the nutritional status of children under 2 years of age and ultimately impact child survival. If children are undernourished

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before they reach the age of 2 years, they could suffer irreversible physical and mental damage and this will undoubtedly influence their future health and wellness. Improving infant and young child feeding practices in children aged 0 to 23 months is therefore critical to improved nutrition, health, and development of children (WHO, 2008a).

The consequences of mild-to-moderate malnutrition, specifically chronic undernutrition, are not always visible, but have significant effects on mortality, morbidity, educability, and the future productivity of children (see Figure 6.2). Evidence of the many consequences of undernutrition in children has been provided by numerous meta-analyses (Jones et al., 2003; Nannan et al., 2007; Engle et al., 2007; Grantham-McGregor et al., 2007). Conversely, overnutrition and overweight in children can contribute to the risk of adult overweight and obesity. Adult obesity is associated with an increased risk of the development of hypertension, coronary heart disease, diabetes, stroke, and some forms of cancer (see Chapter 13).

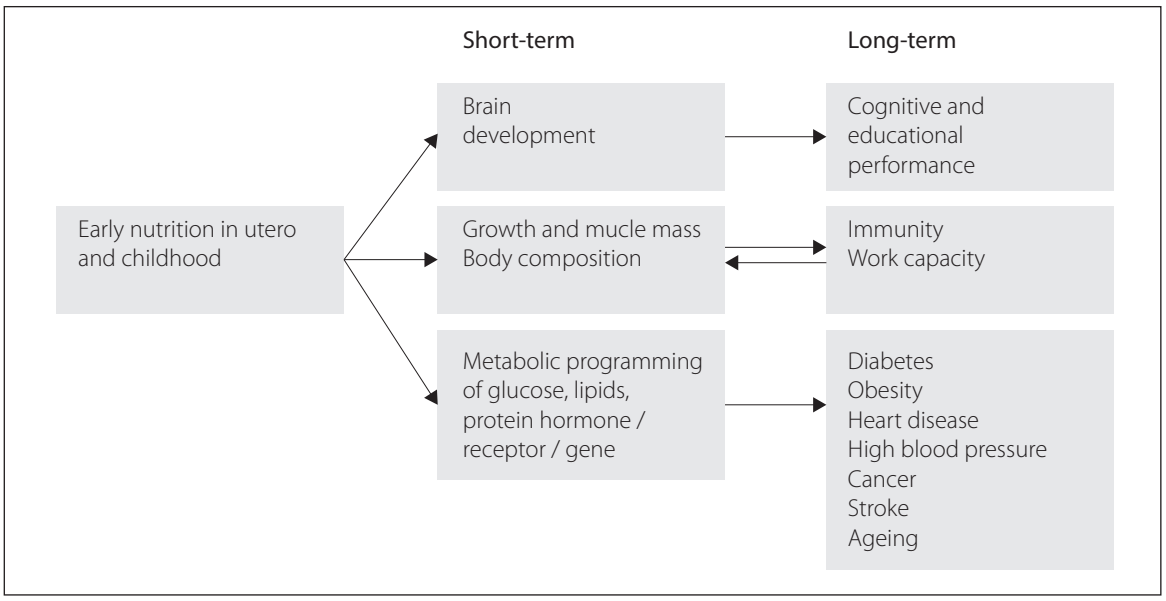


**Figure 6.2:** The short-term and long-term effects of early nutrition.
*Source: ACC/SCN, 2000.*

## 2. GROWTH AND DEVELOPMENT OF INFANTS AND YOUNG CHILDREN

Physical growth and development involve progressive changes in size (Rolfes et al., 1990), as well as accompanying changes in skill and behaviour (Rovee-Collier, 1996; Engle et al., 2007). Growth and development are not uniform. Each living organism and each body system has its own unique schedule of growth and development, varying in rate, patterns, and duration (Rolfes et al., 1990). In community nutrition an awareness of what is normal, as well of normal variation and the reasons for this variation is required in order to make informed decisions as to when action is necessary.

### 2.1 Physical Growth

Normal growth (i.e., the increase in the mass of body tissue as a child changes from an infant to an adult) is the result of a number of factors, such as growth hormones, genetics, nutrition, general health, intrauterine growth, emotional care/deprivation, and psychological factors, as well as the continuous and complex interactions between these factors throughout the whole period of growth (Eveleth & Tanner, 1990; Kumar & Clarke, 2000). In community nutrition settings, growth of the infant and young child is generally measured by assessing weight and length/height, and in certain circumstances head circumference.

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Normal growth patterns from birth to adulthood vary between individuals owing to differences in bodily proportions and composition, as well as differences in timing of growth spurts. All infants demonstrate accelerations and decelerations in growth in response to changes in their environment or because of illness. The majority of environmental factors that affect growth hinge upon the level of nutrition that the infant or child receives (Eveleth & Tanner, 1990). During an illness, even a quite mild one, growth tends to slow down, but if the child is receiving adequate nutrition, this slow-down is followed by catch-up growth, which rapidly restores the child to the normal growth curve. However, if the cause of the delayed growth lasts for a long period of time, catch-up growth may never happen completely (Bax et al., 1990).

The most dramatic period of child growth velocity is between birth and 4 months of age. Many full-term infants lose some weight shortly after birth, which they regain by day 8 to day 10 (Chumlea & Guo, 2004). Thereafter, the average weight gain during the first year of life is 7 kilograms, of which about half is gained in the first 4 months at a rate of almost 200 grams per week. This is followed by an average weight increase of 2 to 4 kilograms in each of the next 2 years with average weight gain per week being about 40 grams. Average birth weight babies usually double their birth weight by 6 months and treble it by one year of age (Frankle & Owen, 1993; Chumlea & Guo, 2004). By 4 to 5 years of age the growth rate stabilizes at an increase of 2 to 4 kg/year. Sex differences in weight during pre-school years are slight, but after 2 years of age girls tend to have higher adipose tissue as evidenced in skinfold measurements (Chumlea & Guo, 2004). Children who start fat development earlier are at an increased risk of obesity and should be monitored regularly.

The average length at birth is 45 to 53 cm for girls and 46 to 55 cm for boys (WHO, 2006a). Infants usually increase in length by 50% by year one (approximately 25 cm), followed by another 12 cm increase between years one and two to double birth length by age 4, and triple it by age 13 (Chumlea & Guo, 2004). During years 3 to 5 there is a greater increase in height relative to weight (Frankle & Owen, 1993).

At birth, average head circumference is about 35 cm and increases by about 12 cm during the first year to about 47 cm. Measuring head circumference during this period is important because it reflects brain growth, and the brain doubles its birth weight by one year of age. From one to two years of age the head grows an average of about 5 cm in circumference, but by age 3 the mean annual increase slows to less than one cm per year (Chumlea & Guo, 2004).

Most growth faltering begins *in utero* or soon after birth. Although this may continue to about 40 months of age, it is most pronounced within a relative short period; from 6 months until about 18 months of age (ACC/SCN, 2000; Grantham-McGregor et al., 2007).

In the first week after birth preterm infants grow very little as they adjust to extra-uterine nutrition. The preterm infant's weight curve is expected to cross the percentile lines during the first few months and by the end of the first year the length of the average preterm infant is usually around the 50th percentile. However, the smallest infants may not reach normal percentiles until after the second year (Bax et al., 1990).

IUGR infants show varying degrees of catch-up growth after birth, which is most marked during the first 6 months of life, resulting in attainment of percentile channels approximately between the 10th and 25th percentile for weight and length by the age of 2 years. By this age, adjustment for gestational age does not have to be done when plotting weight and height of IUGR and LBW infants. Infants who experience slow foetal growth rates before week 34 gestation are likely to remain smaller than those in whom growth restriction was confined to the last 6 weeks of pregnancy. Head circumference of IUGR infants also shows a period of catch-up growth after birth, which suggests that some degree of restriction of overall brain growth occurs in these infants during pregnancy (Bax et al., 1990).

## 2.2 Milestones of Behaviour and Development

Child development refers to the ordered emergence of interdependent skills of sensory-motor, cognitive-language, and social-emotional functioning (Engle et al., 2007). A rapid increase in brain weight takes place during the second half of pregnancy, which continues well into the second post-natal year (brain growth spurt). At birth the brain is already 25% of its adult weight and this reaches 50% by 4 years (Bax et al., 1990). IUGR and undernutrition in infancy have been found to be associated with physical brain deficits such as reduction of brain size, loss of cerebral cortical neurons, deficit in brain lipids, and reduction in the numbers of synapses per cortical neuron. However, there is no simple relationship between head circumference and

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brain size. Findings that a higher proportion of human brain growth occurs post-natally than was formerly thought are a stimulus for providing an ideal nutritional environment for every infant, in both the developed and the developing world (Bax et al., 1990).

The behaviour that an infant displays is constrained by its niche in time (associated with age and abilities) and its current environment (Rovee-Collier, 1996 ). Initially (weeks 0 to 9), the infant maximizes energy intake and minimizes energy expenditure in order to convert energy to optimal growth. Behaviours are either related to ingestion of food (sucking and rooting), or require minimal energy expenditure (such as looking). When the infant is liberated from the initial energy-preserving niche, large amounts of energy can be expended to learn about the environment. During this phase (10 to 24 weeks), what infants will or will not learn is determined by the ergonomics of learning, not by capacity (Rovee-Collier, 1996). Limitations in nutrient supply, especially energy, to the infant and young child will therefore have an impact on whether the infant or child is able to reach his or her developmental milestones and consequent intellectual development potential.

A child's development is also affected by psychosocial and biological factors and by genetic inheritance. Figure 6.3 shows a conceptual model of early childhood development and contributing factors. The first few years of life are particularly important because vital development occurs in all domains (Grantham-McGregor, 2007). Poverty and its accompanying problems are major risk factors for poor developmental outcomes. Development can also be modified by the quality of the environment. Variation in the quality of maternal care can produce lasting changes in stress reactivity, anxiety, and memory function in the offspring (Grantham-McGregor et al., 2007). Caregiver sensitivity is associated with more secure infant attachment, whilst higher levels of maternal responsiveness are associated with higher infant cognitive ability and fewer behavioural problems. The negative effects of exposure to violence are likely to be increased when family cohesion or the mental health of the primary caregivers is disrupted. Recovery from early insults is possible with interventions. Early cognitive and social-emotional development are strong determinants of school progress. Each standard deviation increase in early intelligence or development quotient is associated with substantially improved school outcomes (Grantham-McGregor et al., 2007), although school and family characteristics also play a part.

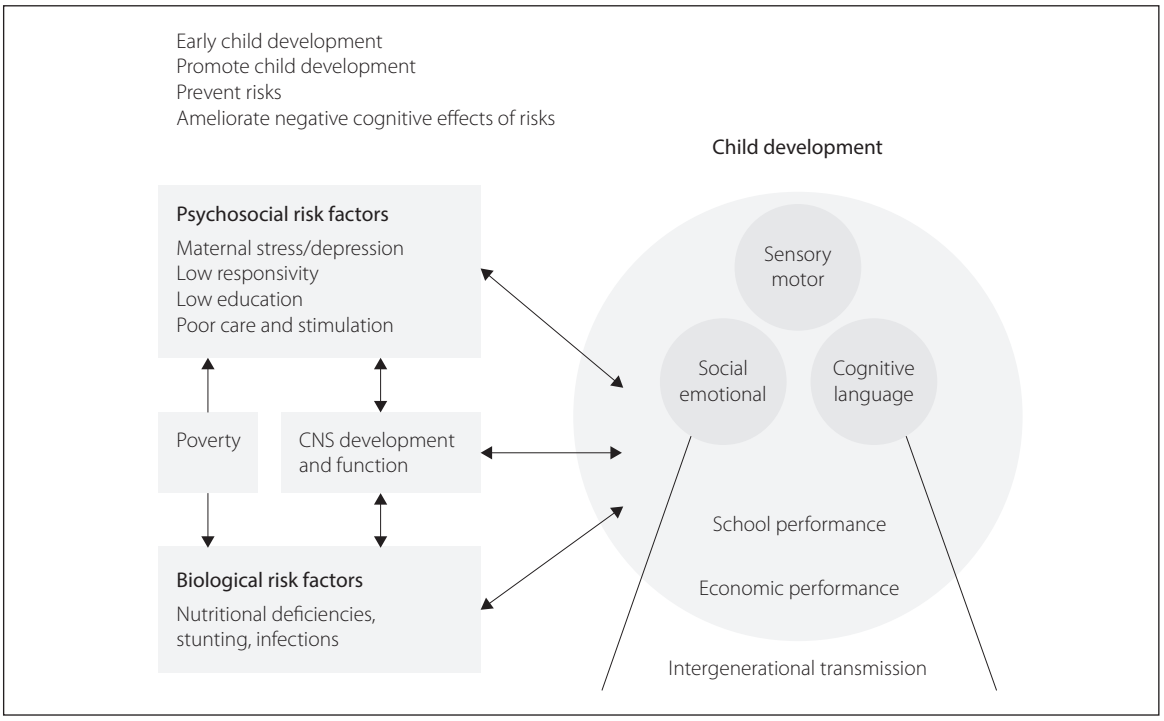


**Figure 6.3:** Conceptual model of early childhood development.
*Source: Adapted from Engle et al., 2007; Grantham-McGregor et al., 2007.*

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Currently, there are no globally accepted indicators for child development. This is often measured through individual assessments of developmental changes in multiple domains, such as cognitive, language, social, and emotional (Grantham-McGregor et al., 2007). The availability of indicators would improve the ability of different countries to set targets, allocate resources, monitor progress, and ensure accountability.

## 3. ASSESSMENT OF MALNUTRITION IN INFANTS AND YOUNG CHILDREN

Malnutrition is the outcome of a complex combination of interrelated causes as depicted in the UNICEF conceptual framework (described in Chapter 1). At the "underlying causes level" major strides against key problems can be achieved through programmatic health and nutrition interventions, if implemented on a sufficient scale (Bhutta et al., 2008).

### 3.1 Growth Monitoring and Promotion

*Growth monitoring* is the process of using periodic anthropometric measurements to track the growth rate of a child in comparison to a standard. Such tracking allows growth faltering to be identified before the child has developed actual undernutrition; it can also serve as a warning of overnutrition (UNICEF, 2008).

A single measurement of a child's weight or length/height can indicate whether the child is within the normal range, but it does not indicate whether the child is growing well. Instead, a child must be weighed and measured regularly and the measurements plotted on a graph to produce a growth curve, which illustrates trends in the child's growth rate. Such a curve reveals whether a child is growing steadily or whether a problem may exist – as, for example, when a child stops gaining weight or is actively losing weight (see Figure 6.4). An individual child's growth curve can also be plotted against standard growth curves, or reference curves (see Figure 6.5). An individual child's growth curve may fall above or below a particular reference curve, but it should increase at the same rate – that is, it should remain parallel to the reference curve. A growth curve that parallels the reference curve indicates that the child is growing well. Flat growth lines indicate that a child's weight and height has not increased at all: the child has stopped growing. This is called growth faltering, and such children are at risk of growth failure. Growth failure is specifically signalled by a loss of weight. Children who are gaining weight after an episode of growth faltering are said to be in the process of catch-up growth.

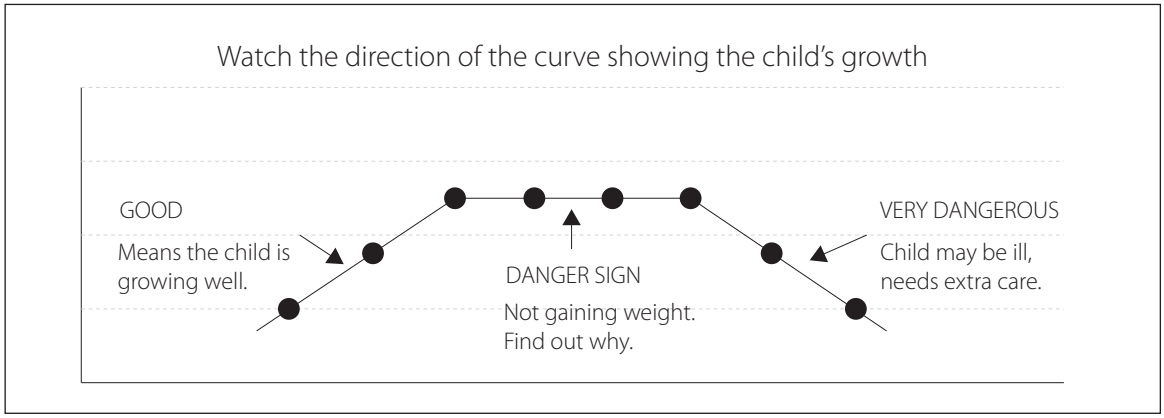


**Figure 6.4:** Growth curve showing changes in a child's weight

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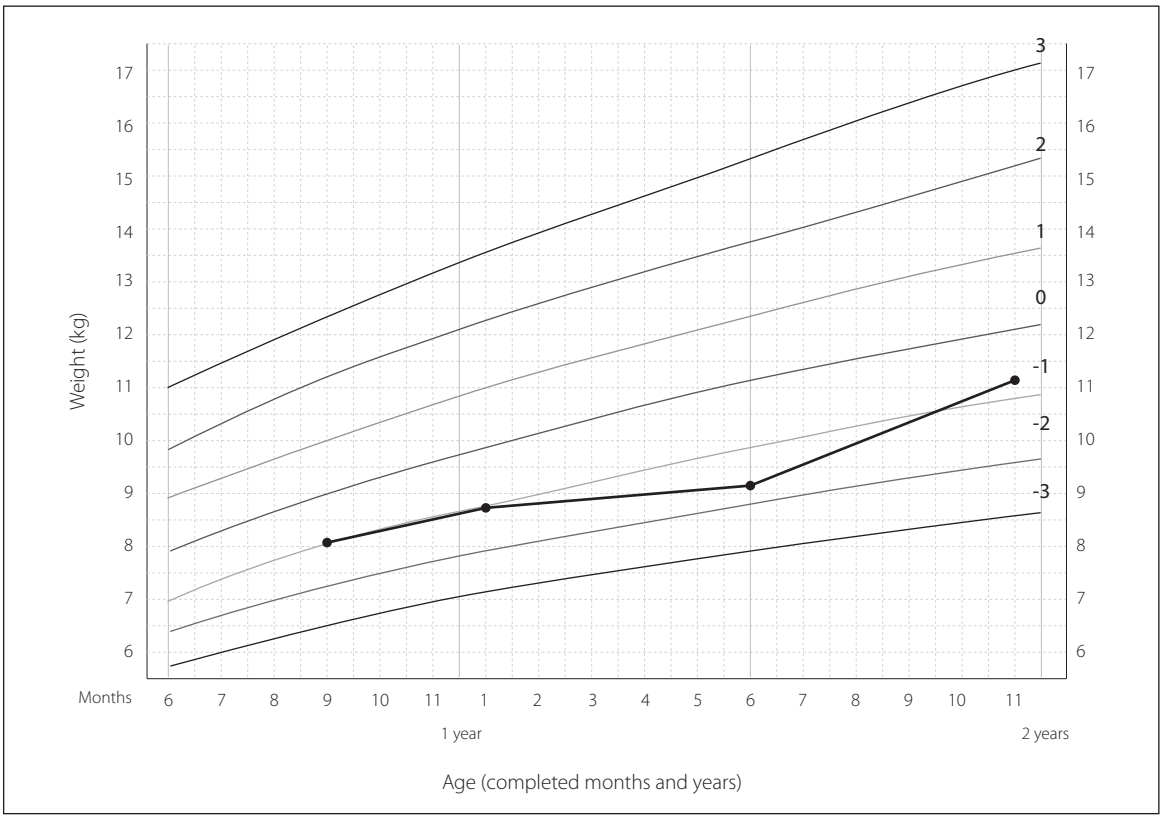


**Figure 6.5:** A growth chart showing weight-for-age according to Z-scores (see section 4.1 of chapter 22). The chart is for boys, aged 6 months to 2 years. The child whose weight is plotted on the chart was below the mean but was growing well up to the age of 13 months. A period of growth faltering then set in, which lasted for 5 months, followed by catch-up growth.
*Source: WHO, 2008b, p. 43.*

As defined by UNICEF (2008, p. 2), *growth monitoring and promotion* (GMP) is "a prevention activity that uses growth monitoring... to facilitate communication and interaction with [a] caregiver and to generate adequate action to promote child growth." This action is the result of:

- Increased caregiver's awareness about child growth
- Improved caring practices
- Increased demand for other services, as needed (UNICEF, 2008, p. 2)

The expected outcomes of GMP are:

- Heightened awareness of the importance of caregiver practices for adequate growth and the link between adequate growth and child health
- Increased knowledge and skills and subsequent improved child feeding and health-care practices by caregivers
- Increased coverage of particular health services, if they are offered along with GMP
- Improved care-seeking/utilization of services when these are promoted/supported through GMP counseling (UNICEF, 2008, p. 3)

Crucial to growth monitoring is the existence of reliable standards against which the growth of either an individual child or a specific population of children can be evaluated. Until fairly recently, assessments relied

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on standard growth curves that had been jointly established by the National Centre for Health Statistics (NCHS) and WHO and were recommended for use internationally. In 1993, however, a WHO Expert Committee questioned the suitability of the NCHS/WHO standards, in part because these reference curves were based on data from children who had, for the most part, been bottle-fed rather than breast-fed (WHO, 1999). As a result, in 1994, WHO began planning for the development of new reference standards that would reflect how children *should* grow in all countries rather than merely describing how they grew in a particular setting at a specific time (de Onis, 2008).

The WHO Multicentre Growth Reference Study (MGRS) (1997–2003) collected primary growth data and related information from roughly 8500 healthy children whose growth appeared normal. The sample was deliberately drawn from a diverse array of countries – Brazil, Ghana, India, Norway, Oman, and the United States – and the children thus represented a wide variety of cultures and ethnicities. The aim was to develop a new set of growth curves that could serve as an international standard for evaluating the growth and nutritional status of children under 5 years of age (WHO, 1999; see also ACC/SCN, 2000). The new WHO growth standards (WHO, 2006a) use the breast-fed infant as the biological norm for growth and development.

The use of these growth charts for the assessment of nutritional status is discussed in detail in section 4.1 of Chapter 22. It is important to note, however, that the newer reference curves produce significantly different results:

> Differences are particularly important in infancy. Stunting will be greater throughout childhood when assessed using the new WHO standards compared to the NCHS/WHO reference. The growth pattern of breast-fed infants will result in a substantial increase in rates of underweight during the first half of infancy and a decrease thereafter. For wasting, the main difference is during infancy when wasting rates will be substantially higher using the new WHO standards. With respect to overweight, use of the new WHO standards will result in a greater prevalence that will vary by age, sex and nutritional status of the index population. (WHO, 2006a, pp. xix–xx)

In interpreting the results of studies pertaining to child growth, one should always look for information about the reference standards that were employed, as different standards will produce different assessments.

## 3.2 Growth Measurements: Undernutrition and Overnutrition

### *3.2.1 Underweight*

In anthropometric terms, underweight is defined in relation to weight-for-age. A child is considered significantly underweight if he or she has a weight-for-age below–2 standard deviations (SD) of the median value for the reference population. Weight is usually one of the first parameters affected by dietary deficiency and/or disease in infants and young children. Underweight is therefore considered one of the primary indicators of recent nutritional stress.

Severe underweight is defined as a weight-for-age below–3SD of the median value for the reference population. A relatively high prevalence of severely underweight individuals in a population is evidence of an acute and extreme nutritional insult (possibly on top of prior undernutrition), such as food shortages experienced during natural disasters and wars, as well as outbreaks of infectious disease (ACC/SCN, 2000).

### *3.2.2 Wasting*

Whereas underweight is defined in terms of weight-for-age, wasting is defined by weight-for-height. Wasting reflects acute undernutrition or severe disease, independent of possible chronic undernutrition. A moderately wasted child has a weight-for-height that is below–2SD of the median value for the reference population; a weight-for-height below–3SD is evidence of severe wasting. Wasting reflects acute undernutrition or severe disease, independent of possible chronic undernutrition that might have compromised the height of the child. Internationally, wasting is not as common as underweight or stunting. These rates can, however, change rapidly, especially in situations of emergency food shortages and population displacements (ACC/SCN, 2000).

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### *3.2.3 Stunting*

One of the indicators of chronic malnutrition is stunting – that is, a retardation in linear growth. Stunting is the product of a number of long-term factors, including chronic insufficient protein and energy intake, recurrent infections, feeding practices that are inappropriate and/or ineffective, and micronutrient deficiencies, notably of vitamin A, iron, and zinc. The condition is classified as moderate if a child's height-for-age is below–2SD of the median value for the reference population and severe if it is below–3SD. According to a study published in *The Lancet* in 2008, an estimated 178 million children under the age of 5 suffered from stunting. Roughly 90% of these children were in a mere 36 countries, mostly in sub-Saharan Africa or South and Southeast Asia (Bhutta et al., 2008, p. 417).

Childhood stunting is a serious medical issue. In infants and small children, it is associated with an increased mortality risk, as well as with poor cognitive and motor development and other impairments in function. These, in turn, have been linked with reduced performance in school. In adults, stunting is associated with lower earning capacity and a greater likelihood of obesity and chronic disease (Allen & Gillespie, 2001; UNICEF, 2013).

Once a child reaches the age of 3, the effects of stunting are extremely difficult to reverse. For this reason, interventions directed at pregnant women and very young children, ideally under the age of 24 months, are critically important. For mothers, these include advice about the importance of breast-feeding, as well as supplements of micronutrients, especially iron and folate. For children, particularly important supplements include vitamin A and zinc supplementation, as well as iron in areas where malaria is not endemic, and the promotion of iodised salt (Bhutta et al., 2008).

### *3.2.4 Overweight*

Overweight (that is, an excessive accumulation of body fat) is most commonly measured in terms of body-mass index (BMI), a calculation based on weight-for-height. Although age-adjusted BMIs are available for children and young adults between the ages of 2 and 20, they are less often used for the assessment of children under the age of 6 years. In young children, overweight is defined as a weight-for-height greater than +2SD of the mean value for the reference population. Childhood obesity, which often persists into adulthood, is associated with several risk factors for later chronic diseases, such as hypertension, heart disease, stroke, type 2 diabetes, and certain types of cancer. These risk factors may operate through the association between childhood and adult obesity, but they may also act independently (Cole et al., 2000).

From a public health perspective, no guidelines exist for assessing the severity of the problem of childhood obesity.It is clear, however, that among both children and adults, the prevalence of overweight and obesity has been steadily increasing throughout the world – a phenomenon sometimes called "globesity." The increase is chiefly the result of a shift in diet in the direction of foods high in sugar and fat but low in nutrient value, in combination with a decline in physical activity. These factors are all closely associated with urbanization and with economic development. Obesity was once primarily confined to relatively affluent, industrialized countries but has now spread to developing countries. Although development-driven obesity is increasing at all social levels, those in the lowest socio-economic categories in developing countries are affected the most dramatically, as the accompanying diseases of lifestyle are superimposed onto health systems that are already struggling to cope with communicable diseases, the incidence of which remains high.

### *3.2.5 Growth monitoring as a tool for public health*

The proportion of children in a given population whose height or weight is abnormal for their age can be important information from a public health perspective. Table 6.1 defines levels of severity in relation to four basic indicators.

There is a long-standing debate regarding the actual impact of large-scale growth monitoring and promotion programmes and whether investments in such programmes are justified. Although growth monitoring can help to signal the presence of malnutrition and other health issues, in order to be effective in reducing child malnutrition and mortality, it must be accompanied by community-based health and nutrition interventions.

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**Table 6.1:** Guidelines for assessing the public health significance of malnutrition and overnutrition in children

| Indicator | Low (%) | Medium (%) | High (%) | Very high (%) |
|---|---|---|---|---|
| Stunting | 20%* | 20–29 | 30–39 | ≥40 |
| Underweight | 10% | 10–19 | 20–29 | ≥30 |
| Wasting | 5% | 5–9 | 10–14 | ≥15 |
| Overweight | 5% | 5–9 | 10–14 | ≥15 |

**Percentages refer to the prevalence among children.*
*Source: For the first three indicators, WHO, 1995.*

As a recent study concluded, growth monitoring and promotion programmes should focus their attention on infants and children under 18 months of age and place an emphasis on nutrition counselling, with a view to maximizing contact between community health workers and caregivers. In addition, training, supervision, and support for health workers must be improved so that they will be equipped with the knowledge and the communication skills they need in order to be effective counsellors in growth promotion programmes. The impact of these programmes will depend in large measure on their coverage, on the intensity of contact between caregivers and health workers, and on the performance of health workers in the field (Ashworth et al., 2008).

## 3.3 Micronutrient Malnutrition

Micronutrient malnutrition is often referred to as "hidden hunger" because the consequences are not always visible. Deficiencies of several micronutrients in pregnancy and early childhood can have serious long-term consequences. Micronutrients of special concern include vitamins A and D, iodine, iron, and zinc. These nutrients are looked at in more detail in other chapters: see Chapters 5 and 9 for iodine, iron, and vitamin A; Chapter 9 for zinc; and Chapter 13 for vitamin D.

## 3.4 Other Factors That Impact the Nutritional Status of Young Children

### *3.4.1 Worm infestations*

In poor communities with inadequate sanitation and hygiene, it is common to find 90% of children infected with at least one parasite, such as hookworm or roundworm. The health impact of helminths (worms) includes anaemia and poor absorption of nutrients, which can lead to stunting and impaired cognitive development. Simple and inexpensive treatments are readily available and can easily be administered to prevent helminthic infestations and to help children reach their full potential for growth. The prevalence and intensity of worm infestations peak in children between the ages of 6 to 15 years (WHO, 2006b). This group is therefore the priority for treatment, and they can also be easily reached through school systems. Regular deworming has been shown to improve school attendance and learning (Fincham & Dhansay, 2006). The WHO's global target was to treat at least 75% of schoolchildren at risk of morbidity from schistosomiasis and soil-transmitted helminths by the year 2010 (WHO, 2006b). Pre-school children, in their exploration of their environment, are at risk of worm infestation and will also benefit from treatment (see WHO, 2007). The WHO recommends that deworming for pre-school children be delivered in an integrated programme that includes vitamin A supplementation and vaccination. The recommended deworming treatment for pre-school children includes albendazole or mebendazole (see Table 6.2 for doses); treatment should always be supervised on site. Children younger than one year should *not* be treated with deworming medication (WHO, 2006b).

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**Table 6.2:** Recommended deworming of pre-school children

| Product | Dose (tablet) | | Frequency |
|---|---|---|---|
| | 12–24 months | >24 months | |
| Albendazole (400 mg tablet) | ½ | 1 | Once or twice a year |
| Mebendazole (500 mg tablet) | 1 | 1 | Once or twice a year |

*Source: WHO, 2006b.*

### *3.4.2 Oral health*

Oral health and nutrition have a synergistic relationship (Naidoo & Myburgh, 2007). Tooth decay is the most common chronic disease of childhood in developed countries. Children with early childhood caries (ECC) are at a higher risk of dental decay in primary and permanent dentition. In many cases ECC is the result of poor dental hygiene in combination with one or more of the following factors:

- Inappropriate use of a bottle or feeding cup whilst sleeping. Because of the decreased saliva flow during sleep, clearance of sugar from the mouth is decreased leading to an increased cariogenic effect of the sugar.
- Constantly snacking or constant drinking sugar-containing substances (from a bottle or feeding cup specifically, but also frequent drinking *per se*). A high frequency of eating and drinking (more than 3 meals and 2 to 3 snacks per day) encourages the growth of *Streptococcus mutans* which leads to an increase in the acidity of the mouth. This then promotes demineralization of the tooth surface (König, 2000).
- Drinks that contain high levels of acid also increase the acidity of the mouth.
- Early malnutrition (as early as 6 weeks gestation when tooth development begins) is linked to increased dental caries. Vitamin A deficiency during tooth formation is also linked to poor tooth calcification and results in hypoplasia of the enamel (Kleinman ed. 2004).
- During childhood, vitamin D deficiency has been reported to interfere with dentin formation.

Basic primary dental preventive care is, however, the most effective way to maintain oral health.

## 4. THE IMPORTANCE OF BREAST-FEEDING

In Chapter 5, we discussed breast-feeding in relation to the health and nutrition of the mother. We now look at breast-feeding in relation to the health and nutrition of the infant.

### 4.1 The Decision to Breast-Feed

WHO recommends exclusive breast-feeding (EBF) for the first 6 months of an infant's life. At that point, complementary foods can be introduced, in combination with frequent or on-demand breast-feeding that should continue at least until the child reaches the age of 2 (WHO, 2008a, 2013).

Breast-feeding is widely practiced throughout the developing world, with initiation rates exceeding 90% in most countries. In fact, the rate is actually increasing, in spite of demographic trends such as urbanization that tend to have a negative impact (ACC/SCN, 2000). Exclusive breast-feeding is, however, uncommon, and yet it is the behaviour that is most associated with infant health and survival (WHO, 2008a, 2013). The highest prevalence of the practice is found in Asia (82% of infants younger than 4 months) and in North Africa (63% in Morocco) (ACC/SCN, 2000). EBF requires not only a decision to breast-feed on the part of the mother but also the willingness to engage in a process of learning, to persevere when difficulties arise, and, sometimes, to defy cultural norms (Hill et al., 2003).

Care is defined as the commitment of caregivers – mothers, fathers, siblings, and child-care providers – to provide the food, health care, stimulation, and emotional support necessary for children's healthy growth and development (ACC/SCN, 2000). The provision of food to young children, from the time they are born until they are able to obtain all their nutrient requirements from an adequate share of the household diet, is

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especially challenging for caregivers, regardless of the level of household food security (Pelto et al., 2003). Particular attention is paid in this section to breast-feeding and complementary feeding.

Many factors interact in infant feeding behaviour (see Figure 6.5). The most proximate of factors are the woman's choice and her ability to act upon her choice. Underlying these two conditions is the availability of information on infant feeding, as well as the physical and social support available to the woman over the period starting from before birth. These factors are in turn influenced by familial, medical, and cultural attitudes and norms, demographic and economic conditions and resources, commercial pressures, and national and international policies and norms (ACC/SCN, 2000). According to the International Food Policy Research Institute (IFPRI), care-giving practices, whether good or bad, seem to reinforce one another, and "it may be that a minimum number of good practices is necessary for any health benefits to be obtained" (Arimond & Ruel, 2001, p. iii). Health programming must therefore be directed towards ensuring that healthy care-giving practices prevail.

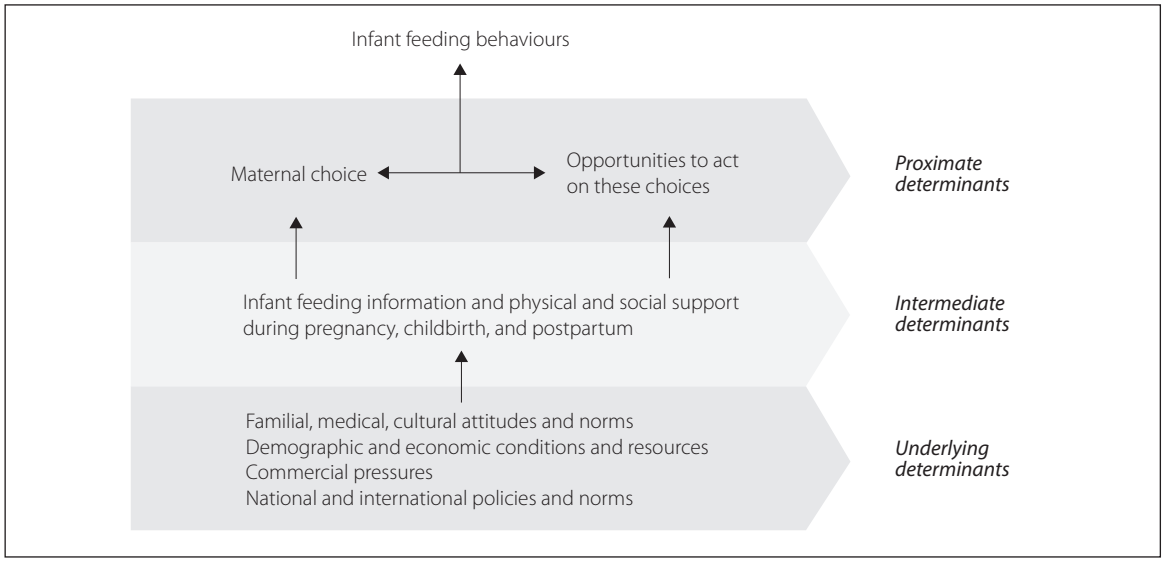


**Figure 6.6:** Determinants of infant feeding behaviours.
Source: ACC/SCN, 2000.

## 4.2 The Nutritional Benefits of Breast-Feeding

Breast-feeding provides the ideal natural first food for babies (Brown, 2002). Breast milk supplies all of the nutrients required by an infant during the first 6 months of life, half of the requirements during the second 6 months, and one-third of requirements in the second year (ACC/SCN, 2000).

Breast milk also promotes sensory and cognitive development (Horta et al., 2007) and protects the infant against both infectious and chronic diseases through its nutritional and immunological qualities (Brown, 2002; Kramer et al., 2001). This effect is greatest during the first months of life (Hill et al., 2003). In particular, EBF reduces infant mortality due to common childhood illnesses, such as diarrhoea and pneumonia (Brown, 2002; Kramer et al., 2001). With EBF, there is no risk of illness due to contamination of food or utensils.

In addition, evidence indicates that breast-feeding helps infants to recover more rapidly during illness. During illness, breast-feeding serves as a sustained source of nutrition, as breast milk intake is not reduced, whereas intake of complementary foods declines considerably when a child is ill (Brown, 2002; Kramer et al., 2001).

The benefits of breast-feeding extend beyond reducing risks of morbidity and mortality due to infectious disease. EBF seems to have a preventive effect on the early development of allergic diseases, including asthma, atopic dermatitis, and suspected allergic rhinitis (Gdalevich et al., 2001; Kull et al., 2002; Oddy et al., 2004). This protective effect has also been shown to be evident in multiple allergic diseases (Kull et al., 2002).

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Although there is clear evidence that breast-feeding presents short-term benefits for child health, its long-term benefits have been the subject of controversy, with some studies reporting a variety of positive effects and others failing to confirm these findings. A WHO report (Horta et al., 2007) therefore set out to conduct a systematic review and analysis of the available evidence regarding the long-term effects of breastfeeding. The report concludes that breast-feeding may indeed have long-term benefits. Adults who had been breast-fed tended to have lower blood pressure and total cholesterol, as well as a lower prevalence of obesity and type 2 diabetes. They also scored better on intelligence tests. All these outcomes were statistically significant, although for some the effect was relatively modest.

## 4.3 Replacement Feeding of Infants

Despite the compelling reasons why breast-feeding is best, many women, for one reason or another, choose to feed their infants using infant formula. Health-care workers should always ensure that these mothers are making an informed decision. Mothers should be made aware of the benefits of breast-feeding and the financial implications and other risks of formula feeding. The requirements for safe formula feeding include:

- Access to safe water and electricity (or another energy source) to allow for safe, hygienic preparation of infant formula and cleaning of utensils
- Sufficient money to buy formula and cups/bottles for the first year of the baby's life. Infant formula is expensive and a baby requires 3 to 4 kg of formula per month for the first 6 months, and thereafter roughly 2 kg per month.

The WHO has emphasized that health-care personnel, community health workers, and parents and other caregivers must be provided with enough information and training on the preparation, use, and handling of powdered infant formula in order to minimize health hazards. They also need to be informed that powdered infant formula may contain pathogenic micro-organisms and therefore carries a risk of infection (WHO, 2013).

Mothers who opt to practice replacement-feeding should be encouraged to follow these instructions for preparing and feeding infant formula:

- Wash hands with soap and water before the formula is prepared
- Boil the water used for formula preparation
- Keep all food and formula preparation areas clean
- Serve the formula in a cup or bowl rather than a bottle, where possible
- Wash the bottle/cup/bowl with soap and water, or by boiling
- Give unfinished formula to an older child rather than saving it for later use (WHO, UNICEF & UNAIDS, UNFPA, 2003 1998)

It is important that the instructions are followed exactly and that the formula is not made more concentrated by adding extra scoops of powder. Nor should it be made too diluted since this can lead to malnutrition.

Household nutrition and hygiene practices are key determinants of the health risks for mothers and their offspring. Infections and diarrhoeal diseases can be exacerbated by inadequate nutrition and poor basic hygiene practices, such as failing to wash one's hands with soap or ashes after urinating or defaecating and before the preparation and eating of meals (UNICEF, 2009).

An especially useful source is the WHO's *Guiding Principles for Feeding Non-breastfed Children 6-24 Months of Age* (WHO, 2005a), which is available in English, French, and Spanish at http://www.who.int/maternal_child_adolescent/documents/9241593431/en/.

## 4.4 Complementary Feeding Practices

The early introduction of solids and or additional fluids (other than water) into the diets of infants is common in many countries in the world. WHO recommends 10 guiding principles for complementary feeding of the breast-fed child (see Box 6.1).

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**Box 6.1:** Guiding Principles for Complementary Feeding of the Breast-Fed Child

**1. Duration of Exclusive Breast-Feeding and Age of Introduction of Complementary Foods**
Practice exclusive breast-feeding from birth to 6 months of age and then introduce complementary foods while continuing to breast-feed.

**2. Maintenance of Breast-Feeding**
Continue frequent, on-demand breast-feeding until 2 years of age or beyond.

**3. Responsive Feeding**
Practice responsive feeding, applying the principles of psychosocial care. Specifically: (a) feed infants directly and assist older children when they feed themselves, being sensitive to their hunger and satiety cues; (b) feed slowly and patiently, and encourage children to eat, but do not force them; (c) if children refuse many foods, experiment with different food combinations, tastes, textures, and methods of encouragement; (d) minimize distractions during meals if the child loses interest easily; (e) remember that feeding times are periods of learning and love-talk to children during feeding, with eye-to-eye contact.

**4. Safe Preparation and Storage of Complementary Foods**
Practice good hygiene and proper food handling by: (a) washing caregivers' and children's hands before food preparation and eating; (b) storing foods safely and serving foods immediately after preparation; (c) using clean utensils to prepare and serve food; (d) using clean cups and bowls when feeding children; and (e) avoiding the use of feeding bottles, which are difficult to keep clean.

**5. Amount of Complementary Food Needed**
Start at 6 months of age with small amounts of food and increase the quantity as the child gets older, while maintaining frequent breast-feeding. The energy needs from complementary foods for infants with "average" breast milk intake in developing countries are approximately 200 kcal per day at 6 to 8 months of age, 300 kcal per day at 9 to 11 months, and 550 kcal per day at 12 to 23 months. In industrialized countries these estimates differ somewhat (130, 310, and 580 kcal/d at 6 to 8, 9 to 11, and 12 to 23 months, respectively) because of differences in average intake of breast milk.

**6. Food Consistency**
Gradually increase food consistency and variety as the infant gets older, adapting to the infant's requirements and abilities. Infants can eat pureed, mashed, and semi-solid foods beginning at 6 months. By 8 months most infants can also eat "finger foods" (snacks that can be eaten by children alone). By 12 months, most children can eat the same types of foods as consumed by the rest of the family (keeping in mind the need for nutrient-dense foods, as explained in item #8 below). Avoid foods that may cause choking (i.e., items that have a shape and/or consistency that may cause them to become lodged in the trachea, such as nuts, grapes, and raw carrots).

**7. Meal Frequency and Energy Density**
Increase the number of times that the child is fed complementary foods as he/she gets older. The appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. For the average healthy breast-fed infant, meals of complementary foods should be provided 2 or 3 times per day at 6 to 8 months of age and 3 or 4 times per day at 9 to 24 months of age, with additional nutritious snacks (such as a piece of fruit or bread or chapatti with nut paste) offered once or twice a day, as desired. Snacks are defined as foods eaten between meals – usually self-fed, convenient, and easy to prepare. If energy density or amount of food per meal is low, or the child is no longer breast-fed, more frequent meals may be required.

**8. Nutrient Content of Complementary Foods**
Feed a variety of foods to ensure that nutrient needs are met. Meat, poultry, fish, or eggs should be eaten daily, or as often as possible. Vegetarian diets cannot meet nutrient needs at this age unless nutrient supplements or fortified products are used (see item #9 below). Vitamin A-rich fruits and vegetables should be eaten daily. Provide diets with adequate fat content. Avoid giving drinks with low nutrient value, such

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as tea, coffee, and sugary drinks such as soda. Limit the amount of juice offered so as to avoid displacing more nutrient-rich foods.

**9. Use of Vitamin-Mineral Supplements or Fortified Products for Infant and Mother**
Use fortified complementary foods or vitamin-mineral supplements for the infant as needed. In some populations, breast-feeding mothers may also need vitamin-mineral supplements or fortified products, both for their own health and to ensure normal concentrations of certain nutrients (particularly vitamins) in their breast milk. (Such products may also be beneficial for pre-pregnant and pregnant women.)

**10. Feeding During and After Illness**
Increase fluid intake during illness, including more frequent breast-feeding, and encourage the child to eat soft, varied, appetizing, favourite foods. After illness, give food more often than usual and encourage the child to eat more.

*Source: WHO, 2002.*

## 5. NUTRITIONAL REQUIREMENTS OF INFANTS AND YOUNG CHILDREN

Adequate nutrition is essential for achieving growth and development potential. The rapid growth experienced by infants and children places great demands on their nutrient intake. Breast milk provides all the energy and nutrients that an infant needs for the first 6 months of life. Nutrient requirements for infants younger than 6 months are therefore based on the quantity of nutrients provided by human milk. Thereafter, the recommended nutrient requirements are based on the consumption of breast milk or breast-milk substitutes, as well as increasing amounts of solid foods.

In North America, tables of recommended nutrient intake are known as the Recommended Dietary Allowances (RDAs). These are part of the Dietary Reference Intakes (DRIs) and are described in Chapter 14. The RDA tables have been used extensively. The World Health Organization publishes the Recommended Nutrient Intakes (RNIs), which can be considered an alternative to the RDAs. The two sets of dietary recommendations are more or less identical for boys and girls up to the age of 9 years.

To ensure optimal nutrient intake, it is essential that the dietary intake of infants and young children be assessed as part of the nutrition counselling component of growth monitoring and promotion activities. See Box 6.2 for questions that can be asked in a community setting in order to gain insight into the dietary intake of infants and young children. Further evaluation, such as a detailed dietary analysis, should be performed if inadequacies are suspected or other conditions exist that adversely affect the infant's health. Instructions for performing a dietary analysis are provided in Chapter 22.

**Box 6.2:** Questions to Ask About an Infant's Diet

| | |
|---|---|
| *Type of feeding* | Is the infant breast-fed, formula-fed, or both? If formula-fed, what kind of formula is used, and how is it prepared? |
| *Quantity and frequency of feeding* | If breast-fed, how frequently does the infant nurse, and how long do feedings last? If on formula, how much does the infant drink each day? |
| *Vitamin and mineral supplements* | Is the infant given supplements? If so, which ones, and how much? |

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| | |
|---|---|
| *Solid food intake* | Is the infant offered solid foods? If so, at what age were solids introduced, which ones does the infant eat, and how often? Are solid foods of the commercial type, or are they home prepared? How often and in what quantities is solid foods consumed? |
| *Feeding behaviour* | Does the infant exhibit unusual or abnormal feeding behaviours, such as food aversions? |
| *Feeding environment* | Where does the child eat, and is the area clean? What social interaction takes place during feeding time? |
| *Alternative dietary practices:* | Does the infant's family deliberately not eat certain foods or food groups? |
| *Food allergies* | Does the infant appear to be allergic to specific foods? |

*Source: Rolfes et al., 1990.*

## 6. NUTRITION INTERVENTIONS AND PROGRAMMES FOR INFANTS AND YOUNG CHILDREN

Improving child health is a long-term investment in the health and development of any country. Goal 4 of the United Nations' Millennium Development Goals is specifically dedicated to reducing child mortality (see Box 6.3).

**Box 6.3:** Recommended Targets and Indicators for Millennium Development Goal 4

| | |
|---|---|
| Goal | Reduce child mortality |
| Targets | Reduce by two-thirds the mortality rate among children under five |
| Indicators | Under-five mortality rate<br>Infant mortality rate<br>Proportion of one-year-old children immunized against measles |

*Source: United Nations, 2007*

The period from the start of pregnancy up to the time an infant reaches the age of 24 months, often referred to as "the first thousand days," presents a critical window of opportunity for nutrition interventions. In Chapter 5, we presented a summary of the evidence for various interventions (see Table 5.1). Effective interventions for infants and young children include promotion of breast-feeding, education on complementary feeding (with additional food supplements in food-insecure populations), supplementation with various micronutrients (including zinc, vitamin A, and iodine), treatment of severe malnutrition, and promoting hygiene practices (Bhutta et al., 2008).

A number of studies have found that the key intervention linked to an increase in EBF and the duration of breast-feeding is interpersonal counselling, more so from peers than from health professionals. Of particular

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importance are the number of contacts with support persons and the timing of these contacts. Counselling should therefore take place as close as possible to the time of the event or situation to which it pertains. Reaching women soon after delivery and within the first month post-partum is critical to increasing the duration of EBF (ACC/SCN, 2000).

Engle et al. (2007) argue that the most effective interventions have the features described in Box 6.4.

**Box 6.4:** Characteristics of Successful Early Child Development Interventions

The integration of health, nutrition, education, and social and economic development, and collaboration between governmental agencies and civil society.

A focus on relatively disadvantaged children, who have the potential to benefit more than other children. Younger children (2 to 3 years) tend to benefit more than older children (5 to 6 years).

Interventions that are of sufficient intensity and duration and that include direct contact with children beginning early in life. Low-intensity programmes that do not direct services at children may have limited effects. Longer exposure results in larger and more consistent effects on child development.

Parents and families as partners with teachers or professional caregivers in supporting children's development. Services and attention offered directly to children are more effective than simply providing information to parents. A clear correlation exists between the frequency of home visits and improvements in child development.

The provision of opportunities for children to initiate their own learning and explore their surroundings by means of age-appropriate activities.

A blend of traditional child-rearing practices with newer evidence-based approaches.

The involvement of early child development staff who are given in-service training and supportive and continuous supervision and who use observational methods to monitor children's development.

*Source: Adapted from Engle et al., 2007.*

The promotion of healthy patterns of feeding for infants and young children requires not only counselling individual mothers but also changing the context in which infant- and child-feeding choices are made (ACC/SCN, 2000). With regard to the latter, three international initiatives have proved especially influential: (1) the International Code of Marketing of Breastmilk Substitutes, adopted by the World Health Assembly in 1981; (2) the Innocenti Declaration of 1989, which operationalized the "Ten Steps to Successful Breastfeeding"; and (3) the WHO/UNICEF Baby-Friendly Hospital Initiative, which was endorsed by the Forty-fifth World Health Assembly in 1992. The gradual implementation of these initiatives by various governments has gone a long way towards achieving optimal infant-feeding practices throughout the world.

Interventions designed to improve a child's intake of complementary foods can greatly enhance infant and child growth. One study, which reviewed efficacy trials and programmes undertaken in 14 different countries and aimed at increasing infant dietary intake, found that the majority of these programmes improved growth rates by 0.10 to 0.50 SD. As the authors noted, "In absolute terms, this range of improvement in growth would reduce prevalences of malnutrition (<–2 SD) at 12 months of age by 1% to 19% and could reduce deaths due to malnutrition by 2% to 13%, depending on the underlying prevalence of malnutrition in the community" (Caulfield et al., 1999, p. 183).

Although, understandably, children at risk of malnutrition are the greatest concern, it is worth remembering that childhood obesity is on the increase throughout the developing world, as well as in highly developed countries. Long-term outcome data regarding possibly successful approaches to the treatment of overweight in children are limited. Growth monitoring can, however, contribute to the early recognition of excessive weight gain relative to linear growth, which can in turn trigger preventive meaures. Nutrition counselling should be provided to parents of overweight, or potentially overweight, children in an effort to foster healthy

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dietary practices and to encourage moderation in food consumption. In particular, it is important to discourage the consumption of snacks full of sugar and fat and the use of sweets as rewards, as well as to emphasize the importance of regular physical activity. The subject of overweight and obesity is discussed in more detail in Chapter 13. (For a useful overview, see Kleinman, 2009, chap. 33.)

## 7. FEEDING PRACTICES FOR PRE-SCHOOL CHILDREN

During the toddler years, fine and gross motor development enhances the ability of children to chew foods of different textures and also to learn to feed themselves. Mothers can continue to breast-feed children beyond the age of 2, but at that age children can be fed their own portions of family meals. Children should also be given two nutritious snacks a day (such as fresh fruit or bread with nut spread) and should be encouraged to eat foods rich in vitamins A and C and iron.

Parents play a crucial role in instilling healthy eating patterns in their children. While it is important to encourage children to eat foods that are nutritious, eating takes place in a specific context, which can be positive or negative. Box 6.5 presents some practical information and recommendations about child feeding.

**Box 6.5:** Key Guidelines for Feeding of Pre-school Children

Parents should respond appropriately to children's hunger and satiety cues.

Parents should focus on the long-term goal of developing healthy self-control of eating in children.

Parental influence should be positively focused on the child's developing food preferences and should encourage the child to select a variety of foods consistent with a healthy diet.

Children have an instinctive preference for foods that are sweet or slightly salty; they tend to dislike bitter, sour, and spicy foods.

Children are often reluctant to accept new foods and unfamiliar flavours, and they may need to be repeatedly exposed to such foods before they are willing to accept them.

Children need to be served appropriate child-sized servings of food. The general guideline is that a portion consists of one tablespoon of food for each year of age (e.g., 3 tablespoons of rice equals a portion of rice for a 3-year-old).

Children should be fed in secure, happy, and positive environments, with adult supervision.
Children should never be forced to eat anything.

*Source: Adapted from Wooldridge, 2008.*

Children of late pre-school age appear to be more responsive to external cues than to their instinctive ability to self-regulate intake. Parents and caregivers should therefore be keenly aware of the role they play in modelling healthy eating behaviours for young children (Birch & Fisher, 1995; Wooldridge, 2008).

## DISCUSSION QUESTIONS AND EXERCISES

1. Visit a local community health centre to observe and, if possible, participate in growth monitoring and promotion. Write a report describing your experience. Be sure to include the following:
   - Profiles of the children who were monitored on that day (e.g., age, gender, anthropometric status, growth velocity, feeding practices, immunization status, vitamin A supplementation status).
   - An overview of promotional activities that accompanied the growth monitoring.
   - A critical assessment of the process, activities, and recommendations for improved practice.

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2. Imagine you are the director of the national nutrition programme. Write a letter to the minister of health to argue for an increase in the budget for nutrition-related interventions, with specific emphasis on infants and young children. Explain why the present budget is inadequate and what more needs to be done.
3. Roberto, aged 9 months, has had frequent episodes of diarrhoea. He cries a lot and is restless. If his skin is pinched, the blood returns slowly, he drinks eagerly, and his tongue is dry. His mother says he seems to be growing slowly and has diarrhoea frequently, "almost every month." He has been taking cow's milk from a feeding bottle since he was one month old and began to eat regular food at the age of 8 months. His mother reports that, since the diarrhoea started, she has given him some formula but no solid food "because he was not hungry." What is wrong with Roberto, and what should be done for him? Develop a comprehensive management plan.

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# CHAPTER 7

# NUTRITION FOR SCHOOL-AGE CHILDREN

## Assessment, Analysis, and Action

*Friede Wenhold, Ellen Muehlhoff, and H. Salome Kruger*

### *Outline*

- Nutritional assessment of school-age children
  - Anthropometric assessment
  - Dietary assessment
- Common nutrition-related problems of school-age children
  - Undernutrition
  - Overweight and obesity
  - Body image and eating disorders
  - Micronutrient deficiencies
  - Adolescent pregnancy
  - Dental caries
- Promoting healthy eating for school-age children
  - Comprehensive school health and nutrition
  - Nutrition education
  - School-based food programmes

### *Objectives*

After reading this chapter, you should be able to do the following with particular reference to school-age children in developing countries:

- Explain why nutrition is important
- Describe the principles of nutritional assessment in a community context
- Outline the individual, social, and macro-environmental factors that influence eating behaviour
- Describe the most prevalent nutrition-related problems
- Explain what is meant by an integrated strategy for nutrition action
- Give reasons why schools present special opportunities for nutrition promotion
- Discuss appropriate content and approaches for nutrition education in schools
- Critically evaluate the advantages as well as the challenges of school-based meal programmes

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# 1. INTRODUCTION

The second of the United Nations' eight Millennium Development Goals – "Achieve universal primary education" – recognizes that children have a right to basic schooling, which is essential to their opportunities in life. But progress towards this goal depends in no small measure on the first of the goals: "Eradicate extreme poverty and hunger." Good nutrition is critical to a child's physical and mental development, which will in turn influence a child's ability to succeed in school. Children everywhere have a right to adequate nutrition, as well as to schooling, and yet many developing countries face enormous obstacles in their efforts to ensure that these rights are realized.

The focus of this chapter is the nutritional well-being of children from the time they begin school until they reach the end of their teens. The United Nations Convention on the Rights of the Child (1989) regards children as all individuals under the age of 18. In practice, however, children are often distinguished from adolescents. The World Health Organization (WHO, 2005b) defines adolescents as persons aged 10 to 19, making them a subset of "youth" or "young people," that is, people from 10 to 24 years of age. While we will sometimes refer specifically to adolescents, unless otherwise specified, the term *children* will be used to refer to both primary and secondary school children.

Historically, developing countries have tended to have a relatively youthful population, owing to higher fertility rates in combination with shorter life expectancies. More recently, a decline in the under-five mortality has contributed to this pattern. The median age in developing countries, especially those in sub-Saharan Africa, remains significantly lower than it is in the industrialized world, with youth representing the broadest segment of the population. This alone provides a compelling reason to invest in the health of school-age children.

For a number of reasons, the period of childhood and adolescence provides a window of opportunity for community nutritionists, particularly those engaged in nutrition promotion (WHO, 2005b):

- Childhood and adolescence are the ideal time to foster sound dietary habits and prevent poor eating patterns from becoming ingrained.
- During this period, previous nutritional inadequacies may be corrected and catch-up growth achieved.
- Improving the dietary behaviour of children and youth is an investment in adult health. Apart from short-term effects, improved nutritional status also has long-term health benefits, such as the prevention of obesity, type 2 diabetes, ischaemic heart disease, osteoporosis, and tooth decay.
- In girls, nutrition interventions may help to break the generation-to-generation cycle of malnutrition, poverty, and chronic disease.
- Households and communities can be reached through children.
- Child-to-child health promotion initiatives offer promising possibilities for the improvement of a population's overall health and nutritional status.

Although representative data on malnutrition among school-age children are scarce, patterns of malnutrition visible among pre-school children appear to persist once children begin school. Dietary interventions targeted at young people face two major barriers, however. First, adolescent morbidity and mortality are not closely linked to nutrition. Globally, among 10 to 24-year olds, the causes of years lost to disability are linked to neuropsychiatric disorders, unintentional injuries, and infectious and parasitic diseases. The main risk factors for disability-adjusted life-years are alcohol consumption, unsafe sex, iron deficiency, lack of contraception, and illicit drug use (Gore et al., 2011). In other words, adolescent morbidity is now less likely to be associated with health-related factors than with social causes. Second, in comparison to other age groups, young people tend to be relatively healthy, with the result that their nutritional needs may be neglected. Although youth may appear to be in a "Cinderella" phase in the life cycle, evidence suggests that young people may not be as healthy as they seem (Fatusi & Hindin, 2010). Bundy (2005) argues that poor health and malnutrition affect access to education, as well as participation in school, level of academic achievement, and the likelihood of completion. Clearly, school-based health programmes can provide an effective solution to addressing nutritional inadequacies among young people.

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Community nutritionists often employ a method known as the Triple A approach: Assessment, Analysis, and Action. It has been described as follows:

> The "Triple A" process or cycle, pioneered by UNICEF, is a participatory decision-making process wherein the problem of undernutrition is *assessed* (in terms of its nature, extent, distribution, etc.), its causes *analyzed*, along with the available resources and capacity to combat it, followed by a decision on appropriate mix of *actions*. The process is cyclical and iterative in that once the actions have been initiated, they are subsequently monitored and evaluated (*reassessment*). (Allen & Gillespie, 2001, p. 89)

This chapter is structured according to this approach. It begins with a focus on the nutritional assessment of children, which is followed by an analysis of the major nutrition problems encountered by children. This analysis serves to highlight the most common causes of malnutrition and the associated risk factors. The last section covers actions – that is, interventions and programmes intended to enhance the nutrition of school-age children.

## 2. THE NUTRITIONAL ASSESSMENT OF CHILDREN IN A COMMUNITY CONTEXT

A comprehensive assessment of nutritional status, involving clinical, dietary, anthropometric, and laboratory methods (see Chapter 22), is rarely feasible in the context of community-based nutrition programmes, especially given the limited resources typically available in developing countries. The backbone of community-based assessment of children is usually the evaluation of anthropometric growth, supplemented by dietary data and information concerning risk factors.

### 2.1 Anthropometric Assessment

The measurement of weight and height is an objective starting point for the health and nutritional assessment of children. An ongoing lack of adequate food, poor health related to chronic infectious diseases, and suboptimal socio-economic conditions are reflected in a low height for age, or *stunting*. *Wasting* refers to a low body mass index (BMI) for age (the equivalent to low weight for height in those under the age of 5). Wasting is typically associated with acute diseases or food crises and is uncommon in children and adolescents in countries in which food security is not generally a problem. The term *thinness* is sometimes used to refer to a low BMI for age. Tables are available that specify international cut-off points for BMI thinness grades 1, 2, and 3 according to sex and age (from 2 and 18 years). For example, at the age of 18, BMIs of 16, 17, and 18.5 correspond to grade 1, 2, and 3, respectively (Cole et al., 2007). The term *underweight* also indicates a failure to grow, but it does not distinguish between children whose weight is low for their height (wasting) and those whose weight is low because they are short for their age (stunting).

Overnutrition in school-age children is best assessed using BMI for age. Regardless of age or sex, an adult with a BMI of 25 is considered overweight, and one with a BMI of 30 is considered obese. In contrast, the interpretation of BMI in children is age- and sex-specific and requires growth charts. There is no universally accepted standard for classifying childhood overweight and obesity. The International Obesity Task Force supports the use of specific BMI cut-off points for overweight and obesity by age (for both genders) which are equivalent to an adult BMI of 25 or 30, respectively. For example, at the age of 6 years, BMI values of 17.6 for boys and 17.3 for girls are equivalent to an adult BMI of 25. The WHO promotes an alternative approach, according to which overweight for children and adolescents aged 5-19 years is defined as 1 standard deviation above the median BMI, whereas obesity refers to 2 standard deviations above the median (Ng et al., 2014).

BMI may not be an accurate measure of overweight and obesity in stunted children. This poses challenges because concurrent stunting and overweight have repeatedly been documented in developing countries (Barquera et al., 2009; Javed et al., 2014). It may therefore be necessary for the nutritionist to take additional measurements when the focus is on excess body fat. The amount of subcutaneous fat can be estimated by measuring skinfolds. Percentile tables of triceps and subscapular skinfolds for age and sex are available, with the 85th percentile again as a cut-off point for risk of overweight and the 95th percentile as the cut-off for overweight. Abdominal obesity among children and adolescents is currently also receiving considerable

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attention. Measurement and interpretation of waist circumference is, however, not yet standardised (de Moraes et al, 2011). Using the mid-upper-arm circumference (MUAC) as a guide to body fat may appear to be an easy alternative to measuring skinfolds. Preliminary studies warn, however, that reference values may differ from country to country and may require regular updating (Ayatollahi & Shayan, 2008).

The above suggests some of the challenges and limitations of anthropometric assessments of children. Percentile charts show the distribution of values in connection with a particular measurement across a given reference population, but they do not necessarily specify cut-off points for values that are excessive or too low. Strictly speaking, the comparison of a child's measurements to percentile charts allows us only to say where that child stands in relation to the reference population. For example, if a child's BMI is at the 25th percentile, this means that 25% of the children in the reference population (of the same age and gender) have a smaller BMI. Nevertheless, in practice measurements smaller than the 5th percentile indicate underweight and measurements above the 95th percentile indicate over-fatness (Fernandez et al., 2004).

The recommendations for the nutritionist are therefore as follows:

- Use repeated measurements (growth monitoring) performed at regular intervals, rather than one-off evaluations. The slope and shape of a child's individual growth curve over time should be compared to the slope and shape of the curve in the percentile chart. The development of under- or overnutrition is signalled by a change in the relative slope or trend of the curve, and action can be taken before malnutrition actually arises.
- Given the shortcomings of existing growth references for children (Butte et al., 2007), it is advisable to use the same anthropometric index, such as BMI for age, and the same reference data (that is, the same percentile chart) throughout the child's period of development. The WHO Reference 2007, a set of reference charts and tables available at http://who.int/growthref/en (see also De Onis et al., 2007), is recommended for the interpretation of anthropometric information for individuals aged 5 to 19 years. (These guides complement the WHO's 2006 reference statistics for younger children, which are discussed in section 3 of Chapter 6.) A useful tool is the WHO AnthroPlus software, which allows for the global application of the WHO Reference 2007: see http://www.who.int/growthref/tools/en.
- For the assessment of the nutritional status of an individual child, supplementary dietary, biochemical, and clinical information should be collected and interpreted as a whole (see Chapter 22). For children with special needs and developmental disorders, this assessment should include an evaluation of behavioural and skills development.
- Abnormal growth patterns that cannot be linked to nutritional status should be referred to a medical practitioner for early detection of other health problems.

## 2.2 Dietary Assessment

Assessing the diets of children involves finding out what they eat, why they eat the way they do, and whether their dietary intake meets nutritional requirements.

### *2.2.1 Factors influencing eating behaviour*

The eating behaviour of children is the result of many influences, Story et al. (2002) proposed four major levels of influence as follows:

A. Individual or intrapersonal influences. These include: (i) psychosocial (food preferences, taste and the sensory perception of food; and level of nutrition knowledge); (ii) biological (hunger and gender); and (iii) lifestyle (time and convenience; cost; meal patterns; and dieting).

B. Social environmental influences (interpersonal). These include: (i) family / household (various demographic and cultural characteristics such as religion and food preferences within the family); (ii) food availability and access (household food security); and (iii) influence of peers.

C. Physical environmental (community settings). These include: (i) schools; (ii) fast food outlets; (iii) vending machines; (iv) convenience stores; and (v) workplaces.

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D. Macrosystem influences (societal). These include: (i) food advertising; and (ii) media reports on such topics as body weight and body image.

Each of the above factors can be a cause (or a potential cause) of poor dietary intake or, conversely, can encourage healthy eating habits. These influences may therefore be important not only in dietary assessment per se but also in the analysis of the determinants of dietary intake. The relative importance of the various factors is affected by stages in the life cycle, by gender, and by a child's individual circumstances, including geographical location, socio-economic class, and cultural background (Joshi & Amandi, 2013; Verstraeten et al., 2014). The relative influence of a particular factor in a particular situation should never be assumed but should be assessed and analyzed. For example, a teenager might be quite knowledgeable about nutrition, but, in comparison to peer pressure, this knowledge may be of little predictive value in determining his or her choices about diet and lifestyle (WHO, 2005b). In situations of conflict or disaster, eating behaviour is to a large extent governed by food availability, an aspect of the physical environment. Factors that play a role in the food choices of street children are obviously very different from those at work when a grandparent is taking care of a child. As everywhere else, context matters!

Identifying the factors that may influence dietary intake uncovers potential risk factors, which should be taken into account in the planning of interventions. For example, an intervention might aim at reducing risk factors by replacing less healthy foods in vending machines with healthier options.

### *2.2.2 Assessing the diet of children and adolescents*

Various techniques are available for assessing a child's diet. Apart from the well-known methods (see Chapter 22), new approaches, as well as modifications of existing approaches, are continuously being developed and tested for children (Boushey et al., 2009). Regardless of the technique used, it should be validated for the specific target group and setting and should take into account the child's level of cognitive development. It appears that once children have reached the age of about 11, they should be able to provide reasonably accurate information about their diet on their own. Before that stage, caregivers should be included in the assessment.

Obtaining valid dietary information from children and adolescents is challenging. The nutritionist should make sure that the child understands what is required, can be relied upon to recall what he or she has eaten with a reasonable degree of accuracy, and is able and willing to pay sufficient attention to the task at hand. The child must also be able to distinguish among types of food and basic methods of food preparation and be able to organize the information as requested – for example, by grouping foods according to category or the occasion on which the food was consumed. The child must also be able to provide information about how much food was eaten (Baxter, 2009). This may involve the creative use of pictures of foods and various other aids for estimating portion size, as well as the ability to ask questions designed to elicit candid and complete information without creating a judgmental atmosphere. Food variety and dietary diversity scores also appear to be a promising method of assessing children's diets, especially in countries where micronutrient malnutrition remains a problem of public health concern (Steyn et al., 2006).

### *2.2.3 Nutritional requirements*

Appropriate standards are needed for the evaluation of dietary assessment data. Many countries have their own dietary guidelines, often based on food groups, which can be used as a rough way to judge food intake. Sometimes special versions are available for school-age children. In evaluating the energy and nutrient level of foods, it is customary to follow the Dietary Reference Intakes of the U.S. Institute of Medicine (Institute of Medicine, 2005). These are described in more detail in section 4.1 of Chapter 14 and in Appendix III. Acceptable Macronutrient Distribution Ranges (AMDRs) as a percent of energy intake for children aged 4 to 19 years are:

| | |
|---|---|
| Carbohydrate | 45% to 65% |
| Fat | 25% to 35% |
| Protein | 10% to 30% |

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The wide ranges refer to *acceptable* limits and should not be confused with recommendations (e.g., for protein the upper recommended level would be considerably lower than 30%).

## 3. ANALYSIS OF COMMON NUTRITION-RELATED PROBLEMS OF SCHOOL-AGE CHILDREN

Undernutrition is, of course, rife in developing countries, but, at the same time, increasing numbers of children consume diets that put them at risk of developing diet-related chronic diseases of lifestyle (CDL), that is, non-communicable diseases. Although seemingly unrelated, it appears that undernutrition *in utero* and during early childhood may leave children especially vulnerable to the effects of overnutrition later in life, with the result that, as adults, they are predisposed to develop obesity and some CDL, particularly if they begin consuming a Western diet (see the discussion in section 3 of Chapter 4).

Children are often affected by infectious diseases and closely related health problems that are associated with poverty, underdevelopment, and undernutrition. Examples include tuberculosis, malaria, and diarrhoea. HIV/AIDS is also a major threat, in that it may hinder the ability of parents or other caregivers to provide for the children who depend on them. More generally, childhood and adolescence are periods of nutritional vulnerability, in part because of the high nutrient requirements associated with accelerated growth. But children and, especially, adolescents are also susceptible to environmental influences, including pressure from their peers, who may encourage them to experiment with various risk-taking behaviours, ranging from alcohol and drugs to crash diets. A nutritionist must always be sensitive to the influences at work in a child's life and strive not to condemn them but to work with them.

### 3.1 Poor Eating Habits

International literature suggests that school-age children often have poor eating habits. Contributory factors include a decline in family cohesion, the growing need for children to take care of themselves (especially in single-parent households or families in which both parents must work to make ends meet), and a greater tendency for the children to eat meals and snacks away from home. Added to these are the marketing of food of poor nutritive value to children, the increased availability of energy-dense, nutrient-depleted foods, and peer pressure. Adolescents, especially females, often have concerns over their physical appearance (Story et al., 2002; WHO, 2005b).

The consumption of food prepared away from home is becoming more common among children in developing countries. This trend is associated with urbanization and with the nutrition transition, while the ability to purchase prepared foods is a mark of socio-economic status. A common sight in cities (and to a lesser extent in rural regions) is street vendors and kiosks. They are often located next to schools. Such foods may be nutritious (fresh fruit, for example), but more often they are inexpensive fast foods and snacks high in fat and sugar. For reasons of hygiene, as well as the potential for spoilage, the safety of these foods is also a concern. School-age children, in particular, may pay scant attention to snack food safety (Gavaravarapu et al., 2009).

Soft drink consumption is on the increase among youth internationally (French et al., 2003). Because these drinks are high in sugar, they can make a significant contribution to daily energy intake and are directly implicated in increased levels of obesity (Chapter 13). Alongside the upsurge in soft drink consumption, milk intake among adolescents has decreased in many countries (Vartanian et al., 2007). Energy-dense snack foods often replace not only milk but fruit, vegetables, and other nutrient-dense foods (Bowman et al., 2004). Low intake of milk has been associated with shorter stature, overweight, and poorer bone health (de Beer, 2012; Louie et al., 2011).

Research conducted with school-age children has also shown that breakfast makes a significant contribution to overall daily nutrient intake (Grantham-McGregor, 2005). Eating a school breakfast or a morning snack has beneficial effects on the cognitive and behavioural performance of undernourished children (Van Stuijvenberg, 2005).

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## 3.2 Undernutrition (Underweight and Stunting)

Both underweight (low weight for age) and stunting (low height for age) are prevalent among school-age children in many developing countries. This is usually the result of a cumulative process that starts in early childhood, perhaps even antenatally (WHO, 2005b). Continuing undernutrition, especially a lack of micronutrients (e.g., zinc, iron, and vitamin A), causes a delay in and subsequent slowdown of the adolescent growth spurt. Stunting can pose particular problems for women, given that short women tend to have relatively small pelvises, which can lead to complications during labour. As the WHO (2005b, p. 16) notes, "delayed growth and maturation in girls as a result of malnutrition further increases the risks associated with adolescent pregnancy, as biological age lags behind chronological age."

Early undernutrition has an adverse impact on height, body mass, and, in particular, muscle tissue. Evidence thus suggests that chronic malnourishment reduces a person's capacity to perform physical labour, which in turn limits productivity. Although few studies have focused specifically on adolescents, in many developing countries families must rely on adolescent children to help with both agricultural and domestic chores (see WHO, 2005b, pp. 16–17). More generally, a population in which a significant proportion of adults were malnourished as children is likely to be at a disadvantage in terms of economic output.

Equally damaging are the effects of malnutrition on brain development. Stunting and underweight in early childhood – especially undernutrition *in utero* and during the first two years of life – have been associated with poor motor skills but also with impaired cognitive function, which later manifests itself in poor school achievement (Wheeler, 2004).

## 3.3 Overweight and Obesity

Many factors, both nutritional and non-nutritional, contribute to the current surge in childhood obesity, a subject discussed more fully in Chapter 13. Although this increase in the proportion of overweight children is a global phenomenon, affecting low-income countries as well as more affluent ones, it can be traced in part to the growing popularity of Western foods high in fat and sugar, such as soft drinks, snack chips, and sweetened breakfast cereals, in tandem with the relatively sedentary lifestyles that tend to accompany urbanization.

The growth of cities in developing countries is leading to a reduction in physical activity. In particular, an increase in childhood obesity or overweight has been linked to depressed neighbourhoods in which children have little or no access to parks or recreation facilities and even the streets may be unsafe (Singh et al., 2010).

Especially in societies in which food insecurity is common, the problem of combatting obesity can be compounded by cultural associations of heaviness and a sedentary lifestyle (that is, the absence of any need to do physical work) with wealth and high social status (Onywera, 2010). Indeed, overweight and underweight often co-exist in developing countries. The rise of obesity does not mean that undernutrition is no longer a problem: the two are often seen together.In Pakistan, for example, a rapid rise in the number of overweight and obese school-age children has been observed despite a persistently high burden of undernutrition (Jafar et al., 2008). Stunting and overweight may even be present in the same child.

## 3.4 Body Image and Eating Disorders

Body image consists of one's perception of one's body – its size, weight, and shape – together with how satisfied one feels about one's body. Body image is therefore heavily influenced by cultural factors, which favour certain body types over others. As is well known, in the Western world, thinness is highly valued: the ideal man is lean and muscular, while the ideal woman is slender but full-breasted. As people in developing countries make the transition from a condition of food insecurity, in which fatness is perceived as a sign of privilege, to one of relative affluence and a Westernized lifestyle, their image of the ideal body tends to shift accordingly.

Body image has a behavioural component. Dissatisfaction with one's body, which is especially common among adolescents, often provokes efforts to alter its shape and size, generally through some combination of diet and exercise. Although in many cases these efforts are harmless (and may even have benefits), distortions in body image can lead to compulsive exercise and potentially harmful dieting practices, as well as to eating disorders, which have now become a major chronic illness among adolescent females, including athletes, in

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many high-income countries. Again, as developing countries, particularly those in the nutrition transition, embrace Western standards, one can expect to see an increased preoccupation with weight loss, especially among adolescent girls (Petersen et al., 2006). Early detection is important, and nutritionists and other health care providers should be alert to the danger signals: a low BMI for age (below the 5th percentile) or significant weight loss (either 2 BMI points or a 10% decrease from the previous weight), and/or evidence of inappropriate feelings of being overweight (WHO, 2005b, p. 71).

## 3.5 Micronutrient Deficiencies

The nutritional management of micronutrient disorders is covered in detail in Chapter 9. However, it is worth highlighting the most important aspects of micronutrient nutrition among school-age children and youth.

*Iron* deficiency is a common problem in school-age children and is associated with loss of appetite, higher morbidity, growth retardation, poor cognitive function, and a reduced ability to concentrate (Low et al., 2013).

*Zinc* deficiency is associated with short stature. Supplementation of children with zinc deficiency results in numerous favourable effects, including improved growth and a lower frequency of infections and diarrhoea (Mayo-Wilson et al., 2014).

The high *calcium* requirement of children during growth spurts is well known. At the same time, calcium intake is often lower than recommendations. This can be a problem as the greatest increase in bone density occurs in mid-adolescence. Milk avoidance is the primary reason for low intake.

Children from *iodine*-poor regions tend to have depressed IQ scores. Children born more than 3.5 years after the implementation of an iodine-supplementation programme in China had significantly higher IQ scores (12 to 17 IQ points) than children born earlier (Qian, 2005).

*Vitamin A* deficiency leads to growth faltering, infection, eye diseases, blindness, and death. Xerophthalmia is associated with stunting and wasting in young children. School-age children appear to remain at risk for vitamin A deficiency, albeit mainly at a subclinical level, as was shown to be the case in a study conducted in Brazil (Custodio et al., 2009).

Micronutrient deficiencies rarely occur in isolation. Furthermore, children with multiple micronutrient deficiencies typically live in disadvantaged communities and may grow up in households where the mother or caregiver provides little care and stimulation to the child. Children's development is influenced not only by their own health and nutritional status but also by the quality of mother-child interaction, the level of stimulation in the home environment, parental educational status, and cultural and neighbourhood factors (Kurpad et al., 2013).

## 3.6 Adolescent Pregnancy

Early pregnancy exposes both the mother and the child to nutritional risk. While this risk stems partly from the potential competition for dietary energy and nutrients, it is also due to the fact that the mother is not yet physiologically mature. Moreover, "the more undernourished or stunted the young mother is, the more immature she may be for her age, and consequently the higher the level of risk" (WHO, 2005b, p. 27). Specific nutrition concerns of adolescent pregnancy relate to the girl's pre-pregnancy weight, which may be too low, her height (as we have seen, short stature is associated with problems during labour), and her iron and folate status. Good nutrition is important not only for maintaining the health of the mother but also for the unborn baby and for breaking the intergenerational cycle of growth failure.

Evidence from Mexico and Bangladesh suggests that pregnancy halts the growth of the adolescent girl (Casanueva et al., 2006; Rah et al., 2008). In rural Bangladeshi women, this cessation of linear growth as the result of early pregnancy was associated with a loss of between 0.6 and 2.7 cm in attained height. It appears that for each year that theage of first pregnancy is below 20, the adult woman's final height is reduced by about a centimetre.

Decreasing the rate of adolescent pregnancy will require long-term interventions based on policies that encourage formal education, including sex education and family planning services. Nutritionists should not only be aware of such programmes but should advocate for them and work to strengthen their nutrition content (Kurz et al., 2005; WHO, 2005b).

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### 3.7 Dental Caries

The vast majority of humans suffer from dental caries. Marked differences exist, however, both between countries and within countries, with respect to sugar intake, fluoride usage, and dental care, as well as in the social and attitudinal factors that influence health maintenance. As Edelstein (2006) notes, whereas in developed countries the prevalence of decayed, missing, and filled teeth (DMFT) among 12-year-olds has steadily declined since 1980, in developing countries the severity of the problem has increased (even though, worldwide, the average rate has remained more or less constant). Given that higher rates of dental caries are associated with both with sugar intake and with urbanization, this increase may reflect, on the one hand, the growing popularity of sugar-laden Western foods and, on the other, the expansion of urban populations in developing countries.

## 4. ACTION: PROMOTING LIFELONG HEALTHY EATING FOR SCHOOL-AGE CHILDREN

An integrated approach to the management of nutrition-related problems of children and adolescents calls for multisectoral collaboration, involving, at the very least, government agencies responsible for health, education, and agriculture. An overall strategy must include nutrition promotion, prevention management, and clinical case management – that is, primary, secondary, and tertiary prevention, respectively (see Figure 7.1).

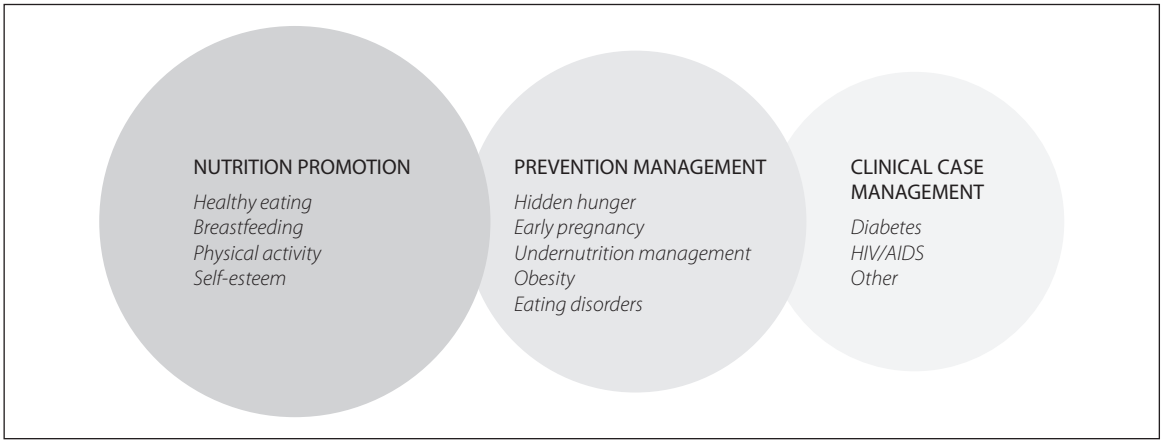


**Figure 7.1:** Three-tiered strategy for nutrition intervention in adolescents.
*Source: WHO, 2005b, p. 50.*

Story et al. (2002) have identified multiple environments, physical and social, all of which influence the eating habits of children and adolescents (see section 2.2). Schools stand out among these environments as one of the main social contexts in which life skills can be developed.

### 4.1 Integrated Approaches to School-Based Nutrition Interventions

Schools are generally acknowledged as critical settings for promoting health and lifelong healthy eating among children. In the context of community nutrition, a focus on schools has a number of advantages: (FAO, 2005a; CDC, 1996):

- Schools can reach almost all children, for a number of years, on a regular basis.
- Schools can provide opportunities to practise healthy and safe eating by means of the meals they provide and the foods sold on their premises.

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- Schools reach children at a critical age, when eating habits and attitudes are formed.
- Schools can teach children how to resist social pressure. Since eating is a socially learned behaviour, social (peer) pressures that discourage healthy eating can be directly addressed, and positive peer pressure can be reinforced.
- Skilled personnel are available. Teachers can receive nutrition training and then use their instructional skills to reach children.
- Health and sanitation services that are linked to nutritional status, such as treatment for worms or the provision of toilet facilities, can be implemented at schools.
- School-based nutrition education programmes have been shown to improve the eating habits of children.

The health problems that stand in the way of children's education differ from country to country, and often even within a country. Consequently, the optimal response will differ too. One widely recognized means of planning the most appropriate response is the FRESH (Focusing Resources for Effective School Health) Framework (UNESCO et al., 2000). This approach promotes school-based health interventions under four "pillars":

- School-based health and nutrition services
- Skills-based health and nutrition education
- Ensuring clean water and sanitation in schools
- Development of health-related policies

These four components are intended to be supported by effective partnerships between all parties involved.

Schools – primary, middle, and secondary, in both urban and rural settings – have often been the site of programmes that seek to improve nutrition. Many of these programmes target undernutrition, in one or more of its multiple dimensions, while others have specific goals, such as reducing the risk factors associated with chronic diseases of lifestyle such as preventing obesity (da Silveira et al., 2013; Saraf et al., 2012; Sbruzzi et al., 2013). Sometimes these are stand-alone nutrition education projects. In other instances, however, they are integrated programmes in which, for example, nutrition education, food provision, agriculture, and/or the promotion of physical activity are combined (Briggs et al., 2003; Masset & Gelli, 2013).

One example of such an integrated approach is the WHO's Global School Health Initiative, launched in 1995. This initiative "seeks to mobilize and strengthen health promotion and education activities at the local, national, regional, and global levels," with the goal of increasing the world's number of genuinely health promoting schools (WHO, 1998, p. 2). A health promoting school is defined as one that:

- Fosters health and learning with all the measures at its disposal;
- Engages health and education officials, teachers, students, parents and community leaders in efforts to promote health;
- Strives to provide a healthy environment, school health education, and school health services along with school/community projects and outreach, health promotion programmes for staff, nutrition and food safety programmes, opportunities for physical education and recreation, and programmes for counselling, social support, and mental health promotion;
- Implements policies, practices, and other measures that respect an individual's self-esteem, provides multiple opportunities for success, and acknowledges good efforts and intentions as well as personal achievements;
- Strives to improve the health of school personnel, families and community members as well as students; and works with community leaders to help them understand how the community contributes to health and education. (WHO, 2005b, p. 44)

The concept of health promotion is an important innovation in health care. It starts from the conviction, expressed in the "Ottawa Charter" adopted at the First International Conference on Health Promotion, that "health is created and lived by people within the settings of their everyday life, where they learn, work, play and love" (WHO, 1986). The health promotion approach defines people as active participants in creating

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health, not merely as recipients of health care. To be effective, health care requires strategies that *produce* health, just as much as they aim to *prevent* health problems.

Health promotion is grounded in respect for human rights. It focuses on achieving equity in health by reducing differences in current health status and by ensuring equal opportunities and resources to enable all people to achieve their fullest health potential. Health promotion explicitly goes beyond traditional curative approaches or simple health education by adding five essential interrelated actions, as shown in Box 7.1.

**Box 7.1:** Essential Elements of Health Promotion

Building healthy public policy
Creating supportive environments
Strengthening community action
Developing personal skills
Reorienting health services
*Source: WHO, 1986.*

In 2005, the Sixth Global Conference on Health Promotion resolved to make health promotion "central to the global development agenda; a core responsibility for all of government; a key focus of communities and civil society; and a requirement for good corporate practice" (WHO, 2005a). The World Bank (2012), in addition, emphasizes a systems approach ("SABER": Systems Approach for Better Education Results), in which school health and school feeding are seen as part of a process which must identify how well a county's policies are oriented toward delivering learning for all children and youth.

When applied to nutrition, a health promotion approach aims at preventing nutritional disorders while at the same time creating nutritional well-being by developing conditions and settings that are conducive to sound nutritional health. It further seeks to involve people as partners in health and to help them develop the skills they need to make healthy choices. South Africa's National School Nutrition Programme (see Box 7.2) is one example of the application of health promotion in the area of nutrition.

Finally, it is important to recognize that nutritionists are becoming increasingly involved in the multidisciplinary management of children with developmental disabilities. The movement away from institutionalization, efforts to achieve full integration of children with developmental disorders into the school system, and a philosophy of inclusion or normalcy are among the factors that have contributed to this shift. Close collaboration with occupational therapists and social workers is essential to ensure that children with special needs receive the care, including the nutritional care, they deserve. This includes, in particular, advocating for funding on behalf of children who have special nutrition requirements or who need help in order to feed themselves (Rokusek et al., 2005).

## 4.2 Nutrition Education

### *4.2.1 Nutrition education within the school curriculum*

Lack of nutrition knowledge is one common reason for inappropriate food choices, with the result that nutrition education has traditionally focused on providing children with information. Increasingly, however, the objectives have broadened to address the values, attitudes, and patterns of behaviour that surround food and to develop skills relevant to nutrition.

Some argue that nutrition should be incorporated into the school curriculum as an independent subject. School curricula are, however, generally overcrowded, and it may be difficult to add another subject. Quite apart from nutrition-related learning as a stand-alone subject in the classroom, there are many other ways for children to learn about food and nutrition within the school context. These include:

- Cross-curricular "infusion" – that is, the incorporation of information about food and nutrition into existing school subjects, when the opportunity arises

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**Box 7.2:** The South African National School Nutrition Programme

The National School Nutrition Programme (NSNP) focuses on improving the health and active learning capacity of primary school learners in South Africa through school feeding. It aims to contribute to improving the quality of education and general health and nutritional status of children by reducing short-term hunger, improving school attendance, addressing micronutrient deficiencies, controlling parasite infestations, and improving nutritional knowledge and behaviour among primary school learners, their parents, and their teachers.

The following are the primary objectives:

- To feed learners at designated schools
- To enhance nutrition education through the curriculum
- To facilitate the establishment of sustainable food production initiatives in schools

An evaluation of the NSNP in 2008 concluded that "The NSNP is generally perceived to have contributed in addressing hunger and poverty among the learners and families and communities in which participating schools are located.

There has been an increase in the school attendance, concentration levels, and social and physical participation by learners in school related activities. The level of absenteeism by learners has dropped among the schools participating in the programme."

*Source: Public Service Commission, 2008.*

- Extra-curricular activities such as excursions to farms, factories, or markets, "school action" days that focus on nutrition and health, or cooking clubs
- School-feeding programmes and school canteens
- School gardening
- Small food shops and food vendors, both in and near the school
- School food policies
- Nutrition-related events and other forms of collaboration with families and the community.

Classroom lessons have an important role to play in reinforcing such initiatives and providing opportunities for discussion. At the same time, nutrition-related homework and projects that involve families and the community can powerfully extend the impact of nutrition education, without making significant inroads on a crowded school timetable.

A framework for nutrition education in the school curriculum is provided in Table 7.1. The framework includes eight broad topics, each with a number of main themes, which should serve as a basis for formulating learning outcomes. The first seven topics are recommended for both developed and developing countries, whereas the eighth, "hygiene and sanitation," is an additional topic of particular importance for developing countries. Tailoring the framework to local conditions and to the various age groups (from 4 to 16 years, grouped according to the school system) is essential. It is also critical that, from the outset, plans are made to include all topics and themes and cover all age groups and that sufficient time is allowed for each topic. Picking and choosing a few topics or skipping around in the progression from topic to topic will not be as effective.

A key feature of the framework is the emphasis, in each topic, on the learner's own responsibility – an empowerment dimension. Imparting knowledge is not enough; attitudinal and skill training are very much part of a holistic approach, enabling the child to take charge.

Research shows that behaviour change correlates positively with the amount of nutrition education received. As a general rule, a minimum of 50 hours per year of nutrition education appears to be required in order to effect positive attitudinal and behavioural change (Lytle & Achterberg, 1995). Apart from enough

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time, the school food environment, sufficient educational materials, appropriate educator training, and adequate funding are important elements for successful implementation of nutrition education in schools that will result in change of eating behaviour (Busch et al., 2013; Faber et al., 2013; Nguyen et al., 2013; Wang & Stewart, 2013).

**Table 7.1:** Framework for a nutrition, food, and eating curriculum

| Topic | Main themes for learning outcomes |
|---|---|
| 1. Food and emotional development | - Sensory awareness<br>- Food preferences<br>- Trying out new foods<br>- Feelings about eating and drinking<br>- Body image<br>- Self-esteem<br>- Social significance of food and eating<br>- Own responsibility |
| 2. Eating habits and socio-cultural influences | - Own eating habits and values<br>- Eating habits of others<br>- Factors influencing food choice (individual, psychological, environmental, and socio-cultural)<br>- Variation in food habits (food trends)<br>- Norms and etiquette for eating behaviour<br>- Own responsibility |
| 3. Nutrition and personal health | - Relationship between eating and health<br>- Growth and eating<br>- Eating and physical activity<br>- Nutrients and their functions<br>- Nutritional value of basic food groups<br>- Food-based dietary guidelines for healthy eating<br>- Energy/weight balance<br>- Food and diet-related problems (overweight, underweight, malnutrition, eating disorders, dental caries, cardiovascular disease, cancer, food allergies)<br>- Own responsibility |
| 4. Food production, processing, and distribution | - The food chain<br>- Production of plant and animal foods<br>- The food industry<br>- Factors influencing food production<br>- Food manufacturing and processing (novel foods, biotechnology, product design)<br>- Distribution of food in the world<br>- Politics of food<br>- Food policies<br>- Environmental implications<br>- Own responsibility |

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| | |
|---|---|
| 5. Consumer aspects of foods | - Food quality<br>- Shopping and buying<br>- The interests of the buyer and seller<br>- Handling a budget<br>- The influence of advertising and marketing<br>- The function of packaging<br>- Food labels<br>- Supply in food shops, markets, and supermarkets<br>- Environmental implications of consumption patterns<br>- Own responsibility |
| 6. Food preservation and storage | - Lifecycle of foods<br>- Food storage<br>- Hygiene<br>- Food poisoning<br>- Food preservation (including additives, irradiation)<br>- Food legislation<br>- Own responsibility |
| 7. Food preparation | - Food and personal hygiene<br>- Cooking techniques (including safe handling of food)<br>- Planning the process<br>- Serving food<br>- Eating as a social event or celebration<br>- Own responsibility |
| 8. Hygiene and sanitation | - Water<br>- Personal hygiene<br>- Food safety<br>- Waste disposal<br>- Diarrhoea<br>- Own responsibility |

*Sources: Dixey et al., 1999; FAO, 2005a.*

### *4.2.2 Moving beyond the classroom*

Internationally, there is a move away from traditional, top-down pedagogical approaches, in which teachers dispense factual information to pupils. The preferred approach, more and more, is interactive, discussion-oriented methods in which learners play an active role. Collective action, in the form of group work and collaborative problem solving, encourages children to explore the cultural, social, political, and economic aspects of food choices (Florencio, 2001). Involving children as partners in spreading the nutrition message to other children, their families, and their communities allows them to become the teachers and fosters a sense of partnership, as well as an awareness of social and economic issues.

Experiential learning, in which nutrition education is linked with practical food- and nutrition-related activities carried out in the school environment, can demonstrably increase young people's knowledge of nutrition and improve their dietary habits. Children generally respond well to "learning by doing." A school garden, for example, can encourage fruit and vegetable intake, as well as providing opportunities to teach children about environmental issues and agricultural techniques (McAleese & Rankin, 2007; Parmer et al., 2009).

Recognizing that the classroom is not the only situation in which children learn about food and nutrition, the FAO has developed the concept of the extended curriculum. The concept rests on a tripartite approach that integrates three areas in which learning occurs: the classroom curriculum, the broader school environment, and the family and community. With regard to nutrition, the FAO notes:

> In no other school subject is there such a constant flow of learning from other sources. School nutrition education must therefore work with and through the other contexts in which nutrition is being learned. This means that schools

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> will need to enter into dialogue with families, collaborate with them, and accept that their own role is to explore and find out, as much as it is to teach and instruct. It will be important to make positive links with families and with other sectors, organizations and individuals concerned with food and nutrition in the community. (FAO 2005a, vol. 1, p. 8)

Instructing children about nutrition is important, but unless what they learn in the classroom is both applied to and reinforced by the surrounding physical and social environment, this learning is apt to have little lasting impact. Initial results from a nutrition and health education programme for primary schools in Zambia suggest, for example, that, even in the absence of school-based nutrition and health services, significant gains in awareness and knowledge, as well as behavioural change, can be achieved among children and their families by means of an actively implemented classroom curriculum backed by teacher training and parent involvement (Sherman & Muehlhoff, 2007).

Classroom learning is embedded the broader school environment, which refers not only to the school's physical surroundings but also to its staff – basically, to everything that exists and occurs outside the classroom proper. The school environment includes:

- Places for eating and the people who keep them clean
- School meals and the people who prepare and serve them
- Snacks and those who provide them
- The playground and those who look after it
- School clubs and staff members who organize and run them
- The school's water supply and those responsible for maintaining it
- The school garden (if one exists)
- The school's stated policies on all of the abovepolicy (FAO, 2002a, p. 73)

As the FAO (2002a, pp. 73–74) explains, actions designed to improve the school environment can include "developing and promoting a school philosophy and policy on nutrition education; obtaining training for staff; creating healthy surroundings; improving the quality of food eaten in school; organizing whole-school activities; involving school staff; [and] above all, *raising awarenes*s of what it means to have a healthy environment. This is part of the concept of the 'health promoting school' – or, in this case, the 'nutrition-promoting school.'" Activities in which all staff and children participate help to increase internal cohesion, while articulating the school's policy on nutrition makes it easier for both children and staff to spread the message.

At the same time, the FAO's tripartite approach acknowledges that, to be effective, nutrition education must extend beyond the immediate school environment to families and the surrounding community. Families are already involved in nutrition "education," if only through the foods they eat together. The school can involve them further by, for example:

- Inviting families to information sessions or "open house" days at the school
- Involving them in school trips
- Encouraging them to take an active interest in their children's homework
- Discussing their ideas about diet and healthy eating
- Consulting with them about food cultivation, preservation, and preparation

Such dialogue and collaboration serve to engage parents' interest and create a sense of common purpose. The chances that schools can make an impact on children are greatly increased if schools have the support of children's families.

Beyond the family, nutrition education should be a community effort. Links can be established with public service agencies and local government, with private companies and organizations, and with churches, as well with food producers and retailers, bars and eating places, the local media, clinics, and youth clubs. Activities involving the community could include inviting speakers to visit schools, planning food shopping, making a trip to a local farm or factory, asking children to study advertisements, making posters as homework assignments, or reporting on the food consumed at a festival. Such activities will allow children to become

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familiar with local foods and food practices.

Because eating is a social phenomenon, it needs to be understood in its social context – the situations in which food is eaten, for what reasons, and in whose company. In addition, meals and the foods associated with them are linked to values that are communicated and thus reinforced by the entire community. Children must also learn to cope with peer pressure, which is often closely tied to advertising and food packaging. The community is therefore a major source of messages about food, including its relationship both to physical health and to social cohesion. Children may benefit simply by seeing that members of the community share a school's concern with healthy eating.

## 4.3 The Provision of Food in Schools

### *4.3.1 General objectives*

Various approaches to school-based feeding programmes are in use around the world. Three basic rationales for such programmes exist, which have much overlap: one focuses on the nutritional status of the child and its implications, one on nutritional problems, and one on the children's potential for scholastic achievement (Florencio, 2001). Within each rationale, a staggered subset of objectives can be identified, as illustrated in Figure 7.2.

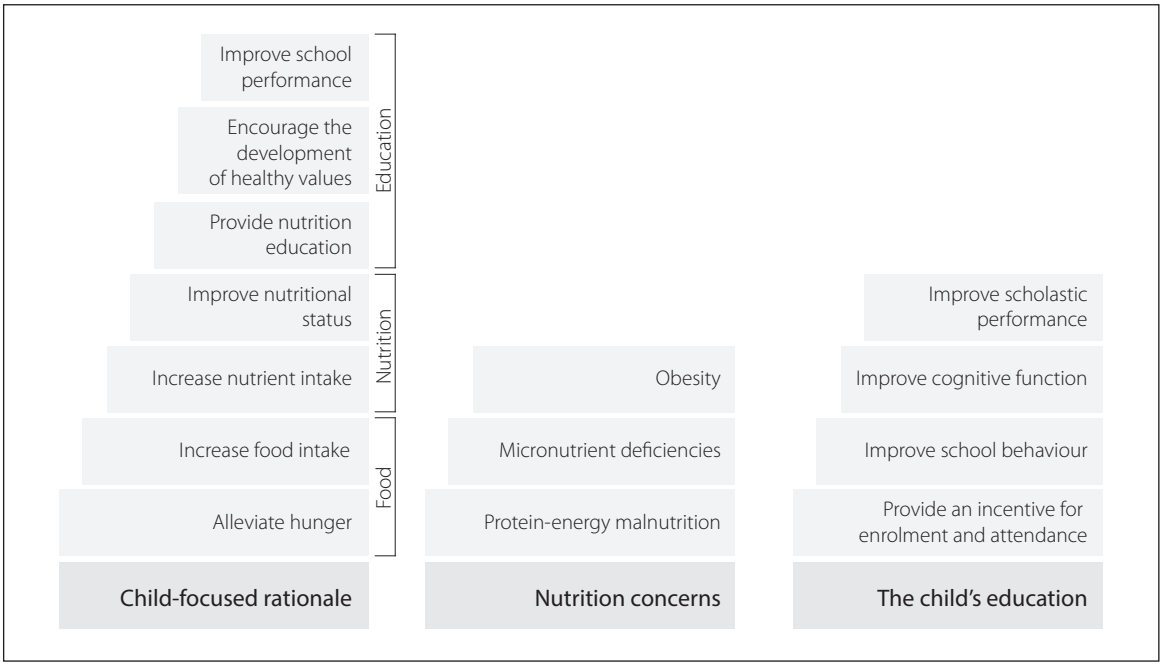


**Figure 7.2:** Three fundamental rationales for school-feeding programmes.
*Source: Florencio, 2001.*

The implementation of school-feeding programmes depends primarily on the objectives chosen, but it also depends on other factors, such as constraints on the resources available, the local or national legislative framework, and the specific circumstances in which the programme will operate. Certain decisions will need to be made, such as whether to provide full meals (breakfast and/or lunch) or simply snacks, whether to offer the food free of charge or to require payment, whether to make the food available to every child or to set eligibility criteria, whether to involve teachers, parents, or other community members (and if they are involved, on what basis), whether to link the feeding programme to school food shops, and whether to provide food during school holidays. Such questions should be thought through carefully before the programme is implemented.

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### *4.3.2 Addressing micronutrient deficiencies*

Interventions aimed at improving the micronutrient status of children can have a positive impact not only on their growth and health but on their degree of educational achievement and their productivity as adults (Micronutrient Initiative & UNICEF, 2003). Numerous interventions that rely on fortified foods have been tested using school-based feeding programmes as a vehicle. A review of South Africa's school-feeding programme, for instance, which examined the use of micronutrient-fortified biscuits, bread spreads, and soup, concluded that such programmes can contribute significantly towards reducing "hidden hunger" – that is, micronutrient deficiencies (van Stuijvenberg, 2005).

Foods that are naturally rich in nutrients are, of course, another option. For example, orange-fleshed sweet potato – a staple food in many developing countires – is rich in beta-carotene. When given as part of school meals, it was well accepted by primary school children and improved their vitamin A status (van Jaarsveld et al., 2005). Interventions designed to address micronutrient deficiencies can also include the supplementation of a child's diet with milk and other dairy products. Evidence indicates, for example, that the addition of cow's milk to the diet of stunted children improves their linear growth, which leads in turn to a decline in morbidity (Hoppe et al., 2006). Similarly, a meta-analysis of findings from severalstudies suggests that, in children whose baseline intake of dietary calcium is low, an increased intake of diary products and dietary calcium significantly increases their bone-mineral content (Huncharek et al., 2008). More robust growth may also be associated with the consumption of meat. A two-year intervention study in Kenya revealed that the growth of school-age children improved when they consumed a diet that provided generous amounts of energy and nutrients from animal-source foods (meat and milk), as distinct from plant foods (Grillenberger et al., 2006).

Jomaa et al. (2011) reviewed the impact of school-based feeding programmes in developing countries and noted a relatively consistent positive effect on energy intake and micronutrient status, as well as on school enrolment and attendance. However, the question remains how such dietary changes can be sustained. In one study, carried out in rural South Africa, primary school children were given biscuits fortified with beta-carotene, iron, and iodine. During the first year of the intervention, a significant improvement was seen in a number of variables, including serum retinol, iron status, and urinary iodine. Then the summer holidays intervened. When school started up again, all variables except urinary iodine had returned to their previous levels. This pattern was repeated, with children showing a gradual deterioration in iron status (van Stuijvenberg et al., 2001). Such findings suggest one answer to the question of whether school-based feeding programmes should continue during holidays. But they also underscore the importance of extending nutrition education beyond the school setting in an effort to achieve broad-based change that is sustained.

### *4.3.3 School gardens*

Gardens offer a key means of improving nutrition. In a set of studies conducted in a rural South African village, home gardens planted with yellow and dark green, leafy vegetables were linked to significant improvements in the vitamin A status of preschool children (Faber, Venter & Benadé, 2002, Faber at al., 2002). There was also a higher intake of several other vitamins. Setting up and maintaining a school garden can likewise play an important role in improving children's nutrition. Beyond that, however, school gardens serve to enhance children's education. As an FAO report observes:

School gardens, both urban and rural, can have several interrelated objectives, including:

- increasing the relevance and quality of education for rural and urban children through active learning and through introduction of agriculture and nutrition knowledge and skills, including life skills, into the curriculum;
- providing school children with practical experience in food production and natural resource management, which serve as a source of innovation they can take home to their families and apply in their own household gardens and farms;
- improving school children's nutrition by supplementing school feeding programmes with a variety of fresh micronutrient and protein-rich products, and increasing children's knowledge of nutrition, to the benefit of the whole family. (FAO, 2004, p. 1)

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School gardens offer a multisensory learning environment that children naturally find engaging. Planting and caring for a school garden can teach children about sustainable methods of food production, about the use of collected rainwater for irrigation, and about environmental issues such as erosion. In addition to encouraging the consumption of nutrient-rich fruits and vegetables, school gardens improve food diversity and, especially in food-insecure communities, provide children with practical skills that can help their families survive in times of food shortage (FAO, 2004). And, of course, they also afford an opportunity for children to get outdoors and engage in physical activity, which can be especially valuable in urban settings.

In addition to horticultural production, raising small animals, such as chickens and rabbits, can be considered a part of sustainable food production in a school context. Small livestock development at the community level, accompanied by appropriate education, is probably the most appropriate way of promoting animal source foods for improving diet quality in developing countries (Neumann et al., 2002). However, both animals and food gardens require maintenance. Thus, if a school is planning to set up a garden, it needs to spell out who will be responsible for the various tasks involved in taking care of it (and the same applies, of course, to raising animals). In addition, thought will need to be given to what will be done with the food produced – whether, for example, it will belong to the school and be incorporated into school meals or whether the school will have the option of distributing it to those most in need of it.

Above all, though, the focus must remain on education. As the FAO (2010, p. 15) notes, "Gardens are particularly able to link abstract and concrete concepts, theory and practice, verbal and visual learning, reflection and action, behaviour and attitude, bringing learning to life and making it memorable." To realize the educational potential of gardens, however, a clear link must be established between the garden and the classroom by integrating garden activities into the curriculum. This is the key to to ensuring that children derive benefits from these practical activities.

### *4.3.4 Promoting healthy school meals and creating dietary change*

Even if material resources are limited, schools can create an environment that encourages healthy eating and lifestyles. Crucial to achieving this goal is the willingness to implement policies that require foods sold and consumed at the school to be consistent with government-mandated dietary guidelines. Schools can, for example, institute programmes that promote the consumption of fruits and vegetables (De Sa & Lock, 2007; Knai et al., 2006). They can also restrict the sale of soft drinks and foods high in fat and sugar on school premises (Budd & Volpe, 2006). Although schools have no direct control over many of the factors that determine a child's diet and lifestyle, such as a family's economic status or the messages conveyed by advertising, they are in a position to exert a countervailing influence that may carry over into the child's adult years.

All nutrition interventions, whether carried out in schools or elsewhere, should emphasize balance, variety, and moderation in food intake, three principles that are also fundamental to most national dietary guidelines. They should also support the objectives of nutrition education.

School initiatives that promote fruit and vegetable consumption appear to have their greatest impact if they integrate several components. One is government support, in the form of the free or subsidized provision of fruits and vegetables to schools. Even in the absence of such support, access can be increased by the promotion of fruits and vegetables in the school canteen, by classroom food tasting or food preparation lessons, and by school gardens. Another important component is nutrition education, which is generally built into the standard curriculum and may involve special training of teachers and peer leaders, who can also serve as role models. In addition, active participation on the part of parents, both at home and at school, helps to reinforce the messages that the school is trying to deliver (De Sa & Lock, 2007). Not surprisingly, although such initiatives can have a short-term impact after as little as one year, the longer they are sustained, the more likely they are to make a lasting difference to dietary habits.

Another promising approach was tested in a pilot intervention carried out over a period of six months in three government primary schools in New Delhi, India, using the government's established Mid-Day Meal (MDM) programme, which provides a free hot lunch to primary school children, as an entry point. The intervention involved the introduction of low-cost seasonal vegetables into the midday meals, in an effort to diversify children's diets as well as to address low intake of vitamin A. In addition, the intervention sought to

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show teachers how to use the MDM programme to educate children about the importance of a balanced meal (one that includes vegetables) and to illustrate how low- and middle-income families can integrate vegetables into their daily meals at an affordable cost. Children also received intensive nutrition education for a period of one week (Muehlhoff et al., 2011).

The scope of the intervention was fairly modest. It did not seek, for example, to assess whether the vegetable-enriched MDM resulted in a net increase in children's consumption of vegetables, nor did it attempt to argue that a short-term infusion of nutrition knowledge could have a lasting impact on food preferences or eating behaviour. However, it demonstrated that incorporating seasonal vegetables into school lunches is a feasible idea that could be sustained at relatively low cost. The conclusion was that, if the intervention were scaled up, it could become a significant tool for improving children's nutritional status and promoting vegetable consumption.

## 4.4 Programme Evaluation

Like other programmes that seek to effect change, nutrition programmes, regardless of their specific objectives, require the investment of time, money, and human effort. They therefore demand evaluation in an effort to determine how effective they are – that is, to what extent they are meeting their objectives – and how they might be improved. This is all the more true of programmes that rely on government funding and other forms of external support. The evaluation of community nutrition programmes is the topic of Chapter 18, and we refer readers to that chapter for a detailed discussion of goals and methods.

Although programme evaluation can be relatively informal, based simply on observation and general impressions, it is more often quite elaborate, often employing both qualitative and quantitative research methods. Evaluations generally focus on three broad categories: inputs, outputs, and oucomes. Inputs are the resources, both material and human, that were invested in the programme; outputs refer to the specific uses that were made of these resources – what the interventions were and at whom they were directed. As distinct from outputs, outcomes are a broader category: a programme's outcomes are its overall results or impact, both short-term and long-term. In other words, outcomes are a measure of change.

It is impossible to list all the possible indicators of change, but assessments very often focus on variables such as:

- The availability of food and the relative ease of access to that food
- The quality and quantity of food and nutrient intake
- Growth rates and the prevalence of stunting, underweight, and overweight or obesity in a population
- The prevalence of specific dietary deficiencies and diseases
- Overall nutritional status
- Motor development, cognitive function (including IQ), and the ability to concentrate
- Levels of school enrolment and consistency of attendance, as well as retention rates (that is, the likelihood that children will remain in school)
- School performance and degree of academic achievement
- Level of nutrition knowledge

Such indicators have the advantage of quantifiability, which makes them attractive both to scientists (who are trained in quantitative methods) and to funding agencies (who tend to be convinced by statistics). In addition, programmes are frequently evaluated purely in terms of cost: cost per beneficiary, cost per unit of a given nutrient, and overall cost-effectiveness (Galloway et al., 2009).

Especially in the case of nutrition programmes that aim to bring about lasting change, however, the critical outcomes are often less easily quantified. These may include:

- Changes in dietary behaviour: what foods are eaten, when and with whom, and for what reason
- The influence of indigenous cultural traditions on food behaviour and the impact of global influences
- Shifts in personal attitudes toward food

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- The impact of nutrition education on children and on their families and local community
- The development of health-related values
- Commitment to lifestyle changes
- The contribution of a programme to social protection – that is, to the reduction of the effects of poverty and the level of vulnerability within a specific population.

Such changes, which involve shifts in attitudes and behaviour, are less easily assessed, in part because they develop over the long term, whereas programme evaluation often seeks to demonstrate short-term effects, not the least because continued funding for programmes often hinges on evidence of relatively quick success. How best to measure the long-term impact of nutrition programmes is thus an issue that warrants careful consideration by nutritionists concerned with health promotion and with sustained improvements in the health status of both the children and the adults who live in developing countries.

Programme evaluation can be broader than the areas mentioned above. Other aspects that can be usefully evaluated include:

- Gender-related issues (is the programme achieving aims that have a specific focus on girls and women?)
- Economic evaluation (is the programme cost-effective, e.g., by delivering improved nutrition to each member of the target group at an acceptably modest cost?)
- Agricultural evaluation (is the programme improving the local agriculture?).

## DISCUSSION QUESTIONS AND ASSIGNMENTS

1. Look at the nutrition curriculum presented in Table 7.1 and select a theme from one of the eight main topics. Next, decide on a target group. Specify the country in which the school is located and whether it is urban or rural; the class size, the age range of the students, their grade level, and their general economic status; and the facilities available (space, equipment, classroom materials). Then design a nutrition education lesson for these students. Describe the content to be covered, the teaching methods to be used, the desired learning outcomes, and how you will evaluate the effectiveness of the lesson.
2. Visit a local primary school and, if possible, make arrangements to conduct an anthropometric screening either of the entire school (if it is relatively small) or of the children at a specific grade level. Prepare a report for the school in which you describe and evaluate your findings and make whatever recommendations seem appropriate. (Note: This assignment is optional, as it depends on the cooperation of the school.)
3. You work in an urban area in which a high proportion of primary school children suffer from vitamin A deficiency. Local schools have expressed their concern about this problem. Plan a school-based health promotion campaign that aims to increase children's consumption of yellow and dark green, leafy vegetables. Consider how this campaign would extend beyond the classroom to the school environment and how it might involve families and the surrounding community.
4. A local school-feeding programme supplies a mid-morning snack and a hot lunch to primary school students. Plan a week's worth of menus. Explain the criteria that you used in planning these menus and evaluate the cost per student per week.
5. Visit three different schools in the region in which you live, including one in a relatively affluent area and one in a low-income area. Assess the nutritional quality of the food served at meals, as well as the snacks sold in school shops and vending machines, with a view to determining how closely the food available at the school aligns with your government's recommended dietary guidelines and/or stated policies on nutrition. Analyse the information you collect and provide realistic recommendations to the schools on possible improvements.

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## ADDITIONAL RESOURCES

European Network of Health Promoting Schools: http://www.euro.who.int/ENHPS

FAO: www.fa5o.org

Nutrition Education and Consumer Awarenes: www.fao.org/ag/agn/nutrition/education_en.stm

Right to Food: www.fao.org/righttofood/index_en.htm

Ottawa Charter for Health Promotion: http://www.who.int/healthpromotion/conferences/previous/ottawa/en/

School Gardens: www.fao.org/schoolgarden/

School Health and Nutrition: www.schoolsandhealth.org/

SCN News–UN Standing Committee on Nutrition: www.unsystem.org/SCN/

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UNESCO: www.unesco.org
WHO: www.who.int

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# CHAPTER 8

# NUTRIENT REQUIREMENTS AND FACTORS AFFECTING NUTRITIONAL STATUS IN OLDER ADULTS

*Karen E. Charlton, Monica Ferreira, and Jean M. Fourie*

## *Outline*

- Population ageing in the developing world
- Nutritional status of older persons
- Age-related changes in body composition and digestive functions
- Risk factors for malnutrition among the elderly
- Assessment of nutritional status in older populations
- Common nutrition-related problems and possible interventions
- Nutrition services and programmes for older persons

## *Objectives*

At the completion of this chapter you should be able to:

- Understand the impact of population ageing in developing countries
- Describe the Madrid Plan
- Explain the relationship between pension income and food security
- Identify which older persons are most vulnerable to food insecurity
- Understand how HIV and AIDS affect older persons
- Describe the physiological changes that accompany ageing and their influence on nutrient requirements
- Know how to assess nutritional risk in older people through anthropometry, biochemical analysis, clinical examination, and an evaluation of diet
- Describe the screening tools most commonly used to assess health and nutritional status
- Describe the most common nutrition-related problems in older people and how to treat them
- Discuss government and non-governmental nutrition programmes for older persons in developing countries


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# 1. INTRODUCTION

## 1.1 Population Ageing in Developing Countries

Population ageing is a global phenomenon, manifested in the growing proportion of people aged 60 or over. The two key drivers of this trend are a decrease in mortality over the lifespan (such that a larger number of people survive to reach old age) and reductions in fertility (which lead to a smaller proportion of the population in the younger age group and therefore a higher proportion in older groups). According to the Population Division of the UN Department of Social and Economic Affairs (UN, 2009), as of 2009 the older population was estimated to stand at 737 million people worldwide, roughly two-thirds of whom were living in developing countries. More than half (54%) lived in Asia, as opposed to 21% in Europe. The ageing of the population is more visible in developed regions: in 2009, one out of five people in Europe was at least 60 years old, versus one out of ten in Asia and Latin America and only one of nineteen in Africa. However, the trend is advancing more rapidly in developing regions – regions that have far fewer resources than their more developed counterparts with which to meet the challenges of an expanded older population.

In 2009, people aged 60 or over constituted 8% of the population in the world's less developed regions and 5% in the least developed areas; by 2050, these figures were projected to rise to 20% and 11%, respectively. (See UN [2009], which also provides a breakdown by both region and country.) Compounding the trend toward ageing is the fact that the older population is itself growing older. Globally, the number of people who are at least 80 years old is increasing at a faster rate than any other population segment. Within the older population (people aged 60 or more), the proportion of people who have reached the age of 80 is highest in developed countries: in 2009, it was 20%, versus 11% in less developed areas (UN, 2009). However, in hard numbers, most of the world's "oldest old" live in developing countries.

In developed regions, life expectancy at birth stood at 77 years in 2005–2010, a figure projected to rise to 83 years by 2045–2050. In developing regions, the corresponding figures are 66 years (2005–2010) and 74 years (2045–2050). An exception to this upward trend is predicted to occur in certain sub-Saharan African countries, where life expectancy at birth has been falling rather than increasing, mainly because of AIDS-related deaths but also because of poor access to health care and exceptionally low standards of living. As a result, life expectancy at birth is far lower in sub-Saharan Africa than in other regions. As of 2005, in twenty-eight of these countries the life expectancy was less than 50 years, while in eight other countries, all in southern Africa, it was less than 40 years, reaching a low of a mere 33.2 years in Swaziland (Velkoff & Kowal, 2006). At the same time, individuals who manage to survive to age 60 and are not infected with HIV are expected to enjoy an increase in longevity.

Although the definition of "older persons" varies globally, "older" is typically defined in terms of chronological age and currently uses a lower cut-off of 60 years. Quantitative definitions may not be entirely practical or appropriate in many developing countries, however. Especially in rural areas of these countries, a person's chronological age may be unknown, and old age may instead be defined in relation to an individual's functioning, physical appearance, and changing social roles (Kinsella & Phillips, 2005; HelpAge International, 2002).

## 1.2 Consequences of Population Ageing

The social and economic impact of population ageing is considerable. Older people tend to be relatively non-productive, in economic terms, and are often dependent on the resources of others, with the result that population ageing tends to retard economic growth.A high proportion of older people in the population decreases the funds held in savings and investments, while increasing the need for the provision of old-age pensions. Moreover, older people generally pay lower taxes, and the longer they live, the less money they have available to pass to their heirs. The ageing of the population also produces changes in household configurations and living arrangements and a growth in the demand for housing and social services. It is reflected as well in greater health care costs and in the social and economic burden of chronic disease.

In general, women live longer than men. Older people who are without a spouse may have a heightened vulnerability to poverty, particularly if they are childless or if their adult children are unable (or unwilling) to provide them with some measure of support. However, men tend to marry younger women, who then outlive

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them, and when men are widowed or divorced, they are more apt to remarry. Older men are thus more likely than older women to be married and hence to enjoy spousal support. In contrast, older women – whether they never married or are widowed or divorced – are more likely to live alone, especially in developed countries, where the nuclear family pattern prevails.

Traditionally, older persons in developing countries were supported and cared for within an extended family system. However, family structures are changing, driven by demographic, social, and economic trends. One key factor is the rural-to-urban migration of younger people in search of employment. Another is the impact of HIV/AIDS – both the disease itself and the associated mortality – on household structures, particularly in southern Africa, where the pandemic is most virulent (see section 1.5 below). Although, for the most part, older people in developing countries still live with family members in a multigenerational household, the capacity of families to care for older relatives is diminishing. Instead, there is a growing prevalence of skipped-generation households, in which grandparents are left to look after a son or daughter's children.

Relatively few older people in developing countries live in residential care facilities. Indeed, few such facilities exist, and, for cultural reasons, older persons prefer to reside with family (UN, 2005). Where available, such facilities are largely reserved for frail individuals and for those who are indigent, lack shelter, and/or need medical care. At least in some countries, a relatively small number of older persons – people who are still active and do not need care but foresee this need in the future – may choose to reside in an assisted living facility. These facilities offer them independence, including the option of cooking for themselves, and access to care when needed.

## 1.3 Policy Approaches to Ageing

Policy approaches to ageing in developing countries, to the extent that these exist, have typically adopted the "welfarist" orientation familiar from Western countries, in which older persons are assumed to be weak, non-productive, resource dependent, and in need of care and support. At the same time, governments in developing nations have tended to view the care and support of older persons as the responsibility of adult children, and few provide services to the older population.

A strong human rights movement now underway is seeking to reaffirm older persons' rights, as originally formulated in the *United Nations Principles for Older Persons* (UN, 1991; see also UN Working Group, 2011). These principles outline older persons' rights to independence, participation, care, self-fulfilment, and dignity. The first principle, which appears under the heading "Independence," lays out a fundamental condition: "Older persons should have access to adequate food, water, shelter, clothing and health care through the provision of income, family and community support and self-help."

New images of older persons are envisioned in the UN's *Madrid International Plan of Action on Ageing* (UN, 2002), adopted in 2002 at the Second World Assembly on Ageing. Informed by a human rights framework, the Madrid Plan proposes that strategies developed to address the issue of ageing be linked to other frameworks for social and economic development and to human rights. Indeed, the plan supports broad economic goals of poverty reduction and the promotion of social development and human rights. To this end, it recognizes the multiple roles that older persons play and the numerous contributions they make to family, community, and society. Recognition of older persons' rights, the plan argues, can help societies to enhance these individuals' agency and to foster their achievement of a secure and dignified old age.

In developing regions in particular, the UN therefore contends that older persons should be viewed as contributors to and beneficiaries of development and that their rights should be respected accordingly. Such an approach both encourages and facilitates older persons' inclusion and active participation in social, economic, and political life. The Madrid Plan calls specifically for attention to be paid to nutritional deficiencies and associated diseases in the design and implementation of health promotion and prevention programmes for older persons. In addition, it proposes the adoption of an intergenerational approach in policy-making.

Older people in developing countries are mostly poor. Some developing countries, notably Brazil and South Africa, provide a non-contributory social pension to eligible individuals, based on age and a means test of income and assets. These pension programmes have been shown to empower beneficiaries and to contribute to social development more broadly. In black African multigenerational households in South Africa,

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pension beneficiaries, women in particular, commonly share pension income with family members or pool the income with other household income (Møller & Ferreira, 2003). An older person's pension income can be put toward general household spending, as well as grandchildren's schooling, and is often used to sustain entire households. Indeed, when breadwinners are unemployed, dispersed family members may regroup around a pension beneficiary and so benefit nutritionally from expenditure of the income on foodstuffs (Barrientos, 2010; Case & Deaton, 1998). Pensions as a form of social assistance can thus improve food security by providing a vital safety net for vulnerable households, although a pension income is not necessarily enough to provide a household with adequate insurance against food poverty.

## 1.4 Effects of HIV/AIDS

The epicentre of the HIV/AIDS pandemic continues to lie in sub-Saharan Africa. Despite a decline in the annual rate of new infections since 2001, the region was responsible for 70% of all new cases in 2012 – while, in northern Africa, the incidence of new infections was on the rise. The disease remains prevalent in large parts of Asia, with the number of new cases increasing in Central Asia, as well as in the Middle East (UNAIDS, 2013, p. 12). In developing countries, the high prevalance of HIV/AIDS has destructive consequences for life expectancy, economic growth, social cohesion, and human dignity, while also imposing a huge social and economic burden.

Older persons are affected by the disease in particular ways. Often they become primary caregivers to adult children with AIDS, as well as to grandchildren made vulnerable or orphaned by the disease (Kinsella & Phillips, 2005). In South Africa, more than 60% of so-called AIDS orphans are estimated to live with their grandparents (Monasch & Boerma, 2004). These caregivers, typically grandmothers, face a range of material, health, and emotional problems in coping and caring for orphaned and vulnerable children (Schatz & Ogunmefun, 2007). Research in Thailand and Cambodia has shown that a large proportion of adults who succumb to AIDS live with or near their parents during the terminal stages of the illness (Knodel, 2006).

More recently, attention is being given to the increasing prevalence rate of HIV/AIDS in older persons (Albone, 2011). Such persons may have been infected with the HIV virus a decade earlier and then develop AIDS when they are in their sixties or even older. In African societies, women are often unable to negotiate safe sex for cultural reasons, and they become infected if their husband has sex with an HIV-positive woman. HIV infection is not routinely suspected or diagnosed in older persons in developing countries, and those who are diagnosed with the virus may not be offered therapeutic intervention because of their age. Older persons with AIDS are a particularly vulnerable group and may lack care and support if their children have already succumbed to the disease. The role of good nutrition in improving the health of patients with HIV/AIDS, as evidenced in a strengthening of the immune response (as indicated by an increased CD4 count), less wasting, and fewer infections, is well documented (Weiser et al., 2011) and is further discussed in Chapter 10.

## 1.5 Food Security in Developing Countries

As is well known, people in developing countries are at high risk of food poverty. Young children, in particular, may be at risk of malnutrition, but older women in the same household may be equally vulnerable, as they tend to prioritize young children's access to food before their own nutritional needs. In agrarian settings, food security may be threatened by ecological factors such as drought, floods, and pestilence, which contribute to a decline in agricultural output and thus threaten livelihoods and basic subsistence. Rural-to-urban migration of able-bodied family members may also diminish agricultural capacity and worsen food insecurity.

.The age of the head of the household appears to be another important factor in determining whether families are food secure. In South Africa in 1995, half of households headed by a person aged 60 or over were found to experience food poverty, compared to 40% of households headed by a younger adult (Charlton & Rose, 2001). The highest rates of food poverty are seen in black African households headed by an older person (Figure 8.1); not surprisingly, the larger the household, the higher the risk of food poverty. Duflo (2003) found that, in South Africa, the association between pension income and improved child nutrition was influenced by the gender of the beneficiary: in contrast women, a man receiving pension benefits had little effect on the health status of children in the household.

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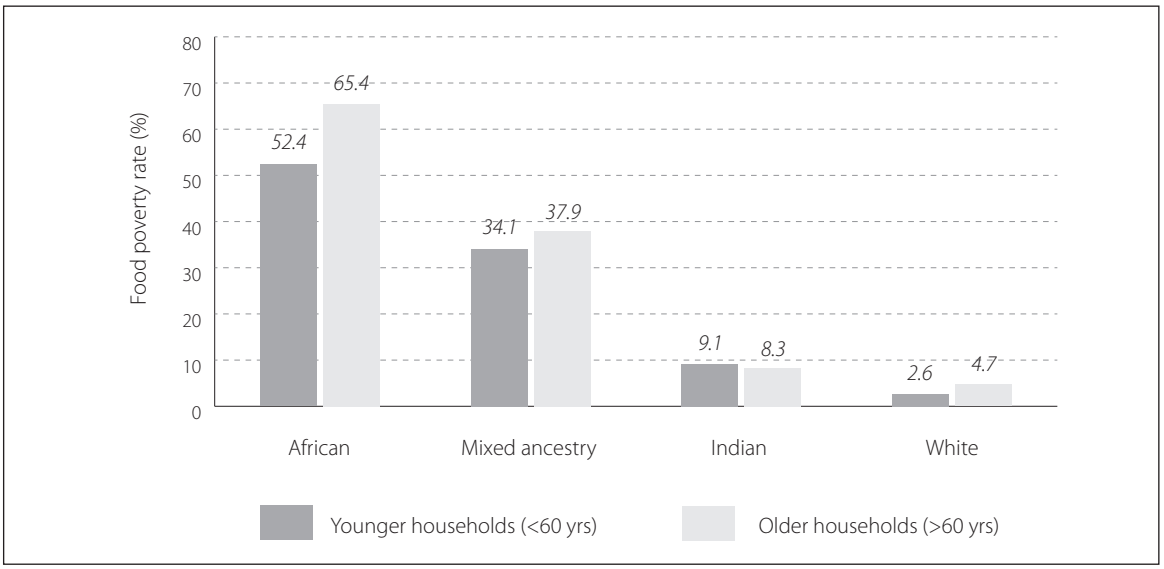


**Figure 8.1:** Prevalence of food poverty in South African households (N = 28,704).
*Source: Charlton & Rose, 2001.*

# 2. HEALTH AND NUTRITIONAL STATUS OF OLDER PERSONS

## 2.1 Malnutrition Among the Elderly

In any country, older persons typically place the heaviest demand on health care services. The growing incidence of chronic diseases in older persons contributes to morbidity and thus to the burden of care. A growing consensus is that the nutritional status of an older person is a major determinant of both physical and cognitive functioning, as well as overall quality of life. Moreover, nutrition is closely involved in both the aetiology and management of various chronic ailments, such as cardiovascular disease and certain cancers.

Malnutrition is common in community-dwelling older persons (that is, those who reside in the community rather than in institutions). Even among the healthiest individuals, the prevalence of malnutrition is about 10%, and it can be as high as 50% among older people who are very frail. Nutritional deficiencies in older persons have serious negative consequences, such as impaired immune function, poor wound healing, and loss of muscle mass, strength, and function. Such outcomes result in an increased risk of infections, falls, and fractures, and ultimately an increase in morbidity and mortality in frail elderly people.

Appropriate screening and intervention have been shown to result in remarkably improved outcomes. A moderate exercise programme, together with adequate dietary intake, can, for example, improve muscle strength and mobility (Fiatorone et al., 1994). Studies conducted among frail and undernourished elderly patients in hospital demonstrated that protein and energy supplementation not only increased weight, muscle bulk, and muscle strength but also improved function and independence, reduced mortality, and allowed a greater number of patients to return home (Milne et al., 2006a, 2006b; Potter et al., 2001). Effective management of malnutrition in older persons can also reduce health care costs. In one study, aggressive nutritional support of malnourished, hospitalized, older surgery patients resulted in a 15% to 30% reduction in rehabilitation time and a 40% reduction in the duration of hospitalization (Delmi et al., 1990).

## 2.2 The Impact of the Nutrition Transition

The ageing process is accompanied by a variety of physiological, psychological, economic, and social changes that may adversely affect nutritional status. Older people have a higher prevalence of chronic diseases, may take multiple medications and supplements, and tend to have a sedentary lifestyle. They also tend to consume less food, through some combination of natural changes in appetite, illness and other physical problems, depression, and inadequate income. Despite lowered energy intakes, however, they may also be obese.

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Let is now look at this in more detail. The relative ratios of protein, fat, and carbohydrate to total energy intake provide an indication of a population's position in the nutrition transition. Urbanization and improved socio-economic status very often lead to a shift towards the so-called Western diet: foods rich in carbohydrates and dietary fibre are replaced by foods that contain a higher proportion of fat (especially saturated fats) and refined sugar (Popkin, 1998). This shift in diet contributes to an increased risk of obesity and other chronic conditions (such as diabetes and cardiovascular disease) as people grow older. Thus, an older person may not be consuming a high-energy diet but may still be overweight. Moreover, low-energy diets tend to be inadequate in most micronutrients. When energy intake falls below about 1500 kcal/day, it is difficult to meet basic requirements for vitamins and minerals. Adding to the problem many of the foods commonly eaten as a result of the nutrition transition have a low micronutrient density (nutrient intake per unit of energy). What this snapshot reveals is that older people in developing countries often have both undernutrition (due to a low energy intake combined with a diet dominated by foods with a low micronutrient density) as well as obesity.

The micronutrient density of the diet may provide a more valid indicator of the adequacy of dietary intake than absolute intakes in older persons and can allow for comparison between groups with different energy intakes. This is because micronutrient density is an indication of food quality. A relatively high energy intake may merely mean that people are eating a diet with a large content of nutrient-depleted foods. However, in samples of diets where overall energy intake is low, the use of micronutrient density values may well provide a favourable picture but one that is misleading.

Sugar is an aspect of the diet that is of particular concern, a topic discussed in more detail in Chapter 13. As we have seen, the nutrition transition is characterized in part by an increased intake of foods high in sugar. Because sugar is an inexpensive source of energy, however, it is often consumed in relatively large amounts in poor communities. A high consumption of sugar, eaten at the expense of foods that are rich in micronutrients, may increase the risk of nutrient deficiencies. This is especially true for older persons because of their generally low energy intake. A study conducted among older adults in South Africa revealed that dietary intake of added sugar is associated with micronutrient dilution (Charlton et al., 1998).

## 3. AGE-RELATED CHANGES IN BODY COMPOSITION AND DIGESTIVE FUNCTIONS

There is a progressive decline in muscle mass (a condition known as sarcopenia) throughout adult life. Loss of muscle mass results in a lowered metabolic rate, reduced energy requirements, and a decline in muscle strength. With advancing age, the proportion of total body fat increases, and body fat is redistributed from the extremities to the abdominal deposits. A major contributor to these changes in body fat and muscle appears to be reduced levels of physical activity with older age. In addition to a loss of active tissue mass (lean body mass), decreased function may occur in several organs and tissues.Between the ages of 50 and 80, levels of cellular enzymes fall in men by an average of 15%, resting cardiac output by 30%, and renal blood flow by 50% (Darnton-Hill et al., 2002). Total body protein synthesis and bone mineralization decrease, and immunological function may also be depressed by the ageing process.

By about 60 years of age, people begin to experience a gradual loss in sense of taste and smell, which may diminish the enjoyment of eating. Poor oral hygiene, periodontal disease, dental caries, oral mucosal problems, poorly fitting dentures, and marginal zinc deficiency also contribute to a diminished sense of taste or smell. Decreased appetite in old age (anorexia of ageing) is a natural phenomenon, but it is often specifically the result of illness, including peptic ulceration, severe constipation and colitis, infections, liver dysfunction, renal impairment, chronic lung disease, and congestive cardiac failure. Loss of appetite may also be a side effect of certain medications, particularly digoxin, fluoxetine, hydralazine, psychotropics, and quinidine. Altered pharmokinetic characteristics predispose older persons to drug toxicity, which may cause anorexia. Drugs such as antibiotics, aspirin, and theophylline may induce nausea and thereby affect appetite adversely.

Reduced salivary flow and dry mouth are usually caused by medications or disease. Reduced thirst sensation associated with ageing can contribute to dry mouth and increase the risk of dehydration, especially in hot weather. The reduced capacity of the stomach to secrete hydrochloric acid is, however, probably the

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most significant change in gastro-intestinal function in many older persons. Atrophy of the gastric mucosa (atrophic gastritis), which leads to a reduced secretion of gastric acid, intrinsic factor, and pepsin, appears to affect about a third of older persons. Consequent lowered absorption of vitamin $B_{12}$ and folate may in turn reduce calcium and iron bioavailability. Age-related physiological changes that have an impact on nutritional requirements are summarized in Table 8.1.

**Table 8.1:** Impact of age-related physiological changes on nutritional requirements

| Change in body composition or physiological function | Impact on nutrient requirement |
|---|---|
| ↓ Muscle mass (sarcopenia) | ↓ Need for energy |
| ↓ Taste and olfactory (smell) acuity | ↑ Need for energy |
| ↓ Bone density (osteopenia) | ↑ Need for calcium, vitamin D |
| ↓ Calcium bioavailability | ↑ Need for calcium, vitamin D |
| ↓ Gastric acid (atrophic gastritis) | ↑ Need for vitamin $B_{12}$, folate, calcium, iron, zinc |
| ↓ Skin capacity for cholecalciferiol synthesis | ↑ Need for vitamin D |
| ↓ Hepatic uptake of retinol | ↑ Need for vitamin A |
| ↓ Efficiency in metabolic utilization of pyridoxal | ↑ Need for vitamin $B_6$ |

*Source: Adapted from Darnton-Hill et al., 2002.*

## 4. OLDER PEOPLE AND THE RISK OF MALNUTRITION

For older adults, the recommended daily allowance (RDA) of protein is the same as for younger adults: 0.80 g/kg/day. However, it has been suggested that older adults may require protein in greater amounts, up to about 1.0 to 1.3 g/kg/day, to maintain nitrogen balance. This may be explained by their lower energy intake, as well as by the fact that the action of insulin during the consumption of meals is impaired in older adults, as compared with young persons (Morais et al., 2006). Further, older persons are less able than younger people to mobilize amino acids from peripheral tissues in response to stressful conditions, such as infection, trauma, or dietary inadequacy. As people age, their micronutrient requirements shift: both men and women need more calcium and vitamin D, and women (but not men) need less iron. In addition, older persons have a lower requirement for dietary fibre. (Dietary Reference Intake values for adults over the age of 50 are shown in Appendix III to this volume. Note that in the case of vitamin D the recommended daily amount increases once people reach the age of 70.)

Older people are at nutritional risk because of impaired digestion and absorption. In addition, the ability of their bodies to utilize nutrients may be compromised by chronic disease and/or by drug-nutrient interactions. Other causes of malnutrition include the effects of physiological, psychological, and socio-economic factors (see Table 8.2). In developing countries, older people are likely to have consumed a diet inadequate in both quantity and quality throughout their life and to have suffered from poor access to health care. As we have seen, however, obesity is becoming increasingly common in many developing countries, largely as a result of the nutrition transition.

Another factor that is often related to the risk of malnutrition is living arrangements. The norm in developing countries is that older people reside with others. However, living alone can often increase the risk of malnutrition. This is because of such factors as poverty, social isolation, depression, and limited ability to care for oneself.

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**Table 8.2:** Major risk factors for nutritional conditions in older persons

| Social factors | Physical factors | Psychological factors |
|---|---|---|
| - Poverty<br>- Isolation (living alone or living in a remote area)<br>- Poor nutrition, difficulty with food preparation, poor knowledge of food safety<br>- Elder abuse and neglect<br>- Institutional environment (hospital or old-age home) | - Dental problems and/or dysphagia (difficulty swallowing)<br>- Diminished sense of smell or taste and/or xerostomia (dry mouth)<br>- Effects of medications<br>- Impaired absorption of nutrients<br>- Increased metabolism (as in Parkinson's disease)<br>- Chronic disease or chronic infection<br>- Severe problems with vision<br>- Physical disabilities and/or impaired performance of basic daily activities (including food shopping, cooking, and eating) | - Widowed or bereaved<br>- Depression<br>- Loneliness<br>- Dementia<br>- Alcoholism<br>- Fear of choking and other food-related anxieties<br>- Anorexia (loss of appetite) |

*Source: Adapted from Darnton-Hill et al., 2002.*

## 5. ASSESSMENT OF NUTRITIONAL STATUS

Ideally, an assessment of nutritional status should be a routine part of the medical care of older persons. This assessment should include anthropometric measurements, bloodwork, and a thorough physical examination, as well as an evaluation of the person's current diet and level of appetite. These topics are covered in more detail in Chapter 22. Here the major focus is on the elderly.

### 5.1 Anthropometry

Anthropometric measurements, if taken regularly, provide useful information regarding changes in nutritional status over time and enable the early detection of malnutrition. A number of different measurements can be taken, depending on the availability of equipment and the mobility of the older person.

#### *5.1.1 Body weight*

Low body weight and rapid unintentional weight loss are highly predictive of mortality and morbidity in older persons. Recent weight loss may be a more sensitive indicator of nutritional status than body mass index (BMI), and the degree of weight loss over time provides an indication of whether nutrition intervention and/or further investigation is required (Table 8.3). If it is not possible to weigh a person on a scale (as, for example, when someone is bedridden), weight may be estimated using calf circumference, knee height (see description below), mid-upper-arm circumference (MUAC), and subscapular skinfold measurements, using the following equations (Eveleth et al., 1998):

Men: weight = (0.98 x calf circumference) + (1.16 x knee height) + (1.72 x MUAC) + (0.4 x subscapular skinfold)–81.69

Women: weight = (1.27 x calf circumference) + (0.87 x knee height) + (0.89 x MUAC) + (0.4 x subscapular skinfold)–62.35

Knee height is the distance from the sole of the foot to the top of the knee joint, measured from the sole of the foot at the heel to the anterior surface of the thigh with the foot and knee each flexed at a 90º angle.

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**Table 8.3:** Assessment of weight loss in older persons over time

| Time | Significant weight loss (%) | Severe weight loss (%) |
|---|---|---|
| One week | 1–2 | >2 |
| One month | 5 | >5 |
| 3 months | 7.5 | >7.5 |
| 6 months or longer | 10–20 | >20 |

### *5.1.2 Height*

If height cannot be measured because of severe kyphosis (overcurvature of the spine), estimated height can be calculated using an equation that incorporates knee height (Eveleth et al., 1998):

Men: height (cm) = (2.08 x knee height [cm]) + 59.01

Women: height (cm) = (1.91 x knee height [cm])–(0.17 x age) + 75

The arm span value is another way to estimate height as it indicates the length of the body (Omran & Morley, 2000). It is the distance from the end of the fingers of one hand to the end of the fingers of the other hand when the arms are stretched out sideways.

### *5.1.3 Body mass index*

BMI is calculated as weight (kg) divided by height (m) squared. BMI reference ranges for older persons are the same as for younger adults (see Chapter 22). BMI is an indicator not only of adiposity (the amount of body fat) but also of muscle mass – perhaps more so in populations with low fat mass. Several studies from developing countries have reported that BMI is correlated with handgrip strength – an indicator of upper body strength and hence of physical function as well as of muscle area (Chilima & Ismail, 2000; Mandahar, 1999; Pieterse et al., 1998).

Both abnormally high and abnormally low BMIs are associated with an increased risk of disease. Mortality associated with low BMI in older persons is often caused by tuberculosis, obstructive lung disease, and lung and stomach cancer. Increased mortality associated with high BMI relates to an increased risk for cardiovascular disease, type 2 diabetes, colon cancer (in men), and post-menopausal breast cancer. Overweight does not appear to be a risk factor in the oldest old, and weight loss is generally not to be recommended in this group.

### *5.1.4 Waist circumference*

Waist circumference is a good indicator of intra-abdominal fat mass in adults. Such fat mass is a better predictor of cardiovascular risk, type 2 diabetes, and other endocrine abnormalities than BMI. Cut-off values for waist circumference (values above which the risk of disease increases) have been proposed for various adult populations (see Chapter 22, section 3). However, these values have not been validated for use in older populations or in African populations, and they lack predictive value in people who are obese (BMI >35) (Gibson, 2005).

### *5.1.5 Mid-upper-arm circumference*

Conventional BMI reference values may not be an appropriate guide to nutritional status in older persons because of changes in body composition and possible kyphosis. MUAC, however, is a valid and reliable indicator. Reference values for older persons in developing countries are shown in Table 8.4. Undernutrition, assessed using these reference values, has been shown to be associated with reduced functional ability – such as handgrip strength, psychomotor speed, co-ordination, mobility, and the capacity to carry out activities of daily living independently – in older people in both Tanzania (Pieterse, 1999) and Malawi (Chilima & Ismail, 2000).

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**Table 8.4:** Mid-upper-arm circumference reference values for older persons

| Mid-upper-arm circumference (cm) | | | |
|---|---|---|---|
| **Men and women of African origin[a]** | **Asians/Caucasians** | | **Nutritional status** |
| | **Men** | **Women** | |
| >24.0 | >22.0 | >22.0 | Normal weight |
| 23.1–24.0 | 22.1–23.0 | 20.1–22.0 | Mild malnutrition |
| 22.1–23.0 | 21.1–22.0 | 19.1–20.0 | Moderate malnutrition |
| <22.1 | <21.1 | <19.1 | Severe malnutrition |

[a] Living in sub-Saharan African, Latin American, or Caribbean countries

*Source: Ismail & Manandhar, 1999;*

### *5.1.6 Skinfold thickness measurements*

Triceps skinfold thickness (TSF) provides a measure of subcutaneous fat. A value of under 4 mm, in men, or under 9 mm, in women, indicates undernutrition (Woodward, 2002).

### *5.1.7 Mid-upper-arm muscle circumference and muscle area*

Mid-upper-arm muscle circumference (MUAMC) is derived from measurements of both the MUAC and TSF. Because the size of the muscle mass is an index of protein reserves, the MUAMC measurement can be used to assess the possible presence of protein-energy malnutrition. It is most suitable for individuals who cannot be weighed and for older persons with severe oedema, in whom BMI or percentage weight loss may be deceptively normal. Arm muscle circumference is, however, relatively insensitive to small changes in muscle mass that might signal the presence of malnutrition. For this reason, the mid-upper-arm muscle area (MUAMA) may be a more reliable indicator of nutritional status.

The MUAMA provides a measure of skeletal muscle mass and is calculated according to the following formula:

$$\text{MUAMA (cm}^2\text{)} = (\text{MUAC (cm)} - [\pi\text{TSF (mm)}/10])^2 / 4\pi$$

A MUAMA value of under 16 $cm^2$ is generally viewed as evidence of undernutrition (Woodward, 2002). At present, however, there are no firmly established reference values for MUAMA derived specifically from samples of older persons.

The corrected upper-arm muscle area (CUAMA) is often used in preference to the MUAMA since this calculation estimates bone-free arm muscle area:

$$\text{CUAMA} = \text{MUAMA} - 10 \text{ (men)}$$

$$\text{CUAMA} = \text{MUAMA} - 6.5 \text{ (women)}$$

The Australian Longitudinal Study of Aging found that, among people aged 70 or more, a low CUAMA (<21.4 $cm^2$ for men and <21.6 $cm^2$ for women) was a useful predictor of mortality at an eight-year follow-up point. This indicates that low CUAMA is another useful indicator of undernutrition in older adults. In contrast, a high or low BMI had no such predictive value (Miller et al., 2002).

### *5.1.8 Percentage body fat and lean body mass*

Percentage body fat can be determined using either a handheld bioelectrical impedance analysis (BIA) monitor or dual-energy X-ray absorptiometry (DEXA). BIA works by measuring electrical conductance through body tissues: the monitor generates an alternating current that is passed through the body by four electrodes placed

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on hand and foot. When compared with estimates of percent body fat derived from underwater weighing, BIA has shown to be as accurate, if not slightly more so, than skinfold measurements. It is also a safe, convenient, portable, rapid, and non-invasive measure, although the cost of the instrument is relatively high. One other weakness of BIA, particularly in the case of older persons, is that it assumes that subjects are adequately hydrated.

### *5.1.9 Measurement difficulties in older persons*

Most anthropometric measurements are affected by the ageing process. For example, age-related loss of height is estimated to be between 1 and 2 cm per decade after the fifth decade, as a result of spinal compression, spinal curves, and loss of muscle tone. Unfortunately, though, normative reference values are generally not available for persons over the age of 75. Moreover, even in the case of older people who have not yet reached the age of 75, anthropometric measurements pose certain difficulties:

- The presence of oedema can produce a falsely high value for weight.
- MUAC and skinfolds measurements may not be accurate because of fluid losses, an increase in the compressibility of fat, and a reduced elasticity of triceps skinfold thickness (TSF) and MUAMA in older persons. Redistribution of subcutaneous fat from the extremities to the abdominal region also affects arm and skinfold measurements.
- Measurements are difficult to perform on bedridden and frail patients.
- Hydration status affects BIA and DEXA measurements.

## 5.2 Biochemical Indices

Biochemical indices are more sensitive than anthropometric measurements and clinical symptoms and may therefore reflect changes in nutritional status earlier than those measures. Indicators of visceral protein status (the amount of protein in the internal organs) and immune function are especially useful in assessing compromised nutritional status. Table 8.5 shows appropriate laboratory reference ranges for older persons.

**Table 8.5:** Reference values for biochemical indicators of nutritional status in older persons

| Serum values | Severity of nutritional deficiency | | |
|---|---|---|---|
| | Mild | Moderate | Severe |
| Serum albumin (g/dl) | 3.2–3.5 | 2.8–3.2 | <2.8 |
| Transferrin (mg/dl) | 180–200 | 160–180 | <160 |
| Total lymphocyte count (n/mm$^3$) | 1500–5000 | 900–1500 | <900 |

Levels of circulating proteins – albumin, pre-albumin, transferrin, and retinol-binding protein – can be important signals of protein deficiency.

- Serum albumin is a non-specific indicator of body protein status over the longer term (half-life = 14–21 days).
- Serum pre-albumin and retinol-binding protein are more sensitive indicators than albumin and allow assessment of protein status over the previous week or days (half-life = 12–48 hours).
- Serum transferrin is not a reliable indicator if chronic inflammation, iron-deficiency anaemia, or iron supplementation are present (half-life = 8–10 days).

The body's immune function is evaluated on the basic of the total lymphocyte count calculated as follows:

Total lymphocyte count = (% lymphocytes x white blood cell count) / 100

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A depressed immune function may be a symptom of protein-energy malnutrition, although it also occurs with sepsis, neoplasia (the growth of tumours), and corticosteroid use.

## 5.3 Clinical Examination

Clinical assessment should include a medical history and physical examination to detect signs of nutritional deficiency (Table 8.6). As part of the medical history, information should be obtained about the person's current use of medication, as both prescribed and over-the-counter drugs may impair appetite and/or affect nutrient digestion and absorption. The physical exam should include an assessment of gums, teeth, and dentures (if any), to ensure that the person is able to eat without difficulty.

**Table 8.6:** Clinical signs of possible nutrient deficiencies in older persons

| Clinical sign | Possible deficiency |
|---|---|
| **Hair** | |
| Can be pulled out easily, sparse | Protein |
| **Skin** | |
| Xerosis | Essential fatty acids |
| Pigmentation | Niacin |
| Flaky dermatitis | Protein |
| Poor tissue turgor | Water |
| Oedema | Protein, thiamine |
| Purpura | Vitamins C, K |
| Pallor | Folate, iron, vitamin $B_{12}$ |
| Pressure sores | Protein-energy |
| Poor wound healing | Protein-energy, zinc, vitamin C |
| Perifollicular haemorrhage | Vitamin C |
| **Lips, oral mucosa** | |
| Angular fissures, stomatitis | B-complex, iron, protein, riboflavin |
| Cheilosis | Vitamin $B_6$, niacin, riboflavin, protein |
| Swollen bleeding gums | Vitamin C |
| **Tongue** | |
| Magenta colour | Riboflavin |
| Fissures, raw | Niacin |
| Glossitis | Pyridoxine, folate, iron, vitamin $B_{12}$ |
| Fiery red colour | Folate, vitamin $B_{12}$ |
| Atrophic papillae | Riboflavin, niacin, iron |
| **Nails** | |
| Spoon shape | Chromium, iron |
| **Muscles, extremities** | |

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| Clinical sign | Possible deficiency |
|---|---|
| Muscular pains | Biotin, selenium |
| Muscular twitching | Pyridoxine |
| Muscular weakness | Sodium, chloride |
| Pain in calves, weak thighs | Thiamine |
| Muscle cramps | Sodium, chloride |
| **Neurological** | |
| Disorientation | Thiamine, sodium, water |
| Decreased vibratory sense, ataxia, optic neuritis | Vitamin $B_{12}$ |
| Weakness, paraesthesia of legs | Thiamine, pyridoxine, pantothenic acid, vitamin $B_{12}$ |
| Mental disturbances, psychosis | Niacin, magnesium, vitamin $B_{12}$ |
| Depression, lethargy | Biotin, folate, vitamin C |
| Peripheral neuropathy | Pyridoxine |

*Source: Adapted from Heymsfield & Williams, 1988.*

In addition, a clinical examination should include an evaluation of the person's cognitive and functional status, with particular attention paid to his or her ability to procure and prepare food. If meals are prepared by others, it is useful to ask about the person's degree of satisfaction with these meals, both in terms of their quantity and quality. A full assessment of cognitive function includes:

- An assessment of the person's ability to perform the activities of daily living (ADL). This assessment can be made using either the 6-item Katz index (Katz & Stroud, 1989) or the 10-item Barthel index (Mahoney & Barthel, 1965). The Katz index measures dependency in bathing, dressing, toileting, continence, transferring (moving between bed and chair), and eating. The Barthel index is similar to the Katz index but separates bowel and bladder continence and includes grooming, climbing stairs, and mobility. Possible scoring on the Katz scale is from 0 to 6 (with 6 indicating full function) and, on the Barthel scale, from 0 to 20.
- An assessment of the ability to perform instrumental activities of daily living using a scale developed by Lawton and Brody (1969). The Lawton scale establishes the level of function of older individuals in caring for themselves and performing more complicated tasks of everyday life: using the telephone, shopping, preparing meals, doing housework, doing laundry, using transportation, taking medication, and managing money. Possible scoring ranges from 0 (totally dependent) to 16 (totally independent).
- An assessment of cognitive function. There are different tests for assessing the cognitive state of an older adult and whether cognitive impairment or senility are present. The most well-known test is the Mini Mental State Examination (MMSE) (Alzheimer's Society, 2014).

The Six-Item Cognitive Impairment Test (6CIT), originally developed as a screening tool in the United Kingdom (Brooke & Bullock, 1999), is useful for this purpose. It measures a person's sense of orientation, ability to concentrate, and memory and can be used in non-literate populations. Scoring is based on the number of errors made by a subject for each item: the higher the score, the more severe the impairment. Scores in the 0 to 7 range indicate normal cognitive function; scores of 8 or higher are considered significant. The maximum score is 28, which indicates severe dementia.

## 5.4 Evaluation of Diet

Finally, critical to any assessment of nutritional status is information regarding a person's current diet. This is

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covered in more detail in Chapter 22. This information can be obtained simply by asking a series of questions and then, as seems necessary, asking follow-up questions. Of particular importance are the following:

- Meal patterns (how many meals are eaten each day and approximately when)
- Who prepares these meals
- The foods that are typically consumed at each of these meals
- The number of times each day that food is eaten from particular food groups
- Favourite foods, as well as food dislikes
- Whether the person routinely takes dietary supplements and, if so, of what sort
- Whether the person consumes alcohol and, if so, its patterns of use

It is important to realize that the information that people provide about their food and alcohol consumption is often inaccurate. Poor memory is the most common cause of this.

It is also helpful to ask about a person's appetite. As we have seen, loss of appetite can have a variety of physical causes, but appetite is also profoundly influenced by emotional factors. Older people can experience feelings of isolation and loneliness, which can lead to chronic low-level depression (see, for example, Cabrera et al., 2007). Because nutritional deficits can be a product of emotional deprivation, an effort should be made to elicit information about an older person's overall sense of well-being. If the person is still reasonably able to move about, it is also useful to ask how often he or she engages in some sort of outdoor activity. Another factor to look at is the person's state of dentition and chewing and swallowing problems.

## 5.5 Screening Tools

In recognition of the importance of optimal nutritional status among older people, many countries have adopted national nutrition screening initiatives for this population. These initiatives aim at the early detection of nutritional problems and the provision of appropriate care to individuals who are especially vulnerable to malnutrition. The DETERMINE Checklist was produced by the US Nutrition Screening Initiative (White et al., 1992) for people seeking the services of the Older Americans Act Nutrition Program. The checklist, which was designed to be self-administered, comprises ten statements pertaining to physical and medical status, food habits, and social factors (isolation and inadequate income). However, the DETERMINE Checklist has not been widely used outside of the United States and has come in for some criticism, even in that country (Sinnett et al., 2010; Zoidis & Dirican, 1997). On its own it does not appear to provide a reliable guide to nutritional status, especially in frail, high-risk patients,

The Mini Nutritional Assessment (MNA®) was originally developed by a team of researchers. In its full form, it is an 18-item questionnaire that combines

1. anthropometric assessment
2. general assessment (independent living, mobility, use of multiple medications, psychological stress, neuropsychological problems, and the presence of pressure sores)
3. dietary assessment
4. self-assessment (health status in comparison to peers and perceived nutritional status).

Since its validation in 1994, the MNA® has been widely used and is available in over twenty languages; it is generally considered both sensitive and reliable and is recommended for use in geriatric populations (Guigoz, 2006; Vellas et al., 2006). In a study of older black South Africans (Charlton et al., 2007), the MNA® proved to be a more effective tool than the DETERMINE Checklist for identifying not only individuals who were actively malnourished but also those at risk of malnutrition. While relatively few (5.3%) of those in the community-dwelling portion of the sample were identified as malnourished, an additional 50% were found to be at nutritional risk. The use of a standardized instrument also facilitates comparison of nutritional status between populations. For example, in a study of community-based Bangladeshi elderly that also employed the MNA®, the prevalence of malnutrition was 26%, and another 62% of the sample was at risk (Kabir et al.,

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2006). Among community-based older people in Brazil, however, a much lower prevalence was found, with a total of only 21.7% classified as either malnourished or at risk (Cabrera et al., 2007).

The MNA®-Short Form (MNA®-SF) is a 6-item screening instrument that permits rapid assessment. It was developed because the length of the 18-item version was perceived to limit its usefulness as a screening tool. Individuals who are identified as at risk of malnutrition using the MNA®-SF can be further evaluated using the longer form (Rubenstein et al., 2001). The six questions pertain to food intake, recent weight loss, mobility, recent psychological stress or acute disease, neuropsychological problems (such as dementia), and BMI. Since its inception, the MNA®-SF has been revised using international databases from elderly populations around the world. The revised version allows calf circumference measurements to substitute for BMI, which may be useful in bedridden elderly or when height and weight measures cannot be taken. (For further information, see Nestlé Nutrition Institute, MNA® Mini Nutritional Assessment, http://www.mna-elderly.com.)

In Asian settings, a Taiwanese version of the MNA® has been developed that uses population-specific anthropometric cut-off points and allows replacement of BMI with mid-arm and calf circumferences. In one study conducted using the modified instrument, those rated as malnourished were shown to be at a seven times greater risk of mortality than those rated as well nourished, while the mortality risk among those considered to be at risk of malnutrition was 2.5 times greater (Tsai et al., 2010).

Another screening instrument was developed by Clausen et al. (2005) to investigate the relationship between food diversity and physical and cognitive functioning among older persons in Botswana. This 5-item questionnaire, which is designed to assess food variety, employs simple "yes/no" responses to questions on age, area of residence, education, cattle ownership, and number of meals per day.

# 6. COMMON NUTRITION-RELATED PROBLEMS IN OLDER ADULTS

## 6.1 Obesity and Chronic Diseases of Lifestyle

In the wake of the nutrition transition, overweight and obesity have become increasingly common problems among older people in developing countries. Both are strongly linked to a risk of hypertension, type 2 diabetes, and high levels of blood cholesterol (hypercholesterolaemia), a condition associated with ischaemic heart disease. Moreover, obesity can aggravate arthritis and impair physical mobility and respiratory function. However, in terms of mortality outcomes, evidence is inconsistent regarding the consequences of weight change in old age, In the absence of cardiovascular risk factors, weight loss in old age may in fact be detrimental to health; for example, it may increase the risk of hip fracture.

Dietary efforts at weight management in older adults should emphasize increased consumption of nutrient-dense foods, such as vegetables, fruit, and wholegrain cereals, as well as low-fat sources of protein, such as beans, fish, and poultry. Extremely low-energy diets (800–1000 kcal) are not appropriate for weight management in older persons because of the risk of compromised micronutrient status. A weight management programme that includes increased physical activity, such as walking, may provide cardiovascular and health benefits over and above weight loss alone. For example, as a study carried out among older people living in socio-economically disadvantaged circumstances demonstrated, a community-based, low-intensity exercise programme conducted twice weekly for 20 weeks can result in increases in lower body strength and balance, as well as improved blood pressure, particularly in those who are hypertensive (Kolbe-Alexander et al., 2006). These positive results were achieved despite a lack of weight loss. Resistance training, which involves lifting a load a number of times in fairly rapid succession, has also been shown to decrease problems associated with obesity, diabetes, ischaemic heart disease, and hypertension, as well as osteoporosis (Darnton-Hill et al., 2002).

Hypertension is common in older populations. Optimal blood pressure control is difficult to achieve in older persons, however, partly because it requires them to return to a health care centre for follow-up visits. Another problem is that many patients have a poor understanding of the condition. Compounding this primary health care facilities often give poor quality treatment, such as inappropriate medications. A diet rich in fruit, vegetables, and low-fat dairy products, such as the DASH (Dietary Attempts to Stop Hypertension) diet, has proved to be optimal for controlling blood pressure (Appel et al., 1997; see also Chapter 12). In addition,

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salt restriction can help lower blood pressure. A combination of the DASH diet and a low-salt diet appears particularly effective (Sacks et al., 2001). Unfortunately, in developing countries, promotion of the DASH eating plan may be unrealistic in some settings because many people, including the elderly, have limited access to fruit, vegetables, and dairy products. Efforts have been made, however, to lower salt intake by reducing the salt content of processed foods. A study conducted in a low-income South African community demonstrated that modification of the salt content of a few commonly consumed foods, together with increased potassium and calcium intake (from fermented milk products), can result in a clinically significant reduction in blood pressure in older hypertensive individuals over a period of only eight weeks (Charlton et al., 2008).

## 6.2 Anaemia

The prevalence of anaemia (a haemoglobin concentration of <13 g/dl for men and <12 g/dl for women) in community-dwelling older adults in developing countries has been reported at 14% and at 25% (Charlton et al., 1997; Charlton et al., 2005, respectively). This is higher than the rates reported in older populations in Europe and the United States. Numerous components of red blood cells facilitate the transport and delivery of oxygen around the body, including the globin proteins in haemoglobin (Hb), iron, folate, and vitamin $B_{12}$ (cobalamin). A deficiency of any of these components may reduce the concentration of Hb, or the number of red blood cells, and thus cause anaemia. Physiological changes that affect iron, folate, and vitamin $B_{12}$ status include a decline in the production of gastric acid (a condition known as achlorhydria) and in the secretion of intrinsic factor, chronic disease, inflammation, chronic polypharmacy (the use of multiple medications), and gastro-intestinal bleeding. However, inadequate dietary intake, whether as a consequence of poverty or the physical inability to prepare food, can obviously affect the status of these nutrients, as can the excessive consumption of alcohol.

The most common cause of anaemia in older persons is chronic disease. Anaemia of chronic disease (normocytic anaemia) may result from underlying conditions such as cancer, rheumatoid arthritis, or chronic infections. Management of this type of anaemia primarily requires adequate treatment of the underlying disease process.

Hyperferritinaemia – a high level of ferritin (a protein that stores iron) in the blood, which is indicative of iron overload – has been reported to be more common than low iron stores in older Africans, particularly in men (Charlton et al., 1997, 2005). However, when iron deficiency coexists with chronic disease, serum ferritin may be raised. As a result iron deficiency may remain undiagnosed. Ferritin is an acute-phase protein and is typically elevated in cases of infection, inflammation, and malignancy. Excessive alcohol consumption is also associated with hyperferritinaemia. Heavy consumption of home-brewed beer that has been fermented in iron pots, as is the practice in many rural areas, may lead to iron overload through an overriding of iron absorption regulation by the upper gastro-intestinal mucosa (Friedman et al., 1990). Cooking in iron vessels may also lead to hyperferritinaemia. An association has been demonstrated between iron overload and ischaemic heart disease and cancer (Salonen et al., 1992; Weinberg, 1992), which further underscores the need to assess iron status correctly in the population at large and in the older population in particular.

## 6.3 Impaired Cognitive Function

Dementia – the most common manifestation of severe cognitive impairment in older persons – can affect eating behaviour and nutritional intake. Typically characterized by memory loss, dementia is estimated to be present in at least 5% of persons aged 65 years and older in certain Asian and Latin American countries but in only 1% to 3% in sub-Saharan Africa and India (Kalaria et al., 2008). In Africa, the prevalence of dementia has been estimated to be 1.6% in persons over the age of 60, compared to 5.4% in Western Europe and 6.4% in North America (Ferri et al., 2005). Greater longevity and an increase in vascular risk factors will, however, contribute to increases in dementia in all ageing populations.

The most common form of dementia is Alzheimer's disease, which accounts for approximately two-thirds of all cases. According to the *World Alzheimer Report 2009,* the disease was anticipated to affect 36 million people worldwide in 2010, and that number was expected to almost double every twenty years, rising to 115 million by 2050. Moreover, "much of the increase is clearly attributable to increases in the numbers of people with dementia in low and middle income countries." The report forecast that, as of 2010, 58% of all people

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suffering from dementia would live in such countries, with the proportion rising to 63% in 2030 and 71% in 2050 (Alzheimer's Disease International, 2010, p. 38). In 2009, a survey of residents from seven low- and middle-income countries around the world found that in five of these countries dementia was the largest contributor to disability (Sousa et al., 2009). In developing countries, however, barriers to health care access may mean that older persons with symptoms of dementia remain undiagnosed. The family of an older person with dementia may not recognize the signs and simply dismiss them as a normal part of ageing. Another problem is that family members may be reluctant to take the person with signs of dementia to a health clinic because of the stigma associated with the condition.

Cognitive impairment in older persons can be both a cause and an effect of malnutrition. For example, a person with dementia may forget to eat or drink or may experience difficulties with shopping and preparing meals, thereby becoming malnourished. Conversely, vitamin $B_{12}$ deficiency can cause dementia to develop, while severe dehydration can result in confusion and delirium.

Epidemiological data on diet and cognitive decline suggest that certain macro- and micronutrients (folate, vitamins $B_{12}$, C, and E, flavonoids, and unsaturated fatty acids) may have a protective effect, and a low intake of total fats has been linked to a lower risk for Alzheimer's disease or slower cognitive decline (Gillette-Guyonnet et al., 2007). Certain dietary patterns, such as the Mediterranean diet (Scarmeas et al., 2006) and traditional diets in African countries (Kalaria et al., 2008), may contribute to a lower incidence of dementia. However, results from observational studies are not necessarily replicated in randomized controlled supplementation trials, and there is no consensus at present on optimal nutrient intakes for the prevention of cognitive decline in older persons. Current evidence thus suggests two conclusions. First and foremost, it is prudent to continue to recommend a varied, healthy diet as a way to prevent cognitive decline with age and the onset of dementia. Second, there is a lack of good evidence that supplementation is of any value

## 6.4 Pressure Sores

Pressure sores, or pressure ulcers, can lead to pain, disfigurement, and slow recovery from comorbid conditions. They interfere with activities of daily living, predispose a person to osteomyelitis and septicaemia, and are associated with longer hospital stays and mortality. Poor diet, particularly low dietary protein intake, is an independent predictor of the development of pressure ulcers. Because protein, carbohydrates, vitamins, minerals, and trace elements are necessary for wound healing, good nutrition is a valued component of treatment. However, as Whitney et al. (2006) point out, relatively few studies exist to document the efficacy of nutritional interventions in the treatment of pressure ulcers. On the principle that adequate nutrition is needed to provide sufficient protein to support the growth of granulation tissue, they suggest the use of prophylactic nutritional assessments. Bedbound persons at home or in aged-care institutions are also at increased risk for pressure sores and should be regularly turned, as well as provided with a nutritious diet.

## 6.5 Impaired Immune Function

The changes in immune function that accompany ageing, together with the widespread prevalence of malnutrition in developing countries, place older people at a high risk for infection. The provision of additional energy, protein, and selected micronutrients is known to improve the immune response in undernourished older persons. In addition, vitamin E, an antioxidant, is necessary to the healthy functioning of the immune system. In a review of research on vitamin E deficiency, Dror and Allen (2011) note that people living in developing countries, especially children and older people, are especially vulnerable to vitamin E deficiency, owing to the combination of poor nutrition and the greater prevalence of oxidative stressors such as malaria and HIV. While they conclude that public health initiatives aimed at improving the vitamin E status of high-risk individuals could help to improve immune function, they also emphasize the need to establish the optimal dose-response relationship for various possible interventions. Such information is essential, as a 1994 study of zinc supplementation well illustrated. The study found that whereas supplemental zinc had immune-enhancing effects in older persons with a low serum zinc level, it had a potentially adverse effect on the immune response in zinc-adequate individuals (Bogden et al., 1994). In older populations in developing countries, where the background diet is inadequate in many micronutrients, nutrient supplementation trials are needed to determine the efficacy and cost-effectiveness of various nutrition interventions. In the absence

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of such data, the use of a low-dose multivitamin and mineral supplement, equivalent to the RDA levels, may be the most sensible approach. The relationship between nutrition and immune function is discussed in more detail in Chapter 10.

### 6.6 Osteoporosis, Falls, Fractures, and Bone Health

Osteoporosis is a skeletal condition characterized by reduced bone strength, diminished bone density, and deterioration in the microscopic architecture of bone. People achieve peak bone mass in their mid-20s, with the size of the bone mass determined in part by genetics. Bone loss with age and following menopause are universal, but rates vary among individuals. Both peak bone mass and subsequent bone loss can be modified by environmental factors, such as nutrition and physical activity, and can also be affected by certain diseases and medications. Prevention of osteoporosis requires adequate calcium and vitamin D intake, regular weight-bearing physical activity, and the avoidance of smoking and excessive alcohol intake. A previous vertebral or hip fracture is the most important predictor of future fracture risk, while low bone density is the best predictor of fracture risk for those without prior adult fractures.

Falls in older persons are common. After a first fall, about a third of patients experience a drastic reduction in independence, and a third of cases result in serious injury or even death (Wei et al., 2001). Many elderly patients with fractured femurs also exhibit signs of protein-energy malnutrition, while those with compromised nutritional status have poorer medical outcomes after a hip fracture (Bastow et al., 1983). Loss of body weight, as measured by BMI, was shown to be an important risk factor for hip fracture in independently living older persons in Taiwan (Wei et al., 2001). Improvement of the nutritional status of this group may reduce rehabilitation time, length of hospital stay, and early mortality (Carpintero et al., 2005).

The benefit of vitamin D supplementation in reducing the risk of fractures has been well demonstrated (Bischoff-Ferrari et al., 2009b). However, evidence related to the role of vitamin D in prevention of falls is inconsistent (Avenell & Handoll, 2007; Bischoff-Ferrari et al., 2009a). A trial conducted in Chile among vitamin D–deficient older persons demonstrated that resistance training over a 9-month period resulted in improved muscle strength, while simultaneous supplementation with vitamin D (10 µg or 400 IU/day) and calcium (800 mg/day) provided even greater benefits (Bunout et al., 2006). These benefits included increased bone mass and better performance on tests of physical function and balance.

Another nutritional supplementation trial, also conducted among older people in Chile, demonstrated that the provision of a nutritional supplement (containing 25% of the daily requirements for various macro- and micronutrients) over a period of 18 months prevented detrimental changes in bone mineral density, as well as in the performance of daily living activities and blood lipid levels. In addition, a resistance-training programme, offered either on its own or in combination with the supplements, improved muscle strength and walking capacity (Bunout et al., 2001). Similarly, in a study conducted in Boston, resistance training was shown to strengthen muscles and reduce sarcopenia (loss of muscle mass with age) even in very old, frail persons (Fiatarone et al., 1994). Importantly, the Chilean training programme was designed using simple and inexpensive means and was carried out in a setting of public primary care clinics; the rate of compliance with exercise sessions was 56%, which was viewed as reasonable for people aged 70 or more. This study provides evidence of the effectiveness and feasibility of community-based exercise and nutritional supplementation programmes for older persons in a developing country setting.

## 7. NUTRITION SERVICES AND PROGRAMMES FOR OLDER ADULTS

Partly for historical reasons, health policy in developing countries tends to be largely preoccupied with children, youth, and mothers; as a result, the health care needs of older persons can be marginalized. Health professionals are generally not trained in geriatric care, and dedicated geriatric services are typically not offered in the public health sector at the primary care level. When older persons seek treatment for a health problem, whether acute or chronic, they must wait their turn at community clinics, along with younger people. In addition, older persons are seldom referred to secondary and tertiary care levels for further investigation

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and management. Primary care health facilities therefore play a crucial role in the detection and treatment of malnutrition. However, overcrowding and severe staff shortages at these facilities, as is commonplace in developing countries, limit the attention that can be given to the nutritional needs of older persons.

At the public health level, nutrition interventions – specifically national food fortification programmes, including salt iodization – deliver micronutrients to older persons much in the same way that they are delivered to younger persons. Formal nutrition programmes for older persons are otherwise limited, for the most part consisting of services offered by non-governmental and voluntary organizations, such as home-based care, luncheon clubs, and meals-on-wheels programmes.

## 7.1 Community-Based Nutrition Services

Community-based nutrition services aim to support older persons who are still living independently, whether with families or on their own. While these services may be subsidized by government departments of health and/or social welfare programmes, they are often delivered by non-governmental organizations. Such nutrition services for older persons include:

*Luncheon clubs and soup kitchens*

Luncheon clubs for older persons and soup kitchens are operated mainly by non-governmental and community-based organizations. Beneficiaries partake of the meals with peers in a social environment, and the setting ensures that older people are consuming the meals themselves, rather than giving food intended for them to their grandchildren (Stevens-O'Connor, 2006).

*Meals-on-Wheels*

Meals-on-Wheels is a community service typically operated by church groups or humanitarian agencies, especially in developing countries. A hot, nutritious midday meal is delivered, usually at a nominal cost, to a recipient's home anywhere from once to five days a week. The service helps to enable older persons whose income is limited or who have difficulty in preparing meals for themselves to continue living in their own home.

## 7.2 Nutrition in Institutional Settings

### *7.2.1 General guidelines*

Guidelines and policy initiatives on the treatment and prevention of malnutrition in older hospital patients, in residents of long-term care facilities, and among community dwellers have been developed in the United Kingdom (National Institute of Health and Care Excellence, 2006; NHS Quality Improvement Scotland, 2003). Unfortunately, similar policies or protocols do not exist for older persons in developing countries. In residential facilities, the evaluation of menus and food service management operations tends to be undertaken by community-based dietitians or nutritionists. Factors that influence the food and beverages available to patients or residents while in hospital or in an old-age home include budgetary considerations, the available staff, as well as their role with respect to the provision of meals, the food service delivery system, and food safety initiatives (Walton et al., 2006).

### *7.2.2 The potential for abuse and neglect*

Residents of care facilities who are frail may be at risk of abuse or neglect, particularly given that they are dependent on staff to feed them. Staff shortages are not uncommon at such facilities, and staff members may lack patience with residents who are demented or who eat slowly because of difficulty in chewing and swallowing food. A frustrated staff member may simply remove uneaten food and thus compromise the resident's nutrition. Withholding food from an older person, however, or failing to ensure an adequate intake of food, violates a dependent person's rights. Consequences of elder abuse and neglect in both institutional and domestic settings can include depression, a loss of self-esteem, and a sense of isolation or abandonment. These may in turn have a negative impact on the person's appetite and eating behaviour and thus on their nutritional status. Self-neglect can have similar effects, resulting in a poor nutritional intake and compromising the individual's health and well-being.

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### *7.2.3 Nutritional supplementation*

Most hospitals and frail-care homes provide nutritional supplementation, typically liquid replacement meals, to older patients and residents at risk of malnutrition, although no consensus exists on optimal frequency and timing of such supplements. Moreover, the benefits of such supplementation can be undermined by poor compliance: it is not always possible to persuade older people to drink liquid supplements (Volkert et al., 1996).

### *7.2.4 Feeding a terminally ill patient*

Numerous occasions exist on which the choice must be made whether to provide or to withdraw nutrition and hydration from terminally ill individuals. Regardless of the person's age, this choice creates ethical dilemmas. Four fundamental principles of medical ethics can offer important guidance to those facing such dilemmas:

*Autonomy:* The patient has the right to be informed and the right to choose.
*Beneficence:* The caregiver must act in the best interests of the patient.
*Non-maleficence:* No harm must be done.
*Justice:* The caregiver must strive to be fair and to treat all people equally.

These principles have been formally endorsed by American Dietetic Association (Maillet et al., 2002). Indeed, dietitians are sometimes called upon to make recommendations regarding whether to prolong or discontinue feeding. In addition to applying the ethical principles listed above, dietitians should bear in mind the following guidelines (MacFie, 2001):

- Personal attitudes and emotions may influence and interfere with the execution of professional responsibilities. The dietitian or health care provider should be aware of this possibility and seek at all times to adhere to evidence-based practice.
- The dietitian, as part of the health care team, has a responsibility to regard each patient as an individual and be attentive to his or her psychological and physiological needs.
- Failure to obtain a patient's informed consent may constitute medical negligence or malpractice.
- Patients always have the right to change their mind.
- In the face of the question of whether to withdraw support, a period of trial feeding, with appropriate and timely reassessment, is often the best option.
- Justification of the recommendations made by the dietitian should be documented clearly and concisely, using as many concrete data as are available.
- Health care staff, including the dietitian if appropriate, should provide emotional comfort and support to the patient and family or guardian through both verbal and non-verbal communication.

Evidence is lacking as to whether nutritional support can in fact prolong life or decrease morbidity in patients with sepsis or who are in the advanced stages of cancer or of cardiac or respiratory disease. Moreover, nutritional support could potentially cause harm, owing to local and/or systemic complications of access devices and the feeding process. Unrequested nutritional support provided by enteral or parenteral route to a terminally ill patient may well be medically and ethically indefensible, as it may increase suffering without improving outcome (Winter, 2000).

Mindful that the circumstances of each individual case are unique, health care providers have a responsibility to explore all resources and options available to a patient (MacFie, 2001). However, the primary and most powerful consideration in any decision remains the wishes of a competent and informed patient or the person who must make decisions on his or her behalf.

## DISCUSSION QUESTIONS AND EXERCISES

1. Many people in developing countries suffer from food insecurity. Explain why older persons are especially vulnerable to food insecurity and why some older people are more vulnerable than others.

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2. What are the most common nutritional deficiencies among older persons, and why are older persons prone to these deficiencies?
3. You are conducting a nutritional assessment of a 71-year-old woman who lives with her daughter-in-law and three grandchildren in a rural village, while her son works in a city some distance away. Anthropometric measures, blood tests, and a physical examination point to fairly serious protein deficiency, and yet when asked about her diet, the woman insists that she has plenty to eat. What would you do in these circumstances?
4. Describe the role of nutrition in anaemia, depressed immune function, dementia, and osteoporosis.
5. As a dietitian, you see a many older people who are malnourished. At the moment, the only nutritional service for elderly available in the area is a hot-lunch program operated by a local church. What recommendations would you make to community leaders? Write a letter in which you describe and defend these recommendations.

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# PART 3

## THE ROLE OF NUTRITION IN THE PREVENTION AND TREATMENT OF DISEASE

# CHAPTER 9

# NUTRITIONAL MANAGEMENT OF MULTIPLE NUTRIENT DEFICIENCIES

*Michael K. Hendricks, H. Salome Kruger, and Thandi Puoane*

## *Outline*

- Causes and risk factors of multiple nutrient deficiencies
- Causes of undernutrition
- Causes of micronutrient deficiencies
- Pathophysiology and consequences of multiple nutrient deficiencies
- Micronutrient and macronutrient deficiencies
- The nutritional management of multiple nutrient deficiencies

## *Objectives*

At the completion of this chapter you should be able to:

- Define undernutrition
- Give an overview of the extent and public-health significance of multiple nutrient deficiencies using a human-rights approach
- Use the United Nations Children's Fund (UNICEF) conceptual framework to explain the relationship between basic, underlying, and immediate causes of undernutrition
- Identify groups of people by gender and age who are at risk of multiple nutrient deficiencies and use the UNICEF conceptual framework to indicate how basic, underlying, and immediate causes of undernutrition affect them, as well as how a human-rights approach may decrease their risk of undernutrition
- Integrate the effects of individual micronutrients to explain the interaction between nutrients in the pathophysiology of micronutrient malnutrition
- Indicate how the effects of inadequate diets and infections are adding to the vicious cycle of undernutrition and infection
- Describe the effects of multiple nutrient deficiencies on the health of vulnerable people in communities
- Advise communities, using food-based dietary guidelines, on economical ways to improve macronutrient and micronutrient intakes
- Recommend innovative approaches to improve micronutrient absorption from foods
- Indicate how an integrated approach can be used to address the problem of multiple nutrient deficiencies


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# 1. INTRODUCTION

Multiple nutrient (i.e., vitamin and mineral) deficiencies prevent almost a third of the world's people from achieving their full physical and mental potential (Micronutrient Initiative & UNICEF, 2003). The management of undernutrition should focus not only on treating severe deficiencies in individuals but also on protecting whole populations from the development of vitamin and mineral deficiencies. Iron-deficiency anaemia in children and women deserves particular attention, as do iodine, vitamin A, and folate deficiencies. In addition, zinc deficiency has been shown to have detrimental effects on health (Shrimpton & Shankar, 2008). Children are the group most vulnerable to deficiencies of these nutrients. Avoiding deficiencies is especially important with pregnant women.

The information in this chapter is based on the assumption that students have a basic knowledge of functions of macronutrients and micronutrients in the human body, the food sources of nutrients, and the effects of deficiencies of these nutrients. The focus here will be on the causes and pathophysiology of multiple nutrient deficiencies, as well as their management by community health services.

# 2. CAUSES AND RISK FACTORS OF MULTIPLE NUTRIENT DEFICIENCIES

## 2.1 Causes of Undernutrition

In 1990, as part of its overall nutrition strategy, UNICEF outlined a conceptual framework that describes the aetiology of undernutrition. The framework distinguishes among basic, underlying, and immediate causes. The *basic* causes of undernutrition are the social, political, and economic factors that produce inequalities. They pertain to the relative ability of particular groups to access and exert some measure of control over resources of all sorts – natural, material, financial, human, and institutional. These fundamental inequalities are manifest in the *underlying* causes of malnutrition – household food insecurity, unsanitary living conditions, inadequate access to health care services, and poor infant and child care practices. These in turn contribute to the *immediate* causes of undernutrition: inadequate food intake and disease (UNICEF, 1990).

For example, some children are prone to undernutrition simply because of where they live. In rural areas where the land is dry and water supply scarce – that is, where access to natural resources is limited – it is difficult to grow vegetables except during rainy seasons. Such circumstances produce food insecurity: families must purchase food in order to supplement the household diet, and they may not be able to afford such food or even have ready access to a market. Rural areas are also often characterized by poor sanitation, as well as inadequate health facilities. A lack of proper environmental sanitation and poor access to clean water precipitate diarrhoeal diseases and other infections that interfere with the child's appetite or food absorption. Such illnesses work synergistically with inadequate food intake to compound the problem of undernutrition, ultimately leading to higher mortality rates (Pelletier et al., 1995).

## 2.2 Causes of Micronutrient Deficiencies

More than one third of the world's population suffers from micronutrient deficiencies, which exist as a form of hidden hunger (Tontisirin, 2002). The most obvious cause of such deficiencies is an inadequate diet. For many years, an insufficient intake of protein and energy was deemed to be the main factor in the aetiology of undernutrition, but it is now recognized that a low intake of micronutrient plays a significant role in its causation. Moreover, although many studies have used a single-nutrient approach to assess the impact of undernutrition, evidence now supports the role of multiple micronutrient deficiencies in determining health outcomes (Manary & Solomons, 2004; Ramakrishnan & Huffman, 2008).

A diet containing both macro- and micronutrients in the required amounts is essential for growth and health. Meat and dairy products, fruits, and vegetables are rich sources of important micronutrients such as vitamins A and C, the B complex of vitamins, and iron, iodine, and zinc. Most multiple micronutrient deficiencies are caused simply by an inadequatedietary intake of such foods. In some instances, however, the food matrix (the mix of foods eaten), the manner of food preparation, the presence of antinutritional factors (inhibitors), and/or drug-diet interactions may compromise the amount of micronutrient content available

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from the food consumed. (Certain trace elements, such as iodine and selenium, are less vulnerable to the influence of such factors, since their concentration in food depends mainly on the type of soil and/or water content of the region in which the foods are found.) One other important aspect of multiple micronutrient undernutrition is the interaction of micronutrients at the physiological and metabolic level. For example, zinc and calcium may reduce iron absorption and thus its bioavailability (Ramakrishnan & Huffman, 2008).

### *2.2.1 The role of infection*

The synergistic relationship between poor diet and infectious diseases is well established. As Calder and Jackson (2000, p. 4) explain, "Malnutrition makes the individual more susceptible to infection and decreases immune defences against invading pathogens. In turn, certain pathogens influence nutritional status, mediated by changes in dietary intake, absorption, and nutrient requirements and losses of endogenous nutrients." A three-way relationship thus exists among malnutrition, decreased immune defences, and infectious disease (see Figure 9.1). Infections have consequences that can lead to reduced nutrient intake or absorption, the loss of nutrients from the body, or an increase in the body's nutrient requirements (see Figure 9.2), all of which contribute to malnutrition. As Calder and Jackson (2000) point out, infection also alters behaviour and can therefore affect feeding practices. A mother who is ill may not be able to provide adequate care for her children.

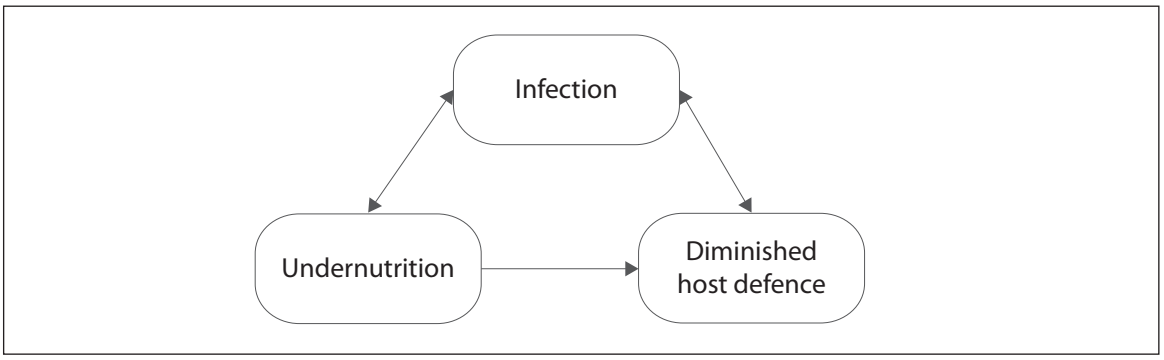


**Figure 9.1:** Interaction between undernutrition and infection.
*Source: Calder & Jackson, 2000, p. 5.*

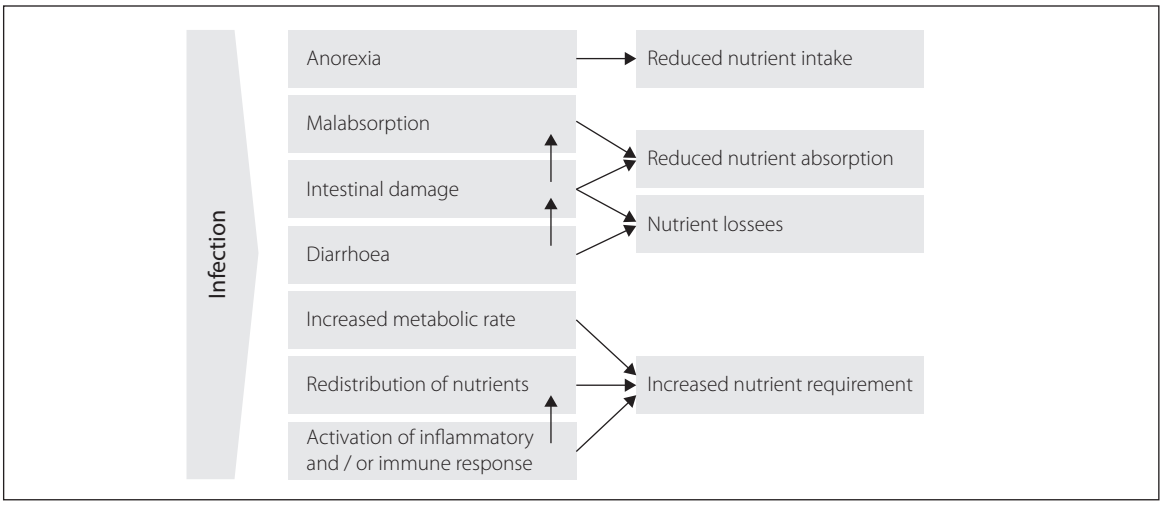


**Figure 9.2:** The impact of infection on nutritional status.
*Source: Calder & Jackson, 2000, p. 5.*

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### *2.2.2 The influence of environmental factors*

As the UNICEF conceptual framework indicates, inadequate dietary intake and disease – the immediate causes of undernutrition – result in part from underlying environmental factors. Household food insecurity is the obvious such factor, but substandard living conditions (poor sanitation, a lack of clean water, inadequate attention to hygiene), insufficient access to health services, and inadequate maternal and child care are also directly implicated in undernutrition. Child care is an especially critical factor in the prevention of micronutrient deficiencies (Black et al., 2003). Among other things, health services provide mothers and other caregivers with the information they need to ensure the optimum growth of children as well as to identify health problems that may be evidence of, and/or contribute to, micronutrient deficiencies. If, for example, local clinics are absent or scarce, evidence of growth faltering may easily be overlooked, and children may not receive medical attention until they are so severely undernourished that they require hospitalization.

## 2.3 Groups at Risk

Although the epidemiology of multiple nutrient deficiencies varies in some respects, according to geographic setting, socio-economic class, and an assortment of other factors, certain commonalities exist. The groups at greatest risk include women of reproductive age (especially those who are lactating, pregnant, or both), infants and young children, adolescents, and elderly people (Ramakrishnan & Huffman, 2008). Adolescents and preschool children are at a high risk of multiple micronutrient deficiency simply because growth places greater nutritional demands on the body.

According to Underwood and Smitasiri (1999), deficiencies of vitamin A and iodine are especially common among children not only because of rapid growth but also because frequent infections lead to a loss of nutrients. In women of reproductive age, these deficiencies may be related to physiological losses, pregnancy, and lactation. In the case of iodine, severe deficiency usually occurs in mountainous areas and in frequently flooded, low-lying interior planes where, over time, iodine has been washed out of the soil.

Elderly people in most populations are at risk of micronutrient undernutrition because of a decline in appetite, decreased mobility, which can complicate physical access to food, and, above all, a decline in income. Added to these are disease-related factors that impair food absorption and increased nutritional requirements during periods of illness or recovery from surgery (Underwood & Smitasiri, 1999).

# 3. PATHOPHYSIOLOGY AND CONSEQUENCES OF MULTIPLE NUTRIENT DEFICIENCIES

Undernourished adults and children with micronutrient deficiencies who live in developing countries are more likely to suffer from serious infections or die from common illnesses such as diarrhoea, pneumonia, or infectious diseases. Such deaths are due to the simultaneous presence of undernutrition and infection. A study by Pelletier et al. (1995), which drew on data from 53 developing countries, found that well over half (56%) of the deaths of children under 5 could be attributed to the effects of undernutrition and that roughly four-fifths (83%) of these nutrition-related deaths were associated with mild to moderate, rather than severe, undernutrition (see also Habicht, 2008; Schroeder, 2008).

## 3.1 Micronutrient Deficiencies: Minerals

### *3.1.1 Iron deficiency*

Anaemia, characterized by low blood haemoglobin concentration, is most frequently due to iron deficiency, but it can also result from chronic disease or deficiencies in folate or in vitamin $B_{12}$. Mild iron deficiency with depleted iron stores, but without anaemia, can also impair iron function. The most commonly recommended cut-offs for anaemia are a haemoglobin concentration of less than 110 g/L for children under 5 and for pregnant women; <115 g/L for children 5-11; less than 120 g/L for children aged 12-14 and for non-pregnant women; and less than 130 g/L for men (WHO, 2011a). Haemoglobin and serum ferritin concentrations can, however, be affected by inflammatory conditions and disease, such as malaria and HIV infection. Therefore,

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measurement of serum transferrin receptors is recommended to distinguish between anaemia caused by chronic infection and iron-deficiency anaemia, although this approach may not be feasible in developing countries because of its cost. Haemoglobin concentrations can be measured in field studies with a HemoCue®, an instrument that provides adequate accuracy and precision (Hudson-Thomas et al., 1994).

Low haemoglobin concentration affects the capacity of blood to carry oxygen and consequently causes fatigue, impaired cognitive function, and behavioural changes. In more severe iron deficiency, the patient develops pallor of the conjunctiva, palms, tongue, and nailbeds. In dark-skinned people, pallor can most easily be detected on the inside of the lips and eyelids (King & Burgess, 1996). Eventually, the tongue papillae become flatter and pale, nails become spoon shaped (koilonychia), and the spleen may become enlarged (splenomegaly) (Vijayaraghavan, 2004).

Because iron deficiency decreases the oxygen-carrying capacity of haemoglobin, as well as impairing on enzymes and muscle function, it can reduce work performance. In developing countries, where a large proportion of the economic output is from physical labour, a reduction in work performance due to iron deficiency can cause substantial economic damage (Ramakrishnan & Semba, 2008). Deaths associated with very severe anaemia (haemoglobin <50 g/L) occur in times of increased physiological demand, for example during acute fever or after childbirth, when oxygen delivery is compromised (Allen, 1997). Iron-deficient persons have an increased absorption of lead and therefore an increased risk of lead poisoning. Treatment of lead poisoning with iron supplements may even help to reduce the lead overload (Hammad et al., 1996).

Iron is a pro-oxidant and thus may increase oxidative stress and exacerbate some types of infections. Limited data indicate that iron deficiency increases the morbidity and mortality of infectious diseases in children but that oral iron supplementation is not associated with a reduction in morbidity (Gera & Sachdev, 2002). Parasitic infestation with *Trichuris trichiura* and hookworm can lead to iron deficiency anaemia. Deworming is therefore an important part of anaemia control in areas where these parasites are endemic (Ramakrishnan & Semba, 2008).

### *3.1.2 Iodine deficiency*

The diagnosis of iodine deficiency disorder (IDD) is based on urinary iodine concentration. Although iodine status is assessed individually, the focus is generally on the prevalence of IDD within a particular group, community, or population, as reflected in median values for urinary iodine concentration (see Table 9.1).

**Table 9.1:** Relative severity of iodine deficiency in a population

| Iodine status | Median urinary iodine concentration (µg/L) |
|---|---|
| Severe deficiency | <20 |
| Moderate deficiency | 20–49 |
| Mild deficiency | 50–99 |
| Ideal intake | 100–200 |

*Source: WHO et al., 1999.*

Iodine is necessary for the production of the thyroid hormone thyroxine ($T_4$), which is essential to the regulation of the body's metabolism. Iodine deficiency leads to a drop in the production of these hormones, which prompts the pituitary gland to produce more TSH (thyroid stimulating hormone). This in turn causes the thyroid gland to enlarge, in an attempt to compensate. An enlarged thyroid gland, or goitre, is the most obvious symptom of IDD. The severity of goitre is based on the size of the thyroid gland (see Table 9.2).

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**Table 9.2:** Classification of goitre

| Grade | Size of the thyroid gland |
|---|---|
| 0 | No palpable or visible goitre |
| 1 | Palpable goitre, not visible when the neck is in the normal position; goitre moves upwards in the neck as the subject swallows; some nodular alterations |
| 2 | Visible swelling in the neck |

*Source: West et al., 2004.*

The total goitre rate in a community or population is calculated as the sum of percentages of subjects with grades 1 and 2. For example, a rate above 5% in 6-to-12-year-old children indicates the presence of a public health problem (West et al., 2004). In areas where the iodine content of the soil and water is extremely low, goitre is common, to the point that it is said to be endemic.

Goitre itself is not a dangerous physical condition, except when extremely large goitres interfere with swallowing and breathing. However, particularly for women and children, the consequences of IDD can be serious. In women, iodine deficiency can cause infertility, while iodine deficiency during pregnancy is associated with harm to the foetus, in the form of slower growth and impaired psychomotor and cognitive development, as well as high perinatal mortality.

In children, severe iodine deficiency can lead to a condition of impaired growth and intellectual disability known as cretinism. Neurological cretinism is characterized by normal stature but severe intellectual disability and deaf mutism. In hypothyroid or myxoedematous cretinism, the pattern is reversed: growth retardation is severe, but intellectual disability less so. Endemic cretinism is associated with areas in which the prevalence of endemic goitre is greater than 30% (West et al., 2004; Semba & DeLange, 2008). Preventing iodine deficiency during foetal life and early childhood, when the developing brain is particularly vulnerable, is therefore of critical importance. Otherwise, irreversible changes during brain development can cause permanent neurological defects (West et al., 2004).

### *3.1.3 Zinc deficiency*

There is currently no simple, low-cost indicator of zinc status, one that is sufficiently sensitive and specific. Blood (i.e., plasma or serum) zinc concentrations is the most widely used indicator, but the concentration change during infection, inflammation, chronic disease, liver disease, pregnancy, and malnutrition. All the same, many recommend that efforts be made to monitor the blood zinc concentration of children in developing countries (Brown, 1998; Shrimpton & Shankar, 2008). As cut-off points indicative of zinc deficiency, Gibson (2006) proposes a blood zinc concentration of under 10.7 µmol/L (<70 µg/dL) for fasting blood samples and under 9.9 µmol/L (<65 µg/dL) for non-fasting blood samples. Also recommended is the measurement of dietary zinc intake. Estimated average requirements (EARs) for zinc are available and provide a guide to adequate intake (see Appendix III). Zinc deficiency is considered to be a public health concern in a community when the prevalence of low blood zinc concentrations and/or the rate of stunting among children under 5 is greater than 20% and/or when the prevalence of inadequate zinc intake is greater than 25% (IZiNCG, 2004).

Clinical manifestations of zinc deficiency are non-specific, but severe zinc deficiency is characterized by loss of hair (alopecia), diarrhoea, increased incidence of infections, skin lesions in the extremities, and anorexia. In extreme cases, individuals suffering from severe zinc deficiency may die from infections and diarrhoea. In children, it is also implicated in severe growth retardation, with stunting, hypogonadism, and delayed sexual maturation (Shrimpton & Shankar, 2008). Severe zinc deficiency also causes impaired neuropsychological function, and, in children, even a moderate deficiency of zinc hinders cognitive performance (Sandstead et al., 1998). In addition, individuals suffering from severe zinc deficiency may die from infections and diarrhoea. Suboptimal zinc status results in down-regulation of the immune system and increased susceptibility to infection (Shankar & Prasad, 1998). Mild zinc deficiency may be associated with impaired taste (hypogeusia) and poor healing of wounds. A low zinc-to-energy ratio in the diet is associated with a diminished rate of growth of lean body mass, although adipose tissue may still be deposited (Golden & Golden, 1981).

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## 3.2 Micronutrient Deficiencies: Vitamins

### *3.2.1 Vitamin A deficiency*

Vitamin A deficiency manifests itself in an abnormally low level of retinol (one of the forms of vitamin A) in the blood. The cut-off point recommended by the WHO is 0.70 μmol/L. Serum retinol is most commonly measured in young children, who are especially vulnerable to the effects of vitamin A deficiency. The prevalence of low serum retinol in a given population of children is regarded as an indicator of the prevalence of vitamin A deficiency in the population overall. According to the WHO (2011b p. 2), the severity of the vitamin A deficiency as a public health problem is reflected in the percentage of children aged between 6 months and 6 years who have a serum retinol level of 0.70 μmol/L or below, as follows:

| | |
|---|---|
| 2% to 9% | mild |
| 10% to 19% | moderate |
| 20% or more | severe |

It is important to note that serum retinol levels are a reliable indicator of the amount of vitamin A stored in the liver only at extremes, that is, when these stores are either severely depleted or excessively large (WHO, 2011b).

The human body needs vitamin A in order to maintain the integrity of epithelial tissue and to allow the immune system to function properly. The consequences of vitamin A deficiency include anaemia, impaired immunity causing increased susceptibility to infection (see below), poor growth, and, in extreme cases, death (West & Darnton-Hill, 2008). The earliest clinical symptom of vitamin A deficiency is night blindness, that is, the inability to see in relatively low light. This is caused by lack of retinal (a form of vitamin A) in the retina.

Vitamin A is involved in mucus production in epithelia tissues. Deficiency leads to dryness in epithelial tissues in various organs including the mouth, stomach, intestines, lungs, and vagina. Dryness of the eyes is known as xerophthalmia. The conjunctiva – the thin membrane that covers the white part of the eye (the sclera) and also lines the eyelids – is composed of epithelial tissue, as is the outermost layer of the cornea. Dryness of the outer layer of the cornea because of inadequate mucus production leads to a disorder known as Bitot's spots. This eventually progresses to blindness (Sommer, 1995; Ahmed & Darnton-Hill, 2004). Vitamin A deficiency is the leading cause of blindness in developing countries.

The consequences of vitamin A deficiency are most serious during infancy, childhood, and pregnancy (Ahmed & Darnton-Hill, 2004; WHO, 2000). In children, it is associated with poor growth, an association that is often signalled by the concomitant presence of xerophthalmia, a condition frequently observed in children suffering from stunting and wasting. When a child receives vitamin A supplements, recovery from xerophthalmia often occurs in tandem with weight gain and an increase in lean body mass (West et al., 1997). Pregnant women who are deficient in vitamin A and also infected with HIV run a greater risk of transmitting the virus to their children (Semba et al., 1994).

A reciprocal relationship exists between vitamin A deficiency and vulnerability to infection. Vitamin A deficiency compromises the immune system, leading to a higher rate of respiratory, gastrointestinal, and urinary tract infections. During infection, there may be a decreased intake of vitamin A as a result of anorexia, malabsorption of vitamin A due to diarrhoea, increased retinol utilization by target organs, and increased excretion of retinol in the urine (Semba et al., 2000; West & Darnton-Hill, 2008). Findings from many clinical trials report a consistent picture that giving vitamin A supplements to young children leads to substantial reductions in all-cause mortality (24% reduction), mortality associated with diarrhoea (28% reduction), and a reduced prevalence of vision problems (32% reduction), including night blindness (Mayo-Wilson et al., 2011).

### *3.2.2 Vitamin D deficiency*

Vitamin D deficiency impairs the body's ability to absorb calcium and is therefore associated with bone weakness. In children, it is associated with rickets, and, in adults, with a condition characterized by osteomalacia (thinning of the bones) and osteoporosis (reduced density of bone mineral). During pregnancy, vitamin D deficiency is associated with poor maternal weight gain, and, in infants, with a higher incidence of neonatal hypocalcaemia, as well as poor neonatal bone mineralization and reduced linear growth (Pettifor,

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2008). Vitamin D deficiency appears to impair the functioning of the immune system. As a result children who are deficient in the vitamin are predisposed to infections.

Vitamin D is examined in more detail in Chapter 13, especially the question of its relationship to chronic diseases.

### 3.3 Micronutrient Interactions

Micronutrient interactions become important when nutrient intakes are inadequate, and such interactions may aggravate undernutrition by causing anorexia and decreased food intake (Golden & Golden, 1991). Vitamin C needs to be present in the gastrointestinal tract in order to improve the absorption of non-haeme iron, but zinc and calcium compete with iron for absorption. Zinc is necessary for the synthesis of retinol-binding protein needed for the transport of vitamin A, with the result that zinc deficiency can exacerbate vitamin A deficiency. Vitamin A deficiency, in turn, inhibits iron utilization and thereby contributes to the development of anaemia (West & Darnton-Hill, 2008).

Zinc and iron metabolism are also interrelated (Ramakrishnan & Huffman, 2008). Despite the competition between iron and zinc for absorption, daily supplementation of the diets of pregnant women with both iron and zinc reduces infection rates, preterm deliveries, and low birth weights (Whittaker, 1998). In one study, anaemic pregnant women who took supplements of both iron and vitamin A were more likely to recover from anaemia than were women who took either iron or vitamin A alone (Suharno et al., 1993). Daily supplementation of the diets of pregnant women with both iron and folic acid was associated with increased birth length and birth weights of infants, suggesting an interaction or synergistic effect between iron and folate (Achadi et al., 1995). (The term *folate* refers to the naturally occurring form of the vitamin; the supplement is called *folic acid,* which is a synthetic form of the vitamin.) Deficiencies of a number of micronutrients – notably iron, zinc, iodine, folate, and vitamins A and $B_{12}$, as well as protein and energy – separately and jointly contribute to childhood growth faltering and disrupt cognition as well as motor and intellectual development (Ramakrishnan & Huffman, 2008).Studies of HIV-infected individuals have indicated low blood concentrations of several micronutrients, such as vitamins A, zinc, and selenium (Fawzi, 2003). There is uncertainty whether these low levels indicate deficiencies and about the role of poor micronutrient status on immune response, on the rate of transition from HIV to AIDS, and on the mother-to-child transmission of HIV also remains to be fully understood. Infections and inflammation activate the immune response, releasing free radicals that can damage cell membranes, injure T-cells, and compromise cell-mediated immunity. Evidence indicates, however, that micronutrients that act as antioxidants may reduce the risk of diseases associated with oxidative stress, such as cancer, coronary heart disease, and HIV infection (Ramakrishnan & Huffman, 2008).

## 4. THE NUTRITIONAL MANAGEMENT OF MULTIPLE NUTRIENT DEFICIENCIES

### 4.1 The Clinical Management of Undernutrition

Nutrition programmes have been found to achieve the greatest impact when they target vulnerable groups, such as pregnant women and children under the age of 3. The interventions likely to be most effective include those that promote exclusive breast-feeding during the first six months of life, followed by partial breast-feeding until two years of age; the introduction of high-quality and micronutrient-enriched complementary foods at the age of six months; supplementary feeding when necessary; and micronutrient supplementation. Implementation of these interventions should take into account the local needs and culture of the population, be integrated into the health service, and incorporate appropriate communication strategies aimed at behaviour change (Schroeder, 2008).

In developing countries, management of undernutrition is most commonly based on the Integrated Management of Childhood Illness (IMCI) guidelines developed by the WHO (2001), which community health workers should be trained to follow. The first step is, of course, to assess a child for any danger signs, such as an inability to drink or to breast-feed, persistent vomiting, convulsions, lethargy, or loss of consciousness. Such signs indicate an urgent need for specific management and referral to a hospital.

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As part of a nutritional assessment (see Table 9.3), a health worker should begin by asking the child's mother or caregiver about weight loss, as well as looking for visible signs of wasting and/or oedema of both feet. The health worker should also weigh the child and plot the weight on a standard growth curve. If the child has been brought to the clinic before, and the clinic has a record of earlier weights, the child's individual growth curve can be assessed. (The WHO child growth standards, available at http://www.who.int/childgrowth/standards/en, provide information on weight-for-age, length-/height-for age, weight-for-length/height, and BMI-for-age. Their use was discussed in Chapter 7.) On the basis of the pattern of growth, the child can be classified as growing well, not growing well (flattening of the growth curve for two consecutive monthly visits or underweight), or severely malnourished (visible severe wasting and/or oedema). The child who is not growing well can be managed as outlined in Table 9.3.

The health worker should also take a proper history on a child's first visit, assess the child for underlying disease (especially tuberculosis and HIV), counsel the mother or caregiver about feeding, deworm the child, check for symptoms of vitamin A deficiency, and provide iron supplements if anaemia is identified. If need be, and if one is available, children may also be referred to a supplemental feeding programme.

**Table 9.3:** The assessment and treatment of the undernourished child

| Ask | Has the child been eating well? Or has the child lost weight or been ill? |
|---|---|
| Look and feel | Weigh the child, plot the weight on a standard growth chart, and evaluate as<br>- normal weight<br>- low weight<br>- very low weight<br><br>Look at the shape of the growth curve to determine whether there is<br>- weight gain<br>- unsatisfactory weight gain (flattening of curve)<br>- weight loss<br><br>Look for visible signs of wasting.<br>Feel both feet for oedema. |
| Classify | *Severe undernutrition (visible severe wasting, oedema, weight 60% or less than expected)*:<br>- Start antibiotics.<br>- Check blood glucose.<br>- Keep child warm.<br>- Give vitamin A.<br>- Refer urgently to a hospital. |
| | *Not growing well (weight below 3rd percentile but above 60% of expected weight)*:<br>- Assess feeding and counsel mother/caregiver.<br>- Deworm child.<br>- Determine whether vitamin A supplementation is needed.<br>- Treat underlying illness (diarrhoea, pneumonia, etc.).<br>- Screen for tuberculosis and treat if necessary.<br>- Follow up feeding problem in 5 days; if no feeding problem, follow up in 14 days. |
| | *Growing well:*<br>- Assess feeding and counsel.<br>- Deworm child.<br>- Determine whether vitamin A supplementation is needed. |

Children with severe undernutrition are at risk of death. Substantial reductions in mortality can be achieved with appropriate management. Severely malnourished children generally require hospitalization and should be managed according to the WHO guidelines for the inpatient treatment of severe undernutrition (see Table

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9.4). Management should occur in two phases: a stabilization phase (week 1) and a rehabilitation phase (weeks 2 through 6).

**Table 9.4:** Management of the child with severe undernutrition

| Step | Recommended management |
|---|---|
| Treat or prevent hypoglycaemia (blood glucose <3 mmol/l) | - Feed immediately with start-up formula or give 10% glucose orally.<br>- If the child develops hypoglycaemia, feed every 2 hours, day and night.<br>- Treat infection with broad spectrum antibiotics.<br>- Monitor blood glucose. |
| Treat or prevent hypothermia (axillary temperature <35.0° C) | - Feed every 3 hours, day and night.<br>- Keep child warm.<br>- Give antibiotics. |
| Treat or prevent dehydration | - Rehydrate orally slowly using a low-sodium rehydration solution.<br>- Avoid intravenous fluids except in shock.<br>- Monitor for signs of overhydration, especially respiratory and pulse rates. |
| Correct electrolyte imbalance | Ensure the following:<br>- Extra potassium 3 to 4 mmol/kg/day<br>- Extra magnesium 0.4 to 0.6 mmol/kg/day<br>- Low-salt diet |
| Treat or prevent infection | Administer the following:<br>- Broad-spectrum antibiotics (ampicillin and gentamicin)<br>- Measles vaccine |
| Correct micronutrient deficiencies | Administer the following:<br>- Vitamin A<br>- Multivitamin supplement<br>- Folic acid 1 mg/day<br>- Zinc 2 mg/kg/day<br>- Copper 0.3 mg/kg/day<br>- Iron 3 mg/kg/day when oedema resolved, infection treated, and the child is gaining weight |
| Start cautious feeding | - If the child is breast-fed, have mother continue breast-feeding.<br>- Give small, frequent feeds orally or via nasogastric tube.<br>- Use the F-75 starter formula: 75 kcal (315 kJ)/100 ml and 0.9 g protein/100 ml.<br>- Feed every 2 hours if the child is very sick; otherwise feed every 3 hours, day and night. |
| Achieve catch-up growth | - Replace the F-75 formula with the F-100 formula: 100 kcal (420 kJ) and 2.9 g protein/100 ml.<br>- Increase amount of food, as much as the child can take.<br>- Introduce family meals and keep record of intake and output.<br>- Monitor weight gain and aim for 10 g/kg/day. |
| Provide sensory stimulation and emotional support | - Involve the mother or other caregiver in comforting, feeding, and bathing child.<br>- Provide stimulating environment and structured play. |
| Prepare for follow-up after recovery (when child's weight is within 1 SD) | - Take history on socio-economic status and feeding practices.<br>- Advise caregiver about frequent high-energy and nutrient-dense foods and structured play.<br>- Advise about regular clinic visits for growth monitoring, vitamin A supplementation, and immunization. |

*Source: Adapted from Ashworth et al., 2003.*

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The major elements in the management of severely malnourished children include:

- Note medical aspects that relate to the treatment of hypoglycaemia; maintain body temperature by covering the child, providing an external heat source, and ensuring frequent feeding; and treat infections with broad-spectrum antibiotics.
- Promote repair of cellular structure by providing potassium and magnesium, limiting the intake of sodium, and ensuring an adequate intake of micronutrients.
- Provide an initial energy intake of 91 kcal (380 kJ)/kg/day to maintain weight and prevent the refeeding syndrome (metabolic disturbances that occur as a result of feeding patients who are starved or severely malnourished); ensure a protein intake of no more than 1 g/kg/day because excretion is impaired and a higher intake could lead to an excess of amino acids that cannot be flushed from the body.
- Do not administer iron during the stabilization phase because it is associated with increased mortality.
- When the child's appetite has improved, provide an energy intake of 150 kcal (630 kJ)/kg/day and a protein intake of 4 g/kg/day, as recommended. Weight gain during this phase should average 10 g/kg/day. A record must be kept of food intake.
- Sensory stimulation is also important in the rehabilitation phase and should include structured play and the involvement of the mother or other caregiver.

Discharge should be considered when oedema has been resolved and infections have been treated, when weight gain is good, and when the mother or other caregiver has received the appropriate counselling and follow-up has been arranged.

Hospitals often cannot fully rehabilitate severely malnourished children because of insufficient hospital capacity. As a result, there is a growing focus on the community-based management of severely malnourished children. Once their appetite has returned, children can be managed at home using a treatment programme that is integrated into the existing health-care system. Promising results have been achieved with home-based care using ready-to-use therapeutic food (RUTF), an energy-dense paste that can be eaten directly from the packet and resists bacterial overgrowth because of its low water content (Ciliberto et al., 2005). Recovery rates in this study among severely malnourished children in Malawi were 78% compared to 46% with the standard WHO protocol. This confirms that, to achieve optimal recovery, severely malnourished children require supplemental foods high in energy and fat (Manary & Solomons, 2004).

## 4.2 Nutrition Education

Nutrition education, which will be discussed in greater depth in Chapter 15, aims to encourage healthy eating habits. Nutrition education that is directed at mothers and other caregivers seeks specifically to promote optimal feeding practices, as well as good prenatal care. It generally consists of information and advice designed to influence feeding behaviour overall, but it can include relatively specific information, such as recipes for improved complementary feeding. While nutrition information is often disseminated by community health workers, a crucial role can be played byschools and other local organizations, especially in the case of older children. As part of its IMCI approach, the WHO offers guidelines with regard to feeding practices (see Table 9.5), which health workers commonly follow when counselling mothers of infants and young children.

Various studies have sought to assess the impact of nutrition education and counselling (Penny et al., 2005; Bhandari et al., 2004; Mackintosh et al., 2002). Although nutrition education cannot fully offset the many factors that play into the development of malnutrition, the findings from these studies show that it can help to reduce the number of children who suffer the often serious consequences of nutrient deficiencies.

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**Table 9.5:** Infant and child feeding: IMCI recommendations

| Age | IMCI recommendations |
|---|---|
| Up to 6 months | *For HIV-negative mother or mother of unknown HIV status:*<br>- Breast-feed as often as the child wants, day and night.<br>- Feed the child at least eight times in 24 hours.<br>- Do not give other foods or fluids, not even water.<br><br>*For HIV-positive mother:*<br>- Breast-feed exclusively as often as the child wants, day and night.<br>- Do not give other foods or fluids.<br>- Make the transition to replacement feeding as soon as this is accessible, feasible, affordable, sustainable, and safe (AFASS).<br>*or*<br>- If replacement feeding is AFASS, give formula exclusively.<br>- Cup feeding is safer than bottle feeding (if formula is used). |
| 6 to 12 months | *For HIV-negative mother or mother of unknown HIV status:*<br>- Breast-feed as often as the child wants.<br>- Introduce soft porridge, vegetables, and fruit.<br>- Gradually increase the frequency and amount of feedings. At 6 to 8 months the child should eat two meals per day, and at 12 months this should increase to five meals a day.<br>- Provide a variety of locally available foods.<br>- For children who are not growing well, mix margarine, fat, or oil with porridge.<br>- Fruit juices, tea, and sugary drinks should be avoided before 9 months.<br><br>*For HIV-positive mother:*<br>- Safely transition from exclusive breast-feeding to no breast-feeding.<br>- Avoid breast-feeding if AFASS criteria are met.<br>- For complementary foods and formula, do the same as for a mother who is HIV negative or of unknown status.<br>- If child not breast-fed, give three cups of full-cream milk each day.<br>- If child gets no milk, give six complementary feedings per day. |
| 12 months to 2 years | *For HIV-negative mother or mother of unknown HIV status:*<br>- Continue breast-feeding as often as the child wants.<br>- If no longer breast-feeding, give full-cream milk every day.<br>- Provide at least five nutritious meals daily.<br>- Give locally available protein daily.<br>- Give fresh fruit and vegetables twice a day.<br>- Give foods rich in iron and vitamins A and C.<br>- Feed actively<br><br>*For HIV-positive mother:*<br>- Feed as for mother who is HIV-negative or of unknown HIV status. |
| 2 years and older | *For HIV-negative mother or mother of unknown HIV status:*<br>- Give the child her own serving of family foods three times a day.<br>- In addition, provide two nutritious snacks such as bread with peanut butter, full-cream milk, or fresh fruit between meals.<br>- Continue active feeding.<br>- Give foods rich in iron and vitamins A and C.<br><br>*For HIV-positive mother:*<br>- Feed as for mother who is HIV-negative or unknown HIV status. |

*Source: Adapted from DOH (Department of Health, South Africa), 2011*

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## 4.3 Food-Based Approaches to Nutrition Management

Food-based strategies are the most obvious way to overcome multiple nutrient deficiencies. One such food-based strategy is dietary diversification, which aims to broaden the diet to include foods that are naturally rich in micronutrients. Another is food fortification, in which micronutrients are added to foods that form part of the existing diet (FAO & ILSI, 1997). Whereas food fortification often targets a specific micronutrient, dietary diversification addresses multiple micronutrient deficiencies simultaneously.

Dietary diversification is the most sustainable way of addressing micronutrient undernutrition, although the benefits are not immediate and implementation should simultaneously include short-term strategies, such as micronutrient supplementation. Production of micronutrient-rich foods can occur through various approaches: small-scale community vegetable and fruit gardens; school-based gardens; production of fish, poultry, and small animals; and the commercial production of micronutrient-rich foods. Key resources needed to ensure the success of these projects include access to water, a regular supply of seeds, capital, or credit to purchase inputs, training on how to grow and care for crops, an adequate labour force, fencing, access to markets, and availability of fertilizer and pesticides. A nutrition education component should be linked to these projects to ensure the increased consumption of micronutrient-rich foods (FAO/ILSI, 1997).

Dark green, leafy vegetables are important sources of folate, vitamins A and C, and calcium, and the consumption of legumes can improve iron, folate, thiamine, and riboflavin status (Ramakrishnan & Huffman, 2008; Faber et al., 2002). While the consumption of fruit and vegetables should therefore be encouraged, meat and dairy products are often a better source of multiple micronutrients. For example, the inclusion of dark green, leafy vegetables, orange-fleshed vegetables, and red and orange fruits in the diet can increase the intake of provitamin A carotenoids, which are converted to retinol, the active form of the vitamin; however, liver, eggs, and milk are the richest source of preformed vitamin A. In addition, organ meats provide vitamins D, E, and folate. The consumption of meat and dairy products can also lead to improvements in the status of iron, calcium, zinc, thiamine, riboflavin, and vitamins $B_6$, and $B_{12}$; this is true for both infants and adults (Krebs et al., 2006).

Other factors can either enhance or inhibit the absorption of micronutrients. For example, in countering iron-deficiency anaemia, it is important not only to encourage the intake of iron-rich foods, such as legumes, green leafy vegetables, and meat, but also to encourage the intake of vitamin C (in the form citrus fruits, for example), which promotes iron absorption. At the same time, because tea is high in tannins that can inhibit iron absorption, it is best not to drink it with foods that would otherwise be excellent sources of iron (Vijayaraghavan, 2004).

Although legumes are a good source of protein as well as iron, they contain phytate, an antinutrient that inhibits the absorption of iron, zinc, and other minerals. Impoverished people tend to consume a diet high in both cereals and legumes, staple foods that are often associated with unsatisfactory growth, probably owing to their high fibre and phytate content. These substances bind to minerals and as a result reduce their intestinal absorption. Household food preparation methods that involve soaking cereals and legumes prior to cooking help promotes the enzymatic hydrolysis of phytate, while also deactivating certain antinutrients, thereby increasing the bioavailability of iron and zinc.

> *"The road to regional health and life-long productivity cannot be passed without removing the obstacle of vitamin and mineral deficiency."*
>
> Joseph Hunt, Health and Nutrition Adviser, Asian Development Bank

## 4.4 Food Fortification

Food fortification improves the quality of the diet by the addition of nutrients to food above and beyond the levels at which these nutrients naturally occur. In developing countries, food fortification offers a sustainable and cost-effective means of improving the micronutrient status of at-risk populations. For fortification methods to be effective, the food used must have the following characteristics:

- The food should be consumed in significant quantities by most members of the target population
- Its nutrient level should be stable during processing, cooking, and storage

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- There should be no changes in the organoleptic properties (colour, taste, and appearance) of the food following fortification.

Developing a successful and affordable food fortification programme requires collaboration between government agencies and the food industry. It must, of course, be possible to implement the programme effectively in its intended context. In addition, the programme needs to include a quality assurance system whereby micronutrient levels in the fortified food are monitored regularly to ensure that the product still contains the specified micronutrient concentration at the time of its consumption (FAO & ILSI, 1997). In one estimate, the cost of a micronutrient, when used as a fortificant in food, ranged from $0.05 to $0.25 per person per year, making food fortification sufficiently affordable to be sustainable (Horton, 2008).

Perhaps the most familiar example of food fortification is the addition of iodine to salt, which is now required by law in most countries. Salt is both inexpensive and widely consumed, and the iodization process is not complicated. Iodized salt has thus proved to be the most effective method of preventing and controlling iodine deficiency disorders. Potassium iodate is the preferred fortificant, because of its stability. An iodine concentration of 20 to 40 mg per kg of salt is recommended. This takes into account losses during storage and cooking and is estimated to provide 150 µg of iodine per person per day. Increasing access to iodized salt can reduce brain damage and intellectual disability (Semba & Delange, 2008). Improving the iodine status of farm animals increases the iodine content of meat, milk, and eggs, which can in turn improve the iodine status of humans.

Along similar lines, several Central American countries have passed legislation requiring that household sugar be fortified with vitamin A. This has led to a significant reduction in the proportion of preschool children suffering from vitamin A deficiency (FAO & ILSI, 1997). In Guatemala, the fortification of sugar was found to be two to four times more cost effective than the use of vitamin A supplements in supplying recipients with adequate amounts of the vitamin (Phillips et al., 1996). Studies conducted with rural Filipino children have, for example, demonstrated that the fortification of margarine and wheat flour with vitamin A improves vitamin A status (Solon et al., 2000; Solon et al., 1996). Other food vehicles used for vitamin fortification include fats and oils, milk, tea, cereals, instant noodles, rice, and infant formulas (Ramakrishnan & Huffman, 2008).

The fortification of commonly consumed foods with iron poses certain difficulties, given that some forms of iron, such as ferrous sulphate, can alter the colour and taste of the fortified food (Trowbridge & Martorell, 2002). These difficulties can be circumvented by the use of the ferric form of iron, which is therefore recommended. Foods that can be fortified with iron include wheat flour, cereals, milk powder, infant formula, sugar, curry powder, and soy and fish sauces (Vijayaraghavan, 2004; Ramakrishnan & Semba, 2008). It is estimated that the fortification of wheat flour with iron could improve the iron intake of large numbers of people and meet at least one-third of the recommended daily allowance (RDA) of iron for women who are not pregnant, thereby reducing the prevalence of iron-deficiency anaemia. However, the fortification of wheat flour is less effective in improving iron intake in infants and preschool children because they consume less flour than do adults (Ramakrishnan & Semba, 2008). A better option, at least in southern Africa, may be the maize-meal porridge commonly fed to infants. In one study, a version of this porridge fortified with the RDA of iron, beta-carotene, and zinc, as well as with copper, selenium, ascorbic acid, B vitamins (riboflavin, $B_6$, and $B_{12}$), and vitamin D, decreased the incidence of anaemia and improved the iron status and motor development of infants aged 6 to 12 months (Faber et al., 2005).

One innovative approach to addressing iron-deficiency anaemia is the use of microencapsulated ferrous fumarate and ascorbic acid in the form of "sprinkles" that can be added to complementary foods without changing their colour or taste. In infants, ferrous sulphate drops, administered three times a day, are a standard approach to the treatment of anaemia, but adherence to this form of treatment tends to be poor. A study conducted in rural Ghana compared the effects of sprinkles versus ferrous sulphate drops in two groups of children aged 6 to 18 months. Iron-deficiency anaemia was successfully treated in each group to a similar extent (58% of the sprinkles group and 56% of the drops group), but because the sprinkles are easier to administer, they are likely to produce better long-term results (Zlotkin et al., 2001).

Food fortification also offers an effective way to address zinc deficiency. Either zinc oxide (ZnO) or zinc sulphate ($ZnSO_4$) can be used as a fortificant. Foods that have been fortified with zinc include maize meal

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and wheat flour, as well as milk powder provided to high-risk infants and young children. Complementary food supplements have also been developed that supply zinc at one to two times the RDA, whether in the form of water-soluble tablets, sprinkles, or spreads. A reduction in biochemical zinc deficiency, as well as an improvement in weight gain, has been reported in children who consume a food-based multiple micronutrient supplement (Gibson, 2006).

The fortification of staples such as wheat flour and maize meal with multiple micronutrients is common in developing countries, especially Latin America (Ramakrishnan & Huffman, 2008). In South Africa, regulations for the mandatory iodization of salt and the fortification of maize meal and wheat flour came into effect in 1995 and 2003, respectively (the National Food Fortification Programme). Under this programme children aged 10 or older who consume 200 grams of fortified maize meal and/or wheat flour are provided with 31% of the RDA for vitamin A, as well as thiamine (25%), niacin (25%), vitamin $B_6$ (25%), folate (50%), riboflavin (17% from maize, 20% from wheat flour), iron (25% from unsifted maize meal, 50% from wheat flour), and zinc (20%). An evaluation of the impact of the programme showed that the two most effective measures have been the salt iodization programme, which has virtually eliminated iodine deficiency, and multiple micronutrient food fortification, which has reduced folate deficiency. The latter may also have contributed to the declining trend in the prevalence of stunting in children aged 1 to 9 years, from 21.6% in 1999 to 18% in 2005 (Labadarios, 2007).

## 4.5 Supplementation with Micronutrients

The use of vitamin and mineral supplements is generally regarded as an interim strategy intended to reduce micronutrient deficiencies in populations until medium- to long-term measures (dietary diversification and food fortification) can be established. Once the latter are in place, supplementation may be targeted at populations that may not be adequately covered by food-based programmes (Ahmed & Darnton-Hill, 2004).

### *4.5.1 Vitamin A*

Vitamin A supplementation has been described as "one of the best-proven, safest and most cost-effective interventions in international public health" (Ross, 2002). High-dose vitamin A supplementation has an efficacy of 90% in preventing xerophthalmia over a 6-month period.

A meta-analysis of randomized controlled trials showed that vitamin A supplementation could reduce child mortality by at least 23% (Beaton et al. 1993). However, the evidence is much weaker regarding the value of vitamin A supplementation for infants. A review of research on the effects of prophylactic vitamin A in children under the age of one month did not produce any evidence that such supplementation contributed to a reduction in mortality or morbidity during the child's first 12 months of life (Gogia & Sanchez, 2009). However, the WHO currently recommends that infants be given a single 100,000 IU dose sometime between the ages of 6 and 11 months and that children thereafter receive a 200,000 IU dose every 4 to 6 months, from the age of 12 months until they reach 5 years (WHO, 2011c). Although it was previously thought that high-dose vitamin A supplementation in postpartum women (two 200,000 IU doses given a day apart) would reduce infant morbidity and mortality, the evidence is inconclusive, and the WHO currently does not recommend this as a routine practice (WHO, 2011d).

Vitamin A can be delivered through targeted, preventive, or universal supplementation. Targeted supplementation restricts the delivery of vitamin A to individuals who are suffering from xerophthalmia, severe undernutrition, and/or infections such as measles, malaria, diarrhoea, and acute respiratory illnesses. Coverage may be poor, however, because it depends on the willingness and the ability of people who are ill to seek out health services. The preventive approach involves the integration of vitamin A supplementation with immunization programmes and the growth monitoring of young children who are brought to clinics. Universal supplementation consists of the delivery of vitamin A supplements to the entire population through community programmes. Social marketing is a key component in sustaining a universal vitamin A supplementation programme.

In infants and young children, vitamin A is usually delivered in the form of high-dose supplements. This approach is effective because vitamin A is stored in the liver, thereby providing reserves that the body can draw on during periods of decreased dietary intake or increased need, such as during infections. In infants,

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high-dose vitamin A supplementation is often provided in tandem with routine immunization, such as the DTP (diphtheria, pertussis, and tetanus) vaccine.

### *4.5.2 Iron*

There are two approaches to iron supplementation, depending on the prevalence of iron deficiency anaemia. In areas where the prevalence is low (less than 10% to 15%), screening for anaemia and the provision of iron supplements to those who are anaemic are recommended. In areas where the prevalence is high universal supplementation is recommended. For example, in developing countries where at least half of all infants are anaemic by 12 months of age, UNICEF recommends giving a daily dose of 12.5 mg of iron to infants between the ages of 6 and 12 months (Ramakrishnan & Semba, 2008). However, evidence suggests that in areas where malaria is endemic, iron supplementation can increase child morbidity and mortality. In such areas, universal supplementation programmes must be implemented with caution, and a targeted approach may in fact be preferable (WHO, 2006; Ramakrishnan & Semba, 2008).

Iron supplementation is generally used in the treatment of iron-deficiency anaemia. Ferrous sulphate is the most inexpensive and widely used oral preparation; other oral preparations include ferrous gluconate and ferrous fumarate. The recommended elemental dose of iron is 60 mg/day for adults and 3 mg/kg daily for children under 5. These supplements are effective if taken as intended, namely, between meals in the morning or the evening and with water or juice. Taking iron with meals or with tea, coffee, or milk reduces its absorption. Haemoglobin should rise 20 g/L over 4 weeks, and treatment should be continued for 3 months after the haemoglobin becomes normal (Vijayaraghavan, 2004).

The use of both iron and vitamin A has been found to be more effective in reducing iron-deficiency anaemia than supplementation with iron alone. Moreover, the combination of iron and folic acid supplementation in pregnant women, to guard against anaemia, is associated with an increase in the child's birth weight and length.

Iron supplementation does not always succeed in reducing anaemia. Such a failure could be due to vitamin A deficiency, to malaria, or to HIV infection. It could also be the result of poor compliance, which is a problem in any situation in which a medication or supplement must be taken on an ongoing basis for prophylactic reasons, rather than to treat symptoms. In the case of iron, the problem is aggravated by gastrointestinal side effects such as constipation, diarrhoea, black stools, and nausea. Persons given iron should be counselled about these potential problems and how best to cope with them (Ramakrishnan & Semba, 2008).

### *4.5.3 Iodine*

Although iodized salt is widely available in developing countries, it is not universally so, especially in remote rural areas. In such areas, iodine deficiency can be effectively treated by the administration of iodized oil Parasitic infections can impair the body's ability to absorb iodized oil, however, so deworming before dosing is recommended. Another option is the monthly administration of 10% potassium iodide solution (West et al., 2004).

### *4.5.4 Zinc*

Zinc supplementation is a short-term strategy to improve the zinc status of high-risk population groups, such as pregnant women, low-birth-weight infants, and malnourished children. When zinc supplements are given alone, they are best taken on an empty stomach, but when used in combination with other micronutrients, they should be taken with meals to prevent antagonistic interactions. The WHO recommends giving zinc with the oral rehydration solution used in the clinical management of diarrhoea (Gibson, 2006). Zinc for this use is provided in blister packs each containing ten 20 mg tablets that can be easily consumed.

### *4.5.5 Micronutrient toxicity*

High-dose vitamin A supplementation can lead to transient side effects, including nausea, vomiting, headache, diarrhoea, and fever, in about 10% of preschool children. About 2% of infants develop a bulging fontanelle

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(the soft spot in the child's skull) following a 50,000 IU dose of vitamin A, a rate that can increase to 4% to 8% with repeated dosing during the first 6 months of life. This side effect resolves without treatment within 48 hours of the dose, however, and has not been associated with long-term abnormalities (West & Darnton-Hill, 2008). High-dose vitamin A supplementation is best avoided in pregnant women, especially during the first semester, owing to its possible teratogenic effects.

There are concerns that fortification with iron may lead to overload in individuals with hereditary haemochromatosis, a genetic disease in which there is increased absorption of iron. However, this condition is rare in Africa and Asia and can be screened for and treated. A more common condition n Africa is a hereditary form of anaemia known as thalassaemia major. Children born with this condition lack the ability to produce normal haemoglobin and may develop iron overload as a result of repeated blood transfusions. It may be associated with a family history and the condition can be managed appropriately following clinical diagnosis. In addition, some concern exists as to whether elevated levels of iron in the body can contribute to the development of chronic disease, although the evidence for this is not clear (Ramakrishnan & Semba, 2008). Similarly, the relationship between iron supplementation and various infectious diseases remains to be fully understood. In one study conducted in a malaria-endemic population in Zanzibar, routine iron and folic acid supplementation of children was associated with an increased risk of severe illness and death (Sazawal et al., 2006). However, another large controlled clinical trial, carried out in Nepal in an area without a significant incidence of malaria, showed that iron and folic acid supplementation did not have an adverse impact on child morbidity or mortality (Tielsch et al., 2006). More research is necessary to establish the risks and benefits of routine iron supplementation in populations affected by infectious diseases, such as malaria, HIV, and tuberculosis. Iron supplementation may need to be targeted through identification of iron-deficient individuals (Ianotti et al., 2006).

## 4.6 Functional Outcomes of the Treatment of Multiple Nutrient Deficiencies

### *4.6.1 Growth and development*

A meta-analysis of 36 intervention trials showed that zinc supplementation moderately improves height in young children (Imdad & Bhutta, 2011). In terms of multiple micronutrient supplementation, some studies have shown an improvement in growth while others have not. Factors that may help explain this include, age, extent of deficiencies, and the content and intake of the supplement (Ramakrishnan & Huffman, 2008).

Studies have variously shown that the use of food and micronutrient supplementation in undernourished children improves motor development, social development, and cognitive function. In one study, feeding infants a fortified maize-meal porridge not only reduced anaemia but enhanced motor development (Faber et al., 2005). In addition, early energy supplementation, especially during the first two years of life, appears to have beneficial effects on emotional development. In a study conducted in Guatemala, undernourished children who received energy supplementation as infants showed greater levels of social involvement, more independence, and less anxiety and passivity by the time they reached school age, in comparison to children whose diet had not included supplements (Barrett et al., 1982; see also Walker et al., 2007). However, long-term benefits of food supplementation programmes have not shown consistent results.

Prenatal and post-natal supplementation with iodine has been linked to an increase in IQ, and studies conducted with infants and children at risk of stunting have shown that iron supplementation benefits motor, social-emotional, and cognitive development Walker et al., 2007). In anaemic children, iron supplementation has likewise been associated with improved motor and cognitive development (Ianotti et al., 2006). The effect of zinc supplementation on infant and child development is unclear. Some studies suggest a correlation between zinc supplementation and higher levels of activity, better development scores, and improved neuropsychological test outcomes in schoolchildren, but more extensive research is needed to confirm these findings (Gibson et al., 2006).

### *4.6.2 Morbidity and mortality*

The efficacy of vitamin A supplementation in reducing the overall mortality rates among children aged 6 to 59 months is mainly due to reductions in the number of deaths from measles, diarrhoea, and possibly

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malaria (West & Darnton-Hill, 2008). Vitamin A supplementation of women of reproductive age has been associated with a 40% reduction in maternal mortality (West et al., 1999), and in children with HIV/AIDS, with a 60% reduction in mortality (Fawzi et al., 1999). A meta-analysis of randomized controlled trials of zinc supplementation in children under 5 showed that supplementation significantly reduced the frequency and severity of diarrhoea and respiratory illnesses as well as the duration of diarrhoeal morbidity (Aggarwal et al., 2007). Zinc supplementation also reduced mortality in low-birth-weight infants and moderately improved height and weight in prepubertal children (Shrimpton & Shankar, 2008). However, further research is needed to assess the effects of zinc supplementation of pregnant women and their offspring in the areas of growth, development, mortality, and morbidity (Gibson, 2006).

## DISCUSSION QUESTIONS AND EXERCISES

1. Using the UNICEF conceptual framework, analyze the relationships among basic, underlying, and immediate causes of undernutrition in the community where you do your practical work.
2. Create a table that lists the clinical manifestations of and possible interventions for the following nutrient deficiencies: iron, iodine, zinc, and vitamins A and D. Then describe the possible interactions among these micronutrients.
3. In some developing countries, micronutrient-fortified glucose sweets have been provided to school-age children. Evaluate the benefits of this strategy and its possible shortcomings. Would you recommend this strategy? Explain why or why not.
4. In many developing countries, bread and maize meal are fortified with iron at levels below the international recommendation. Discuss the possible reasons for this practice.
5. What are the advantages and disadvantages of food fortification in comparison to the use of micronutrient supplements?
6. Children in low-income communities often have inadequate intakes of iron and zinc. Discuss the reasons for this and make a list of foods that can be eaten by these children to increase iron and zinc intake. Take this list to a grocery store where low-income families buy their food and write down the price of each food item and the number of adult servings it represents. Then calculate what it would cost per day to feed a school-age child these foods.
7. Examine the labels on a package of white flour, a loaf of brown bread, and a packet of maize meal porridge. Which minerals and vitamins have been added to these foods? Based on the nutritional problems in your community which other micronutrients should be added to these foods?

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## ADDITIONAL RESOURCES

Food and Agricultural Organization: www.fao.org

Global Alliance for Improved Nutrition (GAIN): www.gainhealth.org

ILSI Research Foundation (International Nutritional Anemia Consultative Group and International Vitamin A Consultative Group): http://www.ilsi.org/ResearchFoundation/Pages/INACG-IVACG.aspx

Micronutrient Forum: http://www.micronutrientforum.org

*Micronutrient Initiative:* www.micronutrient.org

Nutriview (free newsletter published by Nutrition Improvement Program): http://www.nutritionimprovement.com/nutriview.html

United Nations Children's Fund: www.unicef.org

World Health Organization: www.who.int

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# CHAPTER 10

# NUTRITIONAL MANAGEMENT OF HIV/AIDS, TB, AND OTHER INFECTIOUS DISEASES

*Celeste E. Naude, Lisanne M. du Plessis, and Michael K. Hendricks*

## *Outline*

- Role of nutrition in immunity and infectious disease
- Human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS)
  - Nutrition and HIV/AIDS
  - Nutritional management of HIV/AIDS
- Tuberculosis (TB)
  - Nutrition and TB
  - Nutritional management of TB
- Other infectious diseases
  - Malaria
  - Measles
  - Acute respiratory infections

## *Objectives*

At the completion of this chapter you should be able to:

- Describe the global burden of infectious disease and the disproportionate impact of these diseases in developing countries
- Explain the relationship between nutrition, immunity, and infectious diseases in general
- Describe the links between nutrition and HIV/AIDS, TB, malaria, measles, and acute respiratory infections, especially in developing countries
- Outline the pathophysiology and transmission of HIV/AIDS, TB, and acute respiratory infections, as well as the disease progression of HIV/AIDS
- Describe the nutritional management of HIV/AIDS and TB in a community setting in a developing country
- Explain the benefits of proper nutrition for people living with HIV/AIDS and TB
- Understand the interactions between nutrition and antiretroviral drugs (ARVs) and TB medications, as well as the side effects that may undermine nutritional health
- Understand the impact of HIV/AIDS and TB on food security and the importance of addressing food security as part of nutritional management
- Recognize the importance of food safety and hygiene for people living with infectious diseases


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- Describe the nutrition-specific interventions that form part of the management of malaria, measles, and acute respiratory infections

## 1. INTRODUCTION

Infectious diseases are caused by pathogenic microorganisms, notably bacteria, viruses, parasites, and fungi. These diseases can be spread, directly or indirectly, from one person to another. In this chapter, we will consider some of the most serious infectious diseases: human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS), tuberculosis (TB), malaria, measles, and acute respiratory infections (ARIs), especially pneumonia. These diseases are major causes of death, disability, and social and economic disruption for millions of people worldwide. Their prevalence in the developing world is especially alarming, not only when they are considered separately but, even more so, when they function as a lethal combination. These illnesses often strike young adults just when they would normally be contributing most to their family, their community, and their country's economic progress.

The sixth of the eight United Nations Millennium Development Goals (MDGs), adopted by world leaders in the year 2000 and set to be achieved by 2015, is to combat HIV/AIDS, malaria, and other diseases. Although considerable gains have been made since 2000, in many low- and middle-income countries progress has been insufficient. Consider the following:

- An update released by the World Health Organization in January 2014 indicated that, as of the end of 2012, 35.3 million people worldwide had HIV/AIDS. Despite a global decline in the incidence of new infections, the number of new cases in 2012 was estimated at 2.3 million, with sub-Saharan Africa accounting for two-thirds of these cases; of the approximately 1.7 million who people died of AIDS, 230,000 were children. In developing countries, roughly 10 million people were receiving antiretroviral therapy, far short of the number in need of treatment (WHO, 2014b).
- In addition, although the incidence of TB has also been declining, the disease remains a major killer, with the WHO reporting 8.6 million new cases worldwide and 1.3 million deaths in 2012 (WHO, 2014b).
- According to the *World Malaria Report 2013*, as of the end of 2012 only a little better than half (59 out of 103, or 57%) of the countries that reported ongoing malaria transmission in 2000 had met the MDG goal of reversing the incidence of the disease (WHO, 2013e).
- Pneumonia remains the leading cause of childhood mortality worldwide. The WHO estimates that approximately 1.1 million children under the age of 5 die of pneumonia each year – more than the number who die of AIDS, TB, and malaria combined (WHO 2013c).

The circular relationship between nutrition and HIV infection, TB, and other infectious diseases is reasonably well documented. Inadequate dietary intake compromises the immune system, which increases susceptibility to disease and often culminates in active disease. Disease then depresses appetite and the body's ability to absorb nutrients, and the cycle is perpetuated. Against the background of existing malnutrition in a given country, a high incidence of infectious illnesses can have serious consequences for public health, felt at the individual, community, and national levels. Even though safe and effective interventions for many of these infectious diseases exist, many people lack access to needed preventive and treatment care.

## 2. IMPACT OF INFECTIOUS DISEASES

Not only are infectious diseases very prevalent in developing countries, but people suffering from one infectious disease become more susceptible to other infectious diseases, with the result that co-infection is common. For example, persons infected with HIV/AIDS are more vulnerable to TB because of their already compromised immune function (Korenromp et al., 2005; World Food Program, 2004).

The negative impact of infectious diseases is most severe among the poorest people – people whose material, physical, and financial resources are meagre and who have limited or no access to integrated health care, prevention tools, and medications. Children are especially vulnerable to infectious diseases. Pneumonia, diarrhoea, and malaria are leading causes of death among children under the age of 5, and cerebral malaria

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can cause permanent mental impairment (Breman et al., 2004; Rudan et al., 2007). Infectious diseases, even when they do not prove fatal, also undermine the lives of adults, causing disability, a diminished capacity for enjoyment, and decreased productivity.

The lost productivity, missed educational opportunities, and extensive health care costs caused by infectious diseases take a huge toll on both families and communities. Specifically, quite apart from its impact on mortality rates, the scourge of HIV/AIDS has had far-reaching consequences in the areas of food security, health, and education and continues to seriously hamper economic and social development (ECSA-HC & FANTA, 2008). Especially in sub-Saharan Africa, the effect on households, communities, businesses, public services, and national economies has been immense. The impact of HIV/AIDS on children, in particular, cannot be overestated. As parents and family members become ill, children take on more responsibility for earning an income, producing food, and caring for family members. As of 2013, an estimated 17.8 million children worldwide – 85% of them in sub-Saharan Africa – had lost at least one parent to AIDS (UNICEF, 2013). AIDS orphans, defined by the United Nations as children one or both of whose parents have died of the disease, are vulnerable to a host of problems. In addition to malnutrition, these include "increased food insecurity, stigmatization and discrimination, reduced access to education and economic opportunities, and sexual abuse and exploitation" (de Wagt & Connolly, 2005).

Malaria is also responsible for considerable economic losses. Research conducted in 1998 revealed that, in countries with high levels of transmission, the rate of growth in gross domestic product (GDP) fell by as much as 1.3% per year, while as little as a 10% reduction in malaria was associated with a 0.3% increase in the rate of growth (Gallup & Sachs, 2001). Over the long term, these aggregated annual losses have resulted in substantial differences in GDP between countries with and without malaria, particularly in Africa. The health costs of malaria include both personal and public expenditures on prevention and treatment. Like other major infectious diseases, malaria disproportionately affects poor people, who cannot afford treatment or have limited access to health care, thus trapping families and communities in a downward spiral of poverty.

## 3. ROLE OF NUTRITION IN IMMUNITY AND INFECTIOUS DISEASE

The immune system consists of two main tiers: non-specific and antigen-specific. Non-specific immunity is innate – that is, we are born with it. In contrast, antigen-specific immunity, also known as acquired or adaptive immunity, develops as a result of exposure to particular pathogens and thus varies from one individual to another. The non-specific defences include the skin and mucous membranes, phagocytic cells (which consume potentially harmful microorganisms), mucus, cilia, the complement system, lysozymes, and other humoral factors. These innate mechanisms act as the first line of protection and slow down the establishment of active infection. Antigen-specific mechanisms, which include the B cell system of antibody production and the T cell system of cell-mediated immunity, target specific pathogens and are effective in curbing the spread of infection and eradicating invading organisms. With this system the host's response adapts to a specific pathogen (e.g., the measles virus) to develop immunologic memory that will respond more quickly and more efficiently the next time the same pathogen is encountered. Non-specific and antigen-specific defences act in synergy in the body (Wolf & Keusch, 1999).

The role of nutrition in immunity is well known. As both epidemiological research and clinical evidence have demonstrated, malnutrition is associated with a reduction of the integrity of the immune system and thus with an increased risk of infection. Although important roles for specific micronutrients in immune function maintenance have been identified, research suggests that generalized malnutrition can explain much about immune dysfunction (Fields-Gardner & Fergusson, 2004). Indeed, in view of the complex interrelationship of nutritional status and immune function, it would be naïve to believe that any single nutrient can meaningfully modulate the immune system.

Nutrition-related deficiencies, ranging from deficiencies of trace elements and vitamins to protein-energy malnutrition, interfere with both non-specific and antigen-specific immune responses. In particular, most immune responses involve the production of proteins (which have a variety of specific functions), and many nutrients are involved, directly or indirectly, in protein synthesis (Scrimshaw & SanGiovanni, 1997).

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Dietary protein is especially crucial to the maintenance not only of the immune system but of body cell mass. Additionally, the action of all types of immune cells and their products (such as interleukins, interferons, and complements) depends on various metabolic pathways in which various nutrients play a critical role. Lymphoid tissues are especially vulnerable to the damaging effects of malnutrition. Indeed, lymphoid atrophy is a prominent feature of nutritional deprivation (Anabwani & Navario, 2005). An optimal nutritional status therefore supports the efficient functioning of all components of the immune system.

Although malnutrition has many causes, infection is a common precipitating factor. Infectious disease can lead to a cascade of nutritionally adverse events, such as anorexia, diarrhoea, and an inflammatory response, which occurs early in the disease process and during asymptomatic phases. This results in greater nutrient requirements and poor use of the nutrients by the body (FANTA, 2004). This cascade of events is a function in part of the severity of the infection, but it can lead to the rapid loss of lean body mass and increased dysfunction of the immune system (Powanda & Beisel, 2003). At the same time that infection undermines nutritional health, the impaired immune response that results from malnutrition predisposes the body to infections, including HIV and TB, as well as other conditions associated with loss of immune function. Malnutrition and infection thus interact synergistically and are associated with poorer clinical outcomes.

## 4. HIV/AIDS

AIDS (acquired immunodeficiency syndrome) refers to a cluster of illnesses that are caused by a retrovirus known as HIV (human immunodeficiency virus), which attacks the body's immune system, undermining its ability to protect the body against further disease and infection. Since HIV/AIDS was first identified in the early 1980s, the scale of the epidemic has steadily increased. The impact of HIV/AIDS varies across continents, regions, and countries, but the effects of the epidemic are felt throughout the world.

### 4.1 Epidemiology and Burden of Disease

The vast majority of individuals infected with HIV live in developing countries, with sub-Saharan Africa carrying the greatest burden. Globally, however, the incidence of HIV/AIDS has in fact been declining for roughly the past decade, largely in response to public health efforts. According to the 2013 *Global Report* prepared by the Joint United Nations Programme on HIV/AIDS (UNAIDS), the number of new HIV infections worldwide in 2012 (2.3 million) represented a decline of 33% since 2001 (3.4 million). The mortality rate has also been decreasing, from an estimated 2.3 million deaths in 2005 down to 1.6 million deaths in 2012 (UNAIDS, 2013, p. 4).

> Sub-Saharan Africa remains most severely affected, with nearly 1 in every 20 adults (4.9%) living with HIV and accounting for 69% of the people living with HIV worldwide. In 2011 an estimated 23.5 million people in that region were living with HIV. The greatest concentration is in Southern Africa. The region with the second highest number (4 million) is South andSouth-East Asia (UNAIDS, 2012, p. 8)

Between 2001 and 2011, the incidence of new infections fell by 25% or more in 39 of the world's countries. The most significant decreases occurred in the Caribbean (42%) and in sub-Saharan Africa (25%), although the latter still accounted for 71% of all new cases. , However, during the same years the incidence of HIV increased in several regions including Eastern Europe/Central Asia and North Africa/Middle East (UNAIDS, 2012, pp. 8–12).

Although the overall trend after 2000 has been encouraging, it had become apparent that the MDG 6 target of reversing the incidence of HIV/AIDS by 2015 would not be achieved. In 2011r, the UN General Assembly therefore set ten new, and more specific, targets for HIV/AIDS (UN, 2011). These new targets include greater recognition of the socio-cultural and economic factors that work against efforts to halt the spread of the epidemic.

### 4.2 Transmission

The likelihood that an adult person will be exposed to the HIV virus is primarily, although by no means exclusively, a function of lifestyle, coupled with the prevalence of HIV/AIDS in the region in which the

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person lives. The virus is carried in the blood (including menstrual blood), in semen and vaginal secretions, and in breast milk. The virus most commonly enters the body through contact with the mucous membranes in the genitals, anus, rectum, mouth, or eyes or when body fluids in which the virus is present come into contact with an open cut or sore. HIV is not transmitted through insect bites or by contact with saliva, tears, sweat, faeces, or urine.

HIV is transmitted in three ways: sexual, parenteral (by was of syringes), and vertical, or mother-to-child transmission. Sexual intercourse – vaginal, anal, or oral – involves a direct exchange of body fluids. The risk of infection is greatest during anal sex (CDC, 2014), which explains the association between HIV/AIDS and homosexual men. Nonetheless, most HIV infections are the result of heterosexual intercourse (ECSA-HC & FANTA, 2008). People can also be infected with HIV by non-sexual means, such as blood transfusions or a contaminated needle or other sharp object. This is known as parenteral transmission, and it generally involves the passage of the HIV virus directly into the bloodstream. In developed countries, this form of transmission is most closely associated with intravenous drug use. Blood transfusion is another possible route but is now rare because the blood used in transfusions is carefully screened. Health workers can become infected with HIV through needle pricks. Vertical transmission, or mother-to-child transmission (MTCT), occurs when a HIV-positive mother passes the virus to her infant. This can occur in utero and/or during labour and delivery, but the virus can also be transmitted in the mother's breast milk.

Once a person has been exposed to the HIV virus, the likelihood of infection depends on several factors. One is the type of HIV: some strains are more virulent than others. In the case of sexual transmission, another factor is the specific form of sexual behaviour. In addition, overall health and nutritional status influences a person's vulnerability to infection. Someone whose immune system has already been weakened by illness or malnutrition is at greater risk of infection (of any sort) than is a healthy person. Finally, hereditary factors also play a role: some people are inherently more resistant to infection than others.

## 4.3 Pathophysiology and Clinical Presentation

There are two different types of HIV. The most common type, which occurs worldwide, is HIV-1; the other, HIV-2 is chiefly found in West Africa. The two viruses are closely related, but HIV-2 is less pathogenic than HIV-1, which is characterized by high rates of virus production (Popper et al., 1999). Infection with HIV is the underlying cause of AIDS. HIV invades the genetic core of the CD4 or T-helper lymphocyte cells, causing their progressive depletion and leading to immune deficiency, constitutional disease, neurologic complications, opportunistic infections, and certain forms of cancer. AIDS is a diagnostic term applied to HIV-infected persons who have at least one well-defined, life-threatening clinical condition that is clearly linked to HIV-induced immunosuppression (Fenton & Silverman, 2004). HIV is a slow-acting virus; even in the absence of treatment, it can take around ten years for an HIV-infected adult to develop full-blown AIDS. As with the initial likelihood of infection, the length of this period depends on various factors including the general health and nutritional status at and during the time of infection. An outline of the natural history of HIV infection is provided in Box 10.1.

The primary indicators of disease progression during HIV infection are plasma HIV load and circulating CD4 lymphocyte counts. In many developed countries, it is standard clinical practice to monitor these laboratory indicators. In particular, periodically measuring plasma HIV load is essential in individuals on long-term antiretroviral (ARV) therapy, as this serves to monitor viral resistance to treatment. However, measuring both plasma HIV load and the CD4 lymphocyte count requires quite expensive laboratory instruments and facilities, as well as trained personnel. In developing countries, where little or no access to these facilities exists, monitoring of HIV disease progression usually consists of monitoring the complications that accompany the disease (Villamor et al., 2008). WHO has developed a staging system for HIV/AIDS based on clinical symptoms (WHO, 2007). This system can be used to guide medical decision-making in regions where sophisticated laboratory testing is either unavailable or prohibitively expensive.

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**Box 10.1:** Natural History of HIV Infection

**Initial infection**

When a person comes into contact with an infectious agent, antibodies begin to build up in the blood. Someone infected with HIV begins to develop antibodies relatively soon after infection, but it takes time before these antibodies can be detected in the blood. The time from initial infection to the point at which a person tests positive for HIV (seroconversion) is known as the "window period." In most cases, this period lasts from 3 to 6 weeks, although its duration depends in part on the sensitivity of the test. By the end of 6 weeks, most HIV-positive individuals will have developed enough antibodies to produce a positive test, although, in rare cases, the window period can last 6 months or more. During the period, flu-like symptoms may appear, including fever, rash, joint pains, and enlarged lymph nodes. Acute infections of the nervous system, such as aseptic meningitis, may also occur, but, as a general rule, newly infected people are unaware that they are HIV positive, with the result that they can easily transmit the virus to others.

**Progression from HIV infection to AIDS**

Following initial infection, a symptom-free period generally ensues before the disease progresses to full-blown AIDS. An adult infected with HIV may have no symptoms for ten years or more. The rate of progression from HIV infection to AIDS depends on the type and strain of the virus, as well as on certain characteristics of the person who is infected. The presence of other infections, as is frequently seen in malnourished individuals, tends to shorten the symptom-free period, and genetic factors probably also play a role. In addition, the disease generally progresses more quickly in people over the age of 40. HIV infects both the central and the peripheral nervous system early in the course of the infection, which can produce a variety of neurological and neuropsychiatric conditions. As HIV infection progresses and immunity declines, people become more susceptible to opportunistic infections.

*Source: Adapted from WHO, "Fact Sheet 1 HIV/AIDS: The Infection," http://www.who.int/hiv/abouthiv/fact_sheet_hiv.htm.*

## 4.4 HIV in Children

The vast majority of HIV-positive children are infected in the perinatal period, that is, during pregnancy and childbirth. While the progression of HIV infection in children is variable, it is typically more rapid than in adults. Although relatively few children become actively ill during the first few weeks of life, without treatment, roughly a third of HIV-positive children do not live to see their first birthday, and half die before the age of 2. Evidence suggests that beginning antiretroviral treatment before the child reaches the age of 12 weeks can reduce early HIV mortality by as much as 75%. Yet, in 2013, over half (54%) of all pregnant women living in low- or middle-income countries did not receive a test for HIV (UNAIDS, 2014).

As in adults, the rate of progression varies according to the particular strain of HIV, as well as on the efficiency of the child's immune response. In developing countries, where a high proportion of children are malnourished, the infection tends to progress faster, thereby shortening the survival period. The WHO staging system mentioned above includes clinical criteria for the progression of the disease in children under the age of 15. In addition, it provides criteria on which to base a presumptive diagnosis of HIV in children under 18 months when virological testing is not possible and the HIV status of the mother is unknown (see WHO, 2007, pp. 29–39).

## 4.5 Diagnosis

The laboratory diagnosis of HIV infection in adults and children over the age of 18 months is made primarily by testing for the presence of the antibodies formed to fight the virus. As we have seen, these antibodies can usually be detected somewhere between 3 to 6 weeks following infection, but the window period can vary. If an initial antibody test is negative, it should therefore be repeated, preferably 3 months after the initial test.

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Infants born to HIV-infected mothers represent a special case for the diagnosis of HIV. A pregnant woman usually passes on HIV antibodies to her child, which remains in the infant's blood for some time following birth. As a result, an infant born to an HIV-infected mother could test positive for HIV antibodies without in fact being infected. In the absence of more sophisticated methods, such as PCR testing, it is consequently not possible to test for HIV in infants with any degree of reliability until they have reached the age of at least 18 months.

## 5. NUTRITION AND HIV/AIDS

Nutritional status and HIV are closely interlinked. Deficiencies, and sometimes excesses, of nutrients adversely affect immune responses and other normal body functions. Any immune impairment as a result of HIV/AIDS contributes to malnutrition, which in turn aggravates immune impairment, worsens the effect of HIV, and contributes to a more rapid progression of HIV to AIDS. When malnutrition and HIV/AIDS are concurrent, their effect on the immune system is synergistic.

Nutritional status, specifically the maintenance of weight and crucial body-protein stores (body cell mass, BCM), affects a person's ability to survive while living with HIV. Characteristic of the wasting seen in patients with AIDS is a depletion of BCM. Regardless of the presence or absence of other infections, death is likely to occur in HIV-infected patients when BCM declines to 54% of the expected value based on height (Fields-Gardner et al., 2004). Micronutrient deficiencies are common in HIV-infected persons and may also accelerate progression of the disease, which in turn leads to further deterioration of nutritional status. The replenishment of micronutrients has been recommended because their blood levels are dereased; However, it is not clear if low levels of micronutrients can be interpreted as evidence of a true deficiency state or whether they are merely a manifestation of the altered metabolism associated with HIV infection and the attendant inflammatory response (Jiménez-Expósito et al., 2002).

Factors contributing to weight loss and malnutrition in persons living with HIV/AIDS (PLWHA) include reduced energy intake, the malabsorption of nutrients, and elevated energy needs during secondary bacterial and/or systemic opportunistic infections. Additionally, a variety of metabolic abnormalities have been reported, namely, increases in insulin sensitivity, protein turnover, and hepatic de novo lipogenesis. Along with reduced energy intake and opportunistic infections, increased resting energy expenditure and chronic diarrhoea play a role in malnutrition among HIV-positive individuals (Melchior et al., 1999). Figure 10.1 illustrates the complex synergistic relationship between malnutrition and HIV.

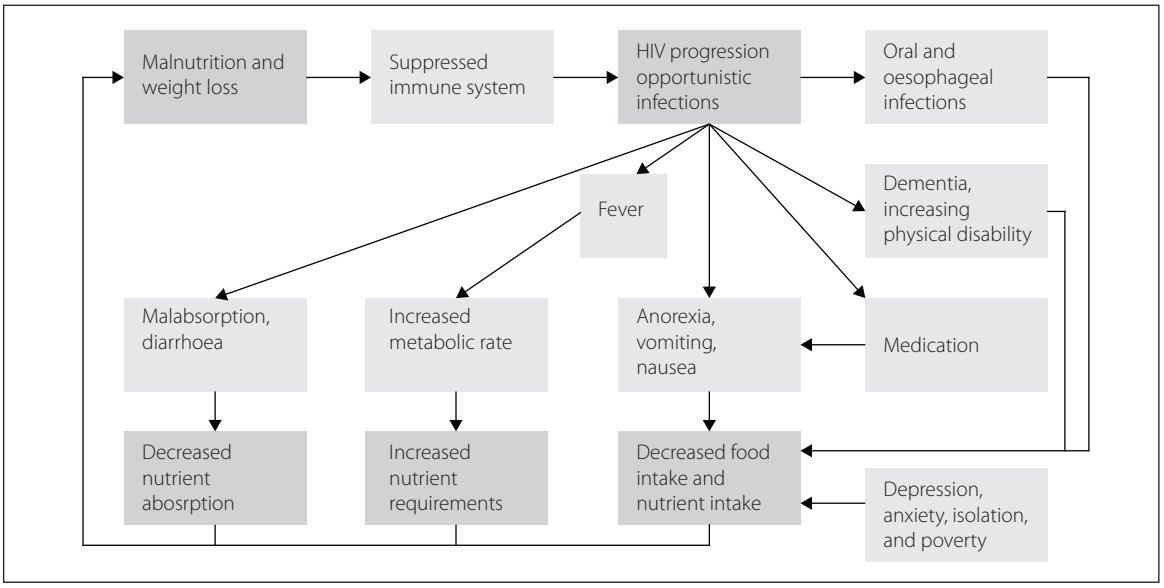


**Figure 10.1:** The interactions between HIV and nutrition.
*Source: Adapted from Wilson et al., 2013.*

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## 5.1 Weight Loss

Weight loss is a strong predictor of death in HIV-infected adults and children (Tang, 2002). Various factors contribute to the weight and protein losses associated with HIV infection, including loss of appetite (anorexia), increased energy use, and poor dietary intake. These factors conspire to produce a condition known as HIV wasting syndrome. Negative nitrogen balance and weight losses are correlated; approximately 80% to 90% of weight loss during acute events can be attributed to protein losses, whereas less protein is lost during the starvation process (Kotler, 2005). HIV-related malnutrition differs notably from simple starvation. The Centers for Disease Control and Prevention (1992, Appendix C) defines HIV wasting syndrome as:

> Findings of profound involuntary weight loss of greater than 10% of baseline body weight plus either chronic diarrhoea (at least two loose stools per day for greater than or equal to 30 days), or chronic weakness and documented fever (for greater than or equal to 30 days, intermittent or constant) in the absence of a concurrent illness or condition other than HIV infection that could explain the findings (e.g., cancer, TB, cryptosporidiosis, or other specific enteritis).

HIV-related wasting syndrome involves two different types of wasting: starvation-related wasting and cachexia-related wasting. Starvation refers to the lack of nutrient substrates in the body, whether as a result of a decreased intake of nutrients, their malabsorption, or an increased loss of nutrients from the body (Fields-Gardner & Fergusson, 2004). In cases of HIV, starvation-related wasting is generally seen in otherwise clinically stable individuals who have yet to develop opportunistic infections. Wasting of this sort can be reversed by nutritional support. In contrast, cachexia-related wasting refers to

> a disproportionate depletion of lean body mass (LBM) as a result of alterations in metabolism. In fighting disease, metabolic output is redirected to energy requirements and substrates needed to fuel the body's response instead of normal maintenance of the body. In the long term this leads to protein (especially skeletal muscle) loss. Feeding is not a sufficient intervention to reverse the effects of cachexia. (South African HIV Clinicians Society Expert Committee 2004, p. 22)

Evidence suggests that, in HIV-infected individuals, a combination of nutritional counselling and support, the use of appetite stimulants and anabolic hormones, and exercise designed to build muscle strength (such as resistance training) can reverse weight loss and increase lean body mass (Grinspoon & Mulligan, 2003).

Among the factors that contribute to wasting are malabsorptive disorders. Malabsorption, especially fat malabsorption, appears to occur throughout the HIV disease process, although it is not always accompanied by diarrhoea or other typical symptoms. Factors that have been linked with malabsorption in HIV disease include the atrophy of intestinal villi, damage to intestinal cells, increased gut permeability, and gastrointestinal pathogens (Fields-Gardner et al., 2004). Poor fat absorption also affects absorption of micronutrients such as vitamins A and E, which are important for the proper functioning of the immune system.

Additionally, HIV directly impacts the gut mucosal immune system. Early HIV replication and severe depletion of CD4 cells occurs in gut-associated lymphoid tissue (GALT). Treatment with highly active antiretroviral drugs is able only to partially suppress viral replication and restore CD4 cells in GALT, and persistent HIV replication in this tissue leads to ongoing replenishment of HIV reservoirs. Resulting enteropathic changes are associated with increased inflammation, the activation of the immune system, and reduced levels of mucosal repair and regeneration (Dandekar, 2007).

## 5.2 Metabolic Abnormalities

HIV infection is associated with metabolic abnormalities, including changes in organ or other tissue function that lead to alterations in the utilization, storage, and excretion of nutrients. These abnormalities may be caused by immune dysfunction, infection of different types, the side effects of medications, or alterations in the hormonal milieu (Fields-Gardner et al., 2004).

Since the introduction of highly active antiretroviral therapy (HAART), several features of abnormal body functioning have been reported. These include altered patterns of body composition, such as the localized loss of fat (lipoatrophy) as well as the deposition of fat in the central section of the body (lipohypertrophy), insulin resistance and/or glucose dysregulation, and dyslipidaemia (abnormal levels of lipids in the blood). HAART has also been associated with mitochondrial toxicity (damage to or depletion of the mitochondria in the body's cells), lactic acidosis (increased tissue acidity caused by an elevated level of lactate), and irregularities

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in bone mineral metabolism (WHO, 2005). Such complications are not necessarily the result of HAART, however: they can also develop independently. An increase in longevity among HIV-positive individuals suggests that health care professionals will have to address these chronic metabolic and physical alterations as a part of routine health care provision (Fields-Gardner et al., 2004).

### 5.3 Breast-Feeding and HIV

Prevention of mother-to-child transmission of HIV (PMTCT) is the single most effective way to reduce the burden of HIV in communities. Its optimal implementation is essential to achieving MDGs 4 (reducing infant and child mortality), 5 (reducing maternal mortality), and 6 (combatting HIV/AIDS, malaria, and other diseases).

Extensive research on maternal or infant prophylaxis during breast-feeding has provided data that has prompted action and a review of existing guidelines on infant feeding and HIV (Goga, 2009; WHO, 2010b). It has been established that transmission of HIV during breast-feeding can be reduced to less than 1 percent if

- mothers whose CD4 count is less than 350 cells/ml receive lifelong ARV therapy and their babies receive daily ARV prophylaxis for 6 weeks after birth, or
- babies whose mother's CD4 count is greater than 350 cells/ml receive daily prophylaxis with Nevirapine (an ARV drug) throughout breast-feeding and for one week after breast-feeding stops.

However, such treatment requires that a mother's CD4 count be known at the time her baby is born and that ARV treatments are available and affordable. Chapter 5 provides additional recent guidelines on HIV and infant feeding.

## 6. NUTRITIONAL MANAGEMENT OF HIV/AIDS

WHO recommends that evidence-based nutrition interventions be part of all national HIV care and treatment programmes (WHO, 2008). The nutritional management of HIV-positive individuals has a number of goals:

- To improve nutritional status by maintaining weight and preventing loss of weight and muscle mass
- To ensure adequate nutrient intake by improving eating habits and building stores of essential nutrients
- To prevent foodborne illnesses by promoting good hygiene and food safety
- To provide palliative care during the advanced stages of HIV disease
- To enhance quality of life by managing symptoms that affect food intake

Nutrition care and support for PLWHAshould include nutritional assessment and counselling, as well as supplementation and food provision if indicated. Additionally, advice should be provided about nutritional practices that can help to manage medication side effects and increase drug efficacy, as should referral to other services, if needed. Approaches to implementing nutrition care and support in food-insecure contexts is also an important component of the nutritional management of HIV-positive individuals (ECSA-HC & FANTA, 2008). In this respect we need to be aware that food insecurity and lower levels of nutrient intake are more likely to occur in advanced HIV disease or in populations at risk for deficient intake, such as the economically disadvantaged, elderly, children, injection drug users, the transitionally housed or homeless, and people with compromised mental health.

### 6.1 Nutritional Assessment

A nutritional assessment gathers information to help guide decisions about nutrition care and support and to monitor the effectiveness of interventions. Especially because food insecurity, inadequate protein intake, general malnutrition, and specific micronutrient deficiencies are endemic in many areas with a high prevalence of HIV, a thorough nutritional assessment should form a routine part of the treatment and care of people who have become infected (WHO, 2008).

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An initial assessment should be followed by appropriate interventions and ongoing monitoring. A complete nutritional assessment for PLWHAincludes the following:

1. Anthropometric measurements: Record weight and weight change, height, body mass index (BMI), and mid-upper-arm circumference.
2. Biochemical information: Arrange for laboratory tests to evaluate vitamin and mineral profiles, possible anaemia, and evidence of metabolic complications (such as lactic acidosis and hyperglycaemia), as well as body composition and viral load. Alterations in nutrition-related laboratory values may reflect an inflammatory response as well as nutritional compromise. Whether it is possible to include biochemical tests in a nutritional assessment will depend, of course, on the resources available.
3. Clinical information: Aim to identify symptoms and illnesses associated with HIV/AIDS infection that can affect nutritional status. Collect information about appetite change, fever, nausea, vomiting, and alcohol intake, as well as symptoms related to appetite change, difficulty with swallowing, mouth and/or throat sores, oral thrush, muscle wasting, TB, fatigue, lethargy, and the effects of drug-food interactions.
4. Dietary information: Assess dietary intake to ensure adequate protein and micronutrients for energy needs and the avoidance of potential drug-food interactions.
5. Food security status: Gather information about food availability and access, and evaluate individual and household food security (ECSA-HC & FANTA, 2008; WHO, 2008).

(For detailed information on the methods used to assess nutritional status, see Chapter 22.)

## 6.2 Nutritional Requirements

Evidence suggests that as the HIV infection progresses, nutrient requirements change (WHO, 2003). Increased nutritional needs among PLWHA are associated with increased resting energy expenditure, accelerated protein turnover, decreased food intake, diarrhoea, and malabsorption (ASSAF, 2007). Nutritional requirements are the same regardless of whether a person is taking ARV drugs, but they differ for the two distinct phases of HIV infection: asymptomatic and symptomatic. The former corresponds to WHO Clinical Stage I and the latter to Clinical Stages II to IV (WHO, 2003). Moreover, if an HIV-infected individual has a history of malnutrition, additional micronutrients and/or macronutrients (energy and protein) may be required.

### *6.2.1 Energy*

Energy requirements increase by 10% during the asymptomatic phase and by 20% to 30% during the symptomatic phase. These increased needs for energy apply equally to pregnant and lactating women living with HIV/AIDS, on top of the already higher nutritional needs that accompany pregnancy and lactation. When possible, this need for additional energy should be met by increasing consumption of foods with high nutrient densities, as opposed to foods that are high in energy but low in protein and micronutrients, such as foods high in fat and sugar (WHO, 2003).

When weight loss occurs during the symptomatic phase in children, energy needs increase by 50% to 100%. It is often difficult for children with opportunistic infections and weight loss to consume 50% to 100% more energy than normal. It is therefore important to encourage children to consume additional food after periods of illness and weight loss (WHO, 2003).

### *6.2.2 Protein*

Protein requirements for all PLWHA, including children and pregnant and lactating women, are the same as for healthy individuals (WHO, 2003).

### *6.2.3 Micronutrients*

Micronutrient deficiencies are common in HIV-positive individuals and become more pronounced as the disease process advances. Although daily multivitamin supplementation has been recommended for HIV-

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positive individuals, and is commonly practised in the USA and Europe, it remains unclear whether this is an effective prophylactic approach to HIV (or, indeed, any disease). Numerous studies have evaluated the effect of micronutrient supplementation in PLWHA. Randomized trials in the USA (Kaiser et al., 2006), Thailand (Jiamton et al., 2003), and Tanzania (Fawzi et al., 2004) have reported associations between multivitamin and/or mineral supplementation and improvements in the immunological and clinical status of people with HIV. However, because these studies (and others) involved a variety of supplements and employed different outcome measures, their results are not readily comparable (Friis, 2006). Consequently, we do not yet have consistent, compelling evidence that the provision of more than the recommended daily allowance (RDA) of any individual vitamin or mineral is beneficial. This RDA is best provided by food, but HIV-positive individuals whose diets are inadequate in micronutrients should be given a daily multivitamin and mineral supplement equivalent to the RDA (WHO, 2008).

### *6.2.4 Nutritional support and supplements*

According to the WHO (2008, p. 36), nutritional support should be provided to HIV-positive individuals whose BMI indicates malnourishment:

> Malnourished adults with HIV are at an elevated and progressive risk of HIV disease progression and mortality as BMI decreases, especially below 18.5. The WHO recommends providing supplementary feeding for mild-to-moderately malnourished adults (BMI <18.5), regardless of HIV status. The most common and cheapest supplementary food is micronutrient-fortified, blended flour (e.g., corn-soy blend or CSB) that can be prepared as a porridge, but other forms (e.g., biscuits or pastes) may be used. Severely malnourished adults (BMI <16) should be provided with a therapeutic food that is formulated to be nutritionally equivalent to the therapeutic F-100 milk.

F-100 milk is a formula that provides 100 kcal/100 ml and is used to treat severely malnourished children. As the WHO notes, F-100 milk is commercially available in powdered form but can also be prepared from basic ingredients: dried skimmed milk, sugar, cereal flour, oil, mineral mix, and vitamin mix. The WHO further recommends that supplemental feeding be continued until the person's BMI has remained stable for 2 to 3 months above 18.5 (WHO, 2008, p. 37).

The standard recommendations for nutrient intake and nutritional support for pregnant and lactating women should be followed, regardless of HIV status (WHO, 2008).

### *6.2.5 Nutritional guidelines and food safety*

Nutritional guidelines and dietary management of HIV-related symptoms should be integrated into health services and outreach activities. Health workers and counsellors can use counselling to assess how clients are managing symptoms and identify alternative options when needed (ECSA-HC & FANTA, 2008). PLWHA should also be provided with practical dietary strategies for addressing common nutrition-related problems, bearing in mind local and personal food habits, food availability, and individual food preferences.

Proper food safety and hygiene are especially crucial for PLWHA because their immune systems have already been weakened, making them more vulnerable to infection. Such infections may lead to diarrhoea and vomiting, which can deplete nutrients and decrease absorption (ECSA-HC & FANTA, 2008). Safe handling of food and water is therefore essential so as to avoid infections caused by bacteria and viruses present in contaminated food and water (FANTA, 2004). Health workers should thus ensure that HIV-positive individuals are provided with guidelines about food safety.

## 6.3 ARV Medications

ARV drugs and other medications used to treat people with HIV/AIDS significantly decrease HIV replication in the body and slow the progression of the disease, but they do not cure the person. The drugs help to delay the onset of AIDS and help to prevent opportunistic infections, increasing the opportunity for a longer, healthier life. HAART combines multiple ARVs in the treatment regimen to enhance the effectiveness of the drugs (ECSA-HC & FANTA, 2008). Studies have found that an increase in the number of people receiving HAART is correlated with decreases in population or community plasma viral load and a reduced number

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of new HIV diagnoses per year. This suggests that HAART may have the secondary benefit of reducing HIV transmission (Das et al., 2010; Montaner et al., 2010).

ARVs and other HIV-related medications can, however, interact with food and nutrients, and the long-term use of these drugs has been associated with metabolic complications, as described in section 5.2 above. To achieve the full benefits of therapy with ARVs, adequate and appropriate dietary intake is therefore essential. In addition, specific nutritional strategies may be needed not only to minimize the negative effects of these drugs on nutritional status but to enhance their efficacy and minimize their side effects (WHO, 2003). Developing meal plans to support medication regimens may involve changes in meal timing and specific food choices (Fields-Gardner et al., 2004). It is also important that those who will be taking these medications be given clear instructions. Some drugs should be taken with food, for example, and others on an empty stomach, while yet others should not be combined with certain foods or should be taken with foods rich in specific nutrients. The WHO regularly updates its guidelines for the treatment of HIV-infected persons. These guidelines provide detailed recommendations for the initiation of treatment and outlines of first- and second-line ARV regimens. (For the most recent guidelines, see http://www.who.int/hiv/pub/guidelines/en.)

As access to ARVs continues to improve in low- and middle-income countries, there is a need to better understand the impact of these drugs on undernourished populations and the role that nutritional status plays in both the efficacy of ARV medications and the nature and severity of their side effects (WHO, 2003). The availability of ARV drug therapies will, however, require additional training of health workers, as well as an increase in the capacity of health care systems, which will need to arrange for the distribution of these drugs, for laboratory tests, and for patient counselling and follow-up (ECSA-HC & FANTA, 2008).

## 6.4 Food Security and HIV

Before the onset of the HIV epidemic, many of the areas that are today most severely affected were already food insecure. The presence of HIV/AIDS in a household or community can cause food insecurity, or it can exacerbate existing insecurity. In turn, lack of food can increase a person's vulnerability to HIV and worsen its impact. As we have seen, PLWHA have greater nutritional needs, and food insecurity can easily make it impossible to meet those needs.

HIV can heighten food security simply by decreasing the workforce and thereby food production. It also depletes human, financial, and physical capital, which may then increase a country's vulnerability to other shocks, such as crop failure, drought, or conflict. Such shocks have an especially serious impact on HIV-affected households, whose ability to cope has already been weakened by the depletion of food and money reserves (Table 10.1). Potentially productive assets may have been sold, and a family's earning capacity is limited by illness and care-giving responsibilities (ECSA-HC & FANTA, 2008).

**Table 10.1:** The relationship between HIV/AIDS and food security

| Effects of HIV/AIDS on food availability and access | Effects of food insecurity on HIV/AIDS |
|---|---|
| - Reduces the availability of labour<br>- Decreases income, depletes savings, and leads to the sale or loss of assets<br>- Depletes food reserves<br>- Interrupts knowledge transfer<br>- Weakens safety nets and support systems | - Limits the quantity and quality of food available to households<br>- Increases vulnerability to illness and infection<br>- May cause people to resort to livelihood strategies that increase the risk of infection |

*Source: ECSA-HC & FANTA, 2008.*

Issues of food security must be addressed as part of the nutritional management of HIV/AIDS. A nutritional assessment is not complete without an evaluation of possible obstacles to improved nutritional practices, including limited food access and availability, as well as a lack of knowledge about nutritional needs. In addition, an assessment should aim to identify a person's or household's strategies for coping with financial pressures, as well as any negative effects of these strategies. Any actions that can feasibly be taken to

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improve household food consumption and dietary options should be identified and implemented. If at all possible, households should be linked up with organizations that can provide food assistance, micronutrient supplementation, and advice about means of livelihood and/or skills training. Food security status should then be monitored regularly and the necessary support provided (ECSA-HC & FANTA, 2008).

# 7. TUBERCULOSIS (TB)

TB is primarily a disease of the lungs, but it can spread to other parts of the body, including bone, lymph nodes, and the central nervous system. Despite a recent decline in the overall incidence of TB, the disease remains an enormous public health problem, with developing countries carrying by far the greatest burden of disease. The emergence of multidrug-resistant TB (MDR-TB) – a form of TB that fails to respond to standard first-line treatment – has exacerbated this global public health threat. Extensively drug-resistant TB (XDR-TB), while still relatively rare, occurs when resistance to second-line drugs develops on top of MDR-TB. These conditions pose a very serious threat to TB control, especially in developing settings, where many TB patients are also infected with HIV. The WHO has urged all countries to implement its Stop TB Strategy, which recognizes the need to "address TB-HIV, MDR-TB, and the needs of poor and vulnerable populations" (WHO, 2014d). WHO and its international partners have also formed the TB/HIV Working Group, which develops global policy on the control of HIV-related TB and advises those fighting against TB and HIV on how best to work together to address this lethal combination.

## 7.1 Epidemiology and Burden of Disease

### *7.1.1 Prevalence and incidence*

According to the *Global Tuberculosis Report 2013* (WHO, 2013a), 8.6 million new cases of TB were reported in 2012, 1.1 million of them among HIV-positive individuals. Asia (defined by the WHO as its South-East Asia and Western Pacific regions combined) accounted for well over half (58%) of all new cases, and the African region for another 27%. The African region also had the highest rate of cases and deaths relative to population – more than double the global average. The number of new cases was highest in India (26% of the worldwide total), followed by China and then South Africa. High numbers are also seen in Nigeria, Indonesia, and Bangladash. The WHO also estimates that some 2.9 million cases went either undiagnosed or unreported that year. Of the 1.3 million people who died of TB, 95% of them lived in low- and middle-income countries, and nearly one quarter (24.6%) were HIV-positive. The WHO (2013a, p. 1) describes the number of TB deaths as "unacceptably large given that most are preventable if people can access health care for a diagnosis and the right treatment is provided."

The number of new cases of MDR-TB in 2012 was estimated at 450,000 worldwide and the number of deaths at 170,000 (WHO, 2013a). However, such figures depend on the ability of individual countries to detect (and report) cases of MDR. Undiagnosed cases of MDR-TB and global gaps in treatment coverage constituted what the WHO report characterized as a "public health crisis." Globally, about 82% of those individuals identified as eligible for second-line treatment were started on such treatment, but that figure was much lower in certain countries – only 51% in the African region, for example (WHO, 2013a, p. x).

The pandemic of HIV, the emergence of MDR-TB, and the greater mobility of populations are complicating the current worldwide TB epidemic. The TB and HIV epidemics overlap in many regions of the world, especially in sub-Saharan Africa, and the possibility that TB will spread even further is cause for serious alarm, especially in areas where the HIV epidemic is already rampant (van Lettow & Whalen, 2008).

### *7.1.2 Highest-risk groups*

Like so many potentially fatal infectious illnesses, TB is a disease of poverty. Although TB affects people of all ages, it is most commonly seen among young adults, people who would otherwise be entering their most productive years. It is an airborne illness, easily transmitted from one person to another. The WHO estimates that, globally, one out of three people has been infected with TB bacteria, although, as latent carriers, they are not actively ill, nor can they transmit the disease (WHO, 2014d). On average, people who have been infected with TB are at a 10% risk of developing active TB over the course of their lifetime, but that risk

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escalates dramatically in the presence of other factors. Understandably, those who live in close quarters with others, as in nursing homes, dormitories, or prisons, run a greater risk of being exposed to the disease (van Lettow & Whalen, 2008). HIV-positive individuals who have been infected with TB are 21 to 34 times more likely to develop active TB than are HIV-negative people (WHO, 2014d). However, anyone whose immune system is compromised – the malnourished, the elderly, those who already have infections – is at greater risk of developing active TB, as are people who smoke. Children under the age of 5 are particularly vulnerable, specifically to extrapulmonary forms of the disease such as TB meningitis. In addition, it appears that children who have recently had the measles are more prone to develop TB (Duke & Mgone, 2003).

## 7.2 Transmission, Pathophysiology, and Clinical Presentation

TB is caused by a bacillus bacterium, *Mycobacterium tuberculosis.* When individuals with active TB in their lungs cough, sneeze, or even speak, they expel these bacteria into the air. These bacteria can stay in the air for several hours, and if another person breathes them in, that person may become infected. Infection occurs when these bacteria, which are carried in aerosol droplets, are deposited onto alveolar surfaces in the lungs. TB is not transmitted by touching: or as a result of kissing or sharing food: the bacteria must be inhaled (CDC, 2012).

TB infection is initially a latent infection, and during this phase, the person infected exhibits no symptoms. Active TB develops when the body's immune system fails to contain the infection and physiological functions are disrupted, thereby producing symptoms. In some individuals, the initial infection progresses directly to active illness: this is known as progressive primary disease. In others the infection remains latent for an extended period of time, until conditions conspire to reactivate the previously dormant infection. As we have seen, 90% of those infected with TB never develop active TB at all. Whether the progression from latent to active TB will occur depends on several factors. An important one is the intrinsic strength of an individual's immune system, as determined by genetics. Environmental factors are also of major importance. TB progression is more likely with a lack of adequate food and sanitation, crowded living conditions, and insufficient rest that serve to weaken the immune system (Smith, 2003; van Lettow & Whalen, 2008).

Pulmonary disease – the most common form of active TB – is characterized by a persistent cough, one that lasts at least 3 weeks and generally produces sputum. Other symptoms include fevers, night sweats, and weight loss. Occasionally, haemoptysis (coughing up blood), dyspnoea (shortness of breath), and chest pain develop. However, although TB bacteria initially settle in the lungs, the disease can invade virtually any site in the body, producing a wide array of conditions that are collectively known as extrapulmonary TB. Extrapulmonary TB occurs in approximately 20% of cases; the most common sites are the lymph nodes, pleura, kidneys, meninges, and bone or joints (van Lettow & Whalen, 2008). Another rare, but frequently fatal, form of TB is miliary TB, which develops when TB bacteria enter the bloodstream and are disseminated throughout the body, causing small lesions to develop, most commonly in multiple sites.

## 7.3 Diagnosis and Treatment

The tuberculin skin test is the principal means of determining whether a person is infected with TB. Although a number of such tests exist, which employ different TB antigens and somewhat different methods, the Mantoux test, or PPD (purified protein derivative) test, is now most widely used, having largely supplanted other versions of the test, such as the Heaf test. In a skin test, tuberculin antigens are injected into the epidermis and, two to three days later, the area is examined for signs of reaction.. For a variety of reasons – some relating to the immunological status of the person being tested, others surrounding the care with which the test is administered – both false positives and false negatives can occur. The reliability of the test thus depends in part on how much is known about the medical status and life circumstances of the person receiving the test. (For a detailed discussion of tuberculin skin testing, see American Thoracic Society, 2000.)

Active TB can manifest itself in a variety of clinical syndromes. Because TB bacteria lodge in the lungs, a chest X-ray can be used as an initial guide, although the presence of abnormalities is not definitive evidence of TB. If TB is suspected, the diagnosis is confirmed by the identification of tuberculosis bacteria (*M. tuberculosis*) in a sample of sputum or some other specimen drawn from the presumed site of infection. A

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microbacterial culture should be performed, which allows for the identification of *M. tuberculosis* in particular (CDC, 2011; van Lettow & Whalen, 2008).

Once TB is diagnosed, a course of antibiotics is prescribed. However, if a person takes a single antibiotic for an extended period of time, as is the case in TB treatment, resistance to the drug tends to develop. For that reason, it is standard practice to use multiple medications in the treatment of TB, which should prevent resistance to any one of them from developing. The standard treatment regimen lasts for 6 months and typically begins with an 8-week "intensive" phase. However, specific recommendations vary somewhat and are frequently updated by both the WHO and the CDC Centers for Disease Control and Prevention, an agency of the government of the United States).

Despite the use of multiple medications in the treatment of TB, strains of *M. tuberculosis* that are resistant to more than one drug have emerged in recent decades (CDC, 2008; WHO, 2012). As mentioned earlier an especially dangerous forms of TB is multidrug-resistant TB (MDR-TB). It fails to respond to standard first-line treatment. An even more dangerous type of TB is extensively drug-resistant TB (XDR-TB). These forms of TB pose a serious global public health threat.

The emergence of MDR-TB is a direct consequence of inadequacies in the initial treatment regimen, whether these involve the choice of medications, the dosages prescribed, or incomplete adherence to the regimen on the part of the patient (van Lettow &Whalen, 2008). Although MDR-TB can be successfully treated, the WHO (2014d) points out that "second-line treatment options are limited and recommended medicines are not always available. The extensive chemotherapy required (up to two years of treatment) is more costly and can produce severe adverse drug reactions in patients."

# 8. NUTRITION AND TB

## 8.1 Malnutrition

A two-way relationship exists between TB and malnutrition. On the one hand, TB – an illness once called "consumption" – is associated with wasting. In particular, active TB has been linked to abnormalities in protein metabolism, specifically a condition known as anabolic block, in which the body oxidizes a disproportionate quantity of the proteins from food, rather than using them for protein synthesis (Gupta et al., 2009). On the other hand, malnutrition weakens the immune system, with the result that malnourished persons are more susceptible to primary infection with *M. tuberculosis*. Similarly, malnutrition increases the risk that the primary infection will progress to active illness, whether in the short term, as progressive primary disease, or in the longer term, in the form of reactivation. Nutritional deficiencies are known to adversely affect precisely those immunological mechanisms that are crucial for the control of mycobacteria, namely, the functions of T-lymphocytes and a variety of phagocytic cells (North & Jung, 2004). Nutritional deficiencies are therefore generally associated with both an increased risk of TB infection and greater severity of the active illness.

It is very likely, therefore, that providing nutritional support to malnourished populations at high risk for TB could reduce the incidence of active TB in these groups, although this has not been directly proven. Because mild-to-moderate malnutrition typically affects larger segments of the population than severe malnutrition, such prevention efforts are unlikely to be successful if they target only the severely undernourished (USAID, 2008).

Without eliminating it completely, a successful immune response is able to keep TB infection in check in most individuals (Stewart et al., 2003). However, TB is often associated with other co-morbid conditions that affect nutritional status and disease risk, such as HIV (Perez et al., 2006) and alcoholism (Mason et al., 2004). Any immunosuppressive condition, such as HIV infection, malnutrition, or ageing, may tip the balance in favour of the pathogen, resulting in reactivation of TB disease (Lillebaek et al., 2002). HIV and TB form an especially dangerous combination. It is known, for instance, that TB patients with concurrent HIV infection tend to be more severely malnourished (see, for example, Schwenk & Macallan, 2000; van Lettow et al., 2003). Nevertheless, in active TB and likewise in HIV/AIDS, it is often difficult to distinguish between predisposing nutritional deficiencies and disease-induced malnutrition (ASSAF, 2007).

Nutritional deficiencies can also inhibit efforts to treat TB by interfering with the action of medications. In most circumstances, current antimycobacterial drug regimens are highly effective, but concomitant malnutrition may diminish the pharmacodynamic effectiveness of these medications (Calder & Jackson, 2000).

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Moreover, malnutrition can hamper the protective efficacy of the BCG (Bacillus Calmette-Guérin) vaccine, thereby increasing the occurrence of disease in vaccinated populations that are nutritionally vulnerable or deficient (ASSAF, 2007).

Proper attention to nutritional status, in combination with pharmaceutical therapy, can help to reduce the burden of disease and promote an enhanced quality of life in TB patients. As antimycobacterial medications begin to take effect, appetite increases, metabolic efficiency improves, and the body's need for additional nutrients and energy diminishes. At the same time, it appears that improvements in nutritional status are chiefly limited to increases in fat mass, as opposed to muscle tissue, which points to the conclusion that "adequate nutritional intake during TB care and recovery is needed to fully restore nutritional status during and following TB treatment" (USAID, 2008, p. 1). Efforts to improve nutritional status can thus serve as an important adjunct to TB treatment, by helping to build muscle and strengthen immunity.

As was mentioned earlier TB is associated with poverty. A major reason for this is because poverty leads to food insecurity and thence to malnutrition and reduced resistance to TB. The active disease then reduces the ability of people to work which then worsens the problem of food security and nutrition. This also happens in reverse: treatment of TB enhances health which improves the ability of people to work. It is important to bear this in mind so that efforts to prevent and treat TB are seen in their wider context.

## 8.2 Nutritional Assessment

The nutritional assessment of people with TB is closely similar to the assessment carried out with HIV-positive individuals. It should begin with a basic anthropometric evaluation. In adults, the following measurements are generally recommended: weight, height, BMI, and mid-upper-arm circumference (WHO Expert Committee, 1995). This evaluation should be supplemented by a clinical assessment that aims to identify symptoms and conditions specifically associated with TB, including those that can affect nutritional status, such as fatigue and loss of appetite. As in the case of HIV-positive individuals, diet should be assessed to ensure a sufficient intake of energy, protein, and micronutrients and to rule out potential drug-food interactions.Information about individual and household food security should also be determined. The initial nutritional assessment should again be followed by any needed interventions and by ongoing monitoring.

## 8.3 Nutritional Requirements

### *8.3.1 Energy and protein*

According to the WHO (2013b), no evidence currently exists to suggest that the optimal *proportion* of protein, fat, and carbohydrate in the diet differs for people with active TB. The standard recommendation is that protein account for 15% to 30% of overall energy intake. However, people with TB routinely require increased energy intake and fluids. This may be especially the case for people with chronic infections and those who perform physically demanding manual labour (Mueller, 2008). The recommendations for TB patients are based on the nutrient and energy requirements for hypercatabolic and undernourished patients (Roberts et al., 2006). Increased nutrient and energy requirements (macronutrients and micronutrients) need to be met since they are known to be associated with increased resting energy expenditure, accelerated protein turnover, decreased food intake, and gastrointestinal symptoms such as nausea.

### *8.3.2 Micronutrients*

Deficiency of single or multiple nutrients can reduce an individual's resistance to any infection. Reduced micronutrient intake, especially of vitamins A, E, and C, as well as zinc and selenium, has been associated with an impaired immune response. Indeed, at the time of diagnosis, patients with active TB often exhibit depressed blood levels of various micronutrients, including retinol, vitamins C and E, zinc, iron, and selenium (USAID, 2008). As mentioned earlier, however, it is difficult to determine how far these deficiencies reflect pre-existing conditions and how far they are a result of the immune system response to infection. Malnutrition-induced impairments of immune function are nonetheless reversed fairly rapidly once the nutritional deficiencies are corrected (Calder & Jackson, 2000).

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For TB, as with other infections, intake of iron beyond that needed to correct iron deficiency may have deleterious effects and should be avoided. Otherwise, data concerning the impact of micronutrient supplementation on TB outcomes are, unfortunately, limited. Research has suggested a link between lower vitamin D levels and both latent and clinical TB (Friis et al., 2008; Gibney et al., 2008; Wejse et al, 2007). Supplementation with vitamin D may be necessary if dietary intake is inadequate and/or exposure to sunshine is limited, although further research is needed on the impact of supplementation with this vitamin during TB treatment. A review which examined the effect of various combinations of nutritional supplements on people being treated for active TB, led the authors to conclude that high-energy supplements and some combinations of zinc with other micronutrients may help people with TB to gain weight. However, evidence was insufficient to allow the effect of other combinations of nutrients to be assessed (Abba et al., 2008).

Additional research is needed on the impact of multiple micronutrient supplements on TB in regions where predominantly cereal-based local diets are unlikely to provide adequate micronutrient intake (USAID, 2008). Regarding micronutrient supplementation and TB, the WHO concludes that "there is currently no reliable evidence that routinely supplementing at or above recommended daily amounts has clinical benefits" (WHO, 2013b, p. 17).

## 8.4 Food Intake and Medications

Health care workers need to be familiar with the possible interactions between food and nutrients and the drugs used in the treatment of TB, which differ from medication to medication. Both isoniazid and rifampicin should, for example, be taken on an empty stomach, whereas ethambutol, which can cause indigestion, is best taken with food. Because isoniazid and rifampicin are associated with the potential for liver damage, the consumption of alcohol must be avoided. Isoniazid may also produce adverse reactions if combined with certain foods, notably bananas, yogurt, avocados, liver, smoked or pickled fish, and yeast (FANTA, 2004). In addition, isoniazid inhibits the proper absorption of vitamin $B_6$, often producing peripheral neuropathy, a condition characterized by numbness and a burning sensation, typically in the feet and hands. Patients receiving isoniazid may thus require supplemental vitamin $B_6$ (USAID, 2008). Isoniazid also interferes with the metabolism of vitamin D, which can in turn decrease the absorption of calcium and phosphorus (Mueller, 2008).

# 9. MALARIA

Malaria is a potentially fatal disease caused by a parasitic protozoa known as *Plasmodium*. Most cases of malaria are caused by one of four species: *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium malariae*, and *Plasmodium ovale.* Of these, *P. falciparum*, which is especially common in sub-Saharan Africa, is associated with the most acute forms of the disease and with higher mortality rates.

While the gravity of the illness depends in part on the species of *Plasmodium,* it also reflects a given individual's degree of immunity to the disease. Malaria is transmitted to people by bites from infected *Anopheles* mosquitoes. As in TB infection does not automatically produce active disease. People who live in regions where malaria is highly endemicare repeatedly exposed to the infection and may thus develop considerable immunity. Children who live in these areas who reach the age of 10 are at relatively low risk of acute morbidity or mortality. Somewhat ironically, as rates of transmission decline, the risk of severe or fatal illness escalates (Shankar, 2008).

After multiplying in the liver, the malaria parasite then infects red blood cells. The initial symptoms are fever, chills, headache, and vomiting (WHO, 2014a). The classic symptom of malaria is, however, malarial paroxysm, that is, the cyclic occurrence of high fever, preceded by chills and shaking and followed by profuse sweating. The cycle initially occurs daily but after a few weeks it occurs every second or third day, depending on the species of *Plasmodium* involved. However, especially in people (including children) who have little immunity, and especially in cases caused by *P. falciparum*, malaria can produce rapid and acute illness and, if not treated, can quickly become life-threatening by disrupting the blood supply to vital organs.

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## 9.1 Epidemiology and Burden of Disease

### *9.1.1 Prevalence and incidence*

Approximately half of the world's population is at risk of malaria – some 3.4 billion people, according to the *World Malaria Report 2013* (WHO, 2013e). At the time the report was written, 97 countries had ongoing malaria transmission, including 43 countries in the African region, and malaria was still considered endemic in another 7. Globally, there were an estimated 207 million cases of malaria in 2012, 80% of them in Africa, and some 627,000 people died of the disease, 90% of them in Africa. More than three-quarters of those who died – 482,000, or 77% – were children under the age of 5.

On the positive side, the WHO (2013e) estimated that, between 2000 and 2012, the global incidence of malaria declined by 25% and by 31% in the African region. Worldwide, mortality rates fell by 42%. At 49% (54% among children), the rate of decrease was also slightly higher in the African region.

### *9.1.2 Highest-risk groups*

As is evident from mortality rates, young children are among those at high risk of malaria, as they are unlikely to have developed only limited immunity against the disease. Pregnant women are another at-risk group. Even if a woman has built up some immunity to the disease, malaria can cause miscarriage, as well as low birth weight in babies. Women who are HIV-positive are at greater risk of malaria, as are all people who have HIV/AIDS. In particular, a woman who develops a malarial infection of the placenta is at greater risk of passing the HIV virus to her unborn child. Another high-risk group consists of people who have been living in an area in which malaria is not endemic, and who thus have no immunity, and who then travel or move into an area in which it is. This includes people who originally came from areas in which the disease is endemic but who subsequently immigrated to a country where malaria does not occur. As a result, their immunity will have been lost or weakened, placing them at greater risk if they return home (WHO, 2014a).

## 9.2 Treatment

Malaria is treated with a variety of drugs. Treatment plans differ in their specifics, depending on the species of *Plasmodium* and the severity of the infection. (For details, see WHO, 2010a.) The development of drug-resistant strains of *Plasmodium*, especially *P. falciparum*, is a continuing source of concern. As in the case of antimycobacterials, resistance is especially apt to result from monotherapy (the use of only a single medication), from inadequate dosages, and from poor compliance.

## 9.3 Nutritional Interventions and Malaria

### *9.3.1 Iron*

The relationship between iron intake and malaria has been the subject of controversy (Raiten et al., 2009). There is little evidence that an iron deficiency offers any protection against malaria. However, some studies have suggested that, in malaria-endemic regions, iron supplementation could actually increase the risk of malaria, by providing parasites with additional iron. Evidence indicates, moreover, that the parenteral administration of iron increases the risk of malaria in infants and pregnant women and should therefore be avoided (Menéndez & Dobaño, 2004). It is important to bear in mind that in many areas where malaria is common iron deficiency is also common. For that reason the best approach may be the fortification of foods with iron, especially for foods intended for infants, children, and women (Raiten et al., 2009). However, the amount of iron used and the iron compound selected needs to be carefully ontrolled.

For a variety reasons, including the overall reduction of side effects, the WHO (2011) now recommends the intermittent, rather than daily, use of iron supplements and proposes that, in malaria-endemic areas, iron supplementation be accompanied by concerted efforts to prevent malaria and to diagnose and treat it promptly.

### *9.3.2 Zinc*

As is well known, zinc is essential to the proper functioning of the immune system. In particular, it is crucial to lymphocyte functions that appear to have a role in resistance to malaria (Shankar, 2008). Whether zinc

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supplementation has a protective effect against malaria remains to be determined, however. A randomized double-blind trial conducted in Burkina Faso, for example, found that, in children up to the age of 6, combined vitamin A and zinc supplementation led to a significant decrease (roughly one-third) in both the prevalence of malaria and the number of malaria episodes (Zeba et al., 2008). Similarly, in a study conducted in Ghana, children up to the age of 24 months who received both zinc and vitamin A supplements proved to have 27% fewer episodes of malaria than children who received vitamin A only (Owusu-Agyei et al., 2013). Others studies, however, have found no evidence that zinc supplementation produces any significant benefit with regard to malaria (see, for example, Veenemans et al., 2011). Clearly, then, further investigation is needed into the effect of zinc supplementation, alone or in tandem with other supplements, on malaria morbidity and mortality.

#### *9.3.3 Vitamin A*

As we saw in Chapter 9, given that vitamin A deficiency is a serious health problem in many developing countries. In the case of malaria, some evidence exists to support the protective effects of vitamin A. The first major documentation came in the form of a study conducted in Papua New Guinea, which demonstrated a 30% decrease in malaria episodes among preschool children as a result of vitamin A supplementation (Shankar et al., 1999). Since then, studies have suggested that vitamin A supplementation reduces the impact of malaria on children's growth, protects pregnant women against malaria, and reduces the severity of malaria episodes (see Shankar, 2008). In a review, SanJoachin and Molyneux (2009) concluded that "although vitamin A supplementation reduces the incidence of uncomplicated malaria by about one-third, it does not appear to reduce the rate of deaths that can be specifically attributed to malaria." They nonetheless recommended the use of vitamin A supplements in children who live in malaria-endemic regions, partly because it is associated with a reduction in all-cause mortality.

## 10. MEASLES

Measles (rubeola) is a highly communicable acute viral infection. The disease is characterized by a high fever and a rash, coupled with coughing, inflammation that affects the upper respiratory tract, and conjunctivitis. The virus is transmitted by droplets spread by coughing and sneezing and hence by close personal contact with an infected person. Transmission is thus more likely to occur in densely populated areas or under conditions of overcrowding, such as refugee camps. Measles can have severe complications, including pneumonia and other severe respiratory illness, encephalitis, and blindness. Especially in young children, it can also produce acute diarrhoea, which can lead to potentially life-threatening dehydration. Death most commonly results not from the primary disease but from ensuing complications (WHO, 2014c).

### 10.1 Epidemiology and Burden of Disease

#### *10.1.1 Prevalence and incidence*

As a result of routine vaccination, measles is now rare in developed countries, but it remains common in many developing countries, especially in sub-Saharan Africa and Asia. The WHO estimates that upwards of 20 million people contract measles each year. Most of them survive, but, in 2012, some 122,000 people died from the disease, primarily children under the age of 5. The vast majority (over 95%) of deaths occur in low-income countries, where public health services are often inadequate. At the same time, the advent of the measles vaccine has produced a massive drop in the mortality rate. In 1980, when vaccination was not yet widespread, the death toll stood at roughly 2.6 million people; by 2000, the figure had fallen to 560,000. It then fell by another 78% between 2000 and 2012, largely as a result of large-scale immunization campaigns (WHO, 2014c).

#### *10.1.2 Highest-risk groups*

Unvaccinated young children are at highest risk of measles. Malnourishment and, in particular, vitamin A deficiency increases risk, as do impairments to the immune function, such as those associated with HIV/

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AIDS. Children under the age of 5 are also more prone to complications. Those under the age of one year are at greatest risk. Pregnant women who contract the measles likewise run a higher risk of severe complications, including miscarriage or premature delivery. Having the measles confers lifetime immunity, but anyone who has not had the disease or has not been immunized against it is at risk.

Poverty also plays a significant role in the degree of risk, as it is associated not only with crowded living conditions but also with lower rates of immunization, which in turn lead to a higher incidence of the disease (Hussey, 2008). Outbreaks of measles can cause many deaths, especially among young, malnourished children. Such outbreaks often occur following a natural disaster, such as an earthquake or severe famine, or in war-torn countries, where health services are disrupted or overwhelmed (WHO, 2014c).

## 10.2 Nutritional Interventions and Measles

### *10.2.1 Vitamin A*

Although high-dose vitamin A supplementation, as recommended by the WHO, appears to reduce a child's overall vulnerability to illness, it is not generally recommended as a treatment for infectious disease. However, numerous studies have established that it can have a beneficial effect in children who have measles. A systematic review of the literature demonstrated that two 200,000 IU doses of vitamin A administered on successive days reduced mortality by 82% in children under the age of 2 (Huiming et al., 2005). The WHO thus recommends that all children in developing countries who are diagnosed with measles should immediately be given two doses of vitamin A, one day apart. Children under the age of 6 months should receive 50,000 IU per dose, children between 6 and 11 months of age should receive two 100,000 IU doses, and children 12 months and older should receive 200,000 IU per dose. In addition to reductions in mortality, vitamin supplementation can also prevent possible eye damage and even blindness (WHO, 2014c; see also Hussey, 2008).

### *10.2.2 Additional nutritional support*

Mothers should be encouraged to provide adequate nutritional support to a child who has measles, even if the child is suffering from diarrhoea. If the child is being breast-fed, feeding should continue; otherwise, mothers are advised to increase the child's energy intake by adding a teaspoon of vegetable oil and a teaspoon of sugar to milk or other suitable food. Children must also be given additional fluids, to prevent dehydration, and preferably also a multivitamin tablet (Hussey, 2008).

# 11. PNEUMONIA AND OTHER ACUTE RESPIRATORY INFECTIONS

Acute respiratory infections (ARIs) are typically classified according to the site of the infection. Acute upper respiratory infections include colds, sore throats, sinusitis, and tonsillitis. Acute lower respiratory tract infections (ALRIs) involve the larynx, glottis, bronchioles, and alveoli. They include laryngitis, bronchitis, and, above all, pneumonia.

## 11.1 Epidemiology and Burden of Disease

### *11.1.1 Prevalence and incidence*

Pneumonia is the world's leading cause of death in children. The WHO estimates that pneumonia accounts for roughly 18% of all deaths in children under the age of 5, with some 1.1 million of them dying each year from the disease (WHO, 2013c). Although it occurs worldwide, it is most prevalent in sub-Saharan Africa and South Asia, and the overwhelming majority of children who die of from pneumonia live in developing countries. In the words of the *Global Action Plan for Prevention and Control of Pneumonia,* "The burden that pneumonia places on families and the health system in low-resource countries in turn exacerbates inequalities; overwhelmingly, children who are poor, hungry and living in remote areas are most likely to be visited by this 'forgotten killer'" (WHO & UNICEF, 2009, p. 1).

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### *11.1.2 Highest-risk groups*

Risk factors associated with ALRIs can be broadly divided into two categories, one more strictly medical and the other pertaining to environmental conditions. Among the former are low birth weight, lack of breast-feeding, and malnutrition, including deficiencies of vitamins A and D, zinc, and selenium. Suppression of the immune system, as in HIV/AIDS, and prior respiratory infections also increase risk, as does the presence of sickle-cell disease. Environmental factors include overcrowded and unhygienic living conditions, as are typically associated with poverty, dampness (whether seasonal or characteristic of the living quarters), the presence in the household of someone who smokes or who has a respiratory illness, and the use of indoor cooking fires or solid fuels for heating (Lanata & Black, 2008). As always, anyone who is in poor health initially or who lacks adequate immunization is a greater risk of infection.

## 11.2 Pathophysiology and Clinical Presentation

Respiratory tract infections are most often transmitted when people touch their mouth, nose, or eyes after their hands have come into contact with nasal secretions from an infected person. These infections can also be spread via the lungs, when someone breathes air containing droplets produced by the coughing or sneezing of an infected person.

The respiratory tract is vulnerable to a great many pathogens, both bacterial and viral. Although some of these pathogens are closely associated with specific diseases, a specific pathogen can be implicated in more than one disease. The bacterium *Streptococcus pneumoniae* is a major cause of bacterial pneumonia, but *Haemophilus influenzae* (once mistakenly thought to be responsible for influenza) can also cause pneumonia, in addition to a variety of other respiratory ailments. ARIs can also result from a broad range of viruses, with the influenza A virus, the measles virus, and respiratory syncytial virus (RSV) most closely implicated in mortality.

RSV, which is the leading cause of ALRIs in young children, tends to be prevalent during rainy seasons, in the form of seasonal epidemics. It most commonly presents as bronchiolitis, which chiefly affects infants under the age of 12 months, with the incidence highest between the ages of 2 and 6 months (Riley, 2004). However, some 30% of children who are infected with RSV have pneumonia (Lanata & Black, 2008). The development of an RSV vaccine is a public health priority, and research is currently underway.

Pneumonia occurs when the pathogens overwhelm the host defences in the lower respiratory tract. It may lead to a reduction in lung volume and pulmonary function later in life (Lanata & Black, 2008). The main bacterial causes of pneumonia in children aged 2 months to 5 years and living in developing countries are *S. pneumoniae* and *H. influenzae.* In developing countries, children encounter these bacteria at a younger age and higher carriage rates occur (Rasmusen et al., 2000).

## 11.3 Diagnosis

Acute upper respiratory infections typically produce one or more of a sore throat, runny nose, cough, and earache. ALRIs manifest themselves in a cough plus additional symptoms of respiratory distress, such as an increased rate of respiration, wheezing, and chest in-drawing (in which the lower chest wall retracts, rather than expanding, during inhalation) (Lanata & Black, 2008). In adults, pneumonia is usually diagnosed by means of clinical symptoms – a cough, difficulty breathing, chest pain, and fever – plus a chest X-ray. In children under the age of 5, however, the low specificity of chest X-rays makes them unreliable as an initial diagnostic tool: for example, in one study, 82% of children suffering from non-severe pneumonia proved to have normal chest X-rays (Hazir et al., 2006). Instead, pneumonia in young children is diagnosed chiefly on the basis of clinical signs, foremost among them fast breathing – defined by the WHO as more than 40 breaths per minute in children aged 1 to 5 years, more than 50 breaths in children aged 2 to 11 months, and more than 60 breaths in children under one month old – and chest in-drawing. Children who display additional symptoms such as cyanosis, very pronounced chest in-drawing or other signs of serious respiratory distress, and general danger signs, including convulsions, lethargy, and/or the inability to breast-feed or drink, are suffering from severe pneumonia and require hospitalization. Children with non-severe pneumonia require antibiotics but can usually be treated at home (WHO, 2013d).

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## 11.4 Nutrition and Pneumonia

### *11.4.1 Zinc*

There has been much research into the effectiveness of zinc supplementation for the prevention of ARLIs in young children in developing countries. Results have been generally positive. Reviewing the results of six randomized controlled trials from four countries, Lassi et al. (2010) found that zinc supplementation reduced the incidence of pneumonia in children between the ages of 2 months and 5 years. Another review, which summarized the findings from ten studies, looked more broadly at ARLIs (rather than just pneumonia). Zinc supplements reduced the inclidence of ARLIs in children aged under age 5 (Roth et al., 2010). Both reviews reported that quite different results were reported based on the method of diagnosis.. The effect of zinc supplementation was negligible when fast breathing (with or without chest in-drawing) was used as the basis for diagnosis, but when the diagnosis was confirmed by chest examination and/or X-ray, zinc supplementation was shown to be effective.results to date thus suggest that, in regions where zinc deficiency is prevalent, routine zinc supplementation can have a protective effect against pneumonia.

Twenty trials have been carried out to determine whether zinc supplements are of value in the treatment of pneumonia in children aged under age 5. Four studies have been carried out in developing countries and taken together they indicate that zinc supplements are of no value when given in addition to the usual treatment (Haider et al., 2011).

### *11.4.2 Vitamin A*

A systematic review was carried out of studies conducted in developing countries that investigated whether supplements of vitamin A are of value with respect to pneumonia in children. The overall conclusion based on the twenty studies included in this review was that vitamin A supplements have no useful benefit in either the prevention or treatment of pneumonia (Mathew, 2010). These findings are somewhat surprrising as vitamin A deficiencies have often been reported in developing countries and this is closely associated with a depressed state of the immune system.

### *11.4.3 Selenium*

Evidence suggests that selenium deficiency may increase the risk of respiratory infections among malnourished children. A study of low-birth-weight infants found that low plasma selenium levels were significantly correlated with an increase in respiratory morbidity (Darlow et al., 1995). Studies conducted in China in the late 1990s indicated that a 1 mg dose of sodium selenite had a positive impact in children hospitalized with pneumonia related to RSV or *Mycoplasma pneumonia,* while subsequent studies in Russia pointed to a similar effect from food additives that contain selenium (see Lanata & Black, 2008). However, further research is required to determine the role of selenium in the management of ALRIs in children.

### *11.4.4 Breast-feeding*

Breast-feeding has been found to protect infants from ARIs. Infants who are being breast-fed acquire antibodies from their mother through her milk, and breast milk also contains antibacterial and antiviral substances that help to ward off infections and decrease the severity of infectious illnesses. Breast-feeding also reduces the risk of infection from formula feed, as may occur, for example, when it is prepared with contaminated water. A study conducted in Bangladesh demonstrated that breast-feeding significantly reduces the risk of mortality from both ARIs and diarrhoea (Arifeen et al., 2001). The authors estimated that if 80% of all children were exclusively breast-fed during the first 4 months of life, infant mortality could be reduced by a third. In addition, the results of another study suggested that the prevention of malnutrition and low birth weight could reduce deaths from pneumonia by at least 25% (Victora et al., 1999). In short, exclusive breast-feeding is probably the single the most effective way to safeguard infants from pneumonia and other serious infections.

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## DISCUSSION QUESTION AND EXERCISES

In view of the importance of nutritional status in people living with and affected by HIV/AIDS, TB, and other infectious diseases, the student is encouraged to answer the following question:

1. Develop a nutritional management plan for a primary health-care facility to ensure adequate nutritional care and follow-up of HIV/AIDS and TB patients. The nutrition care plan should take the format of a flowchart.

### Case Study 1

Thandi is a 2-year-old girl. Her mother brought her to the local clinic because she has a rash on her face, arms, and chest and she has been crying a lot. On closer assessment, the clinical nurse practitioner establishes that Thandi has a fever and a persistent cough. She is also underweight for her age and appears lethargic. The nurse further inquires about the rest of the members of the household. There are eight people living together, three adults (two men and the mother) and five children (three are under 5 years of age) in an old brick house with two rooms and one bathroom. The house becomes damp in winter. There is no running water in the home, and they use paraffin for cooking. Only one of the adult men, the brother of the mother's husband, earns an income. He smokes and sometimes comes home drunk. The family does not always have enough food for all members of the household. As a result, the mother sometimes first feeds the two men and the children, and she then goes without food in the evening. She reports that she has lost her appetite, she has been coughing for a while, and she sweats a lot at night. She shows the nurse that her skirt, which fitted her nicely a few months ago, is now very loose around her waist.

1. Describe the vicious cycle of infectious disease.
2. Discuss the family's food security dilemma and its consequences.
3. Devise a plan of action to assist the family with medical and nutritional care. Make this plan appropriate for your community.

### Case Study 2

Rafael, 29, came to the city from the small village in which he grew up to look for work. He has frequently been unemployed and has had a series of girlfriends, some of whom helped him out financially. When he was 22, Rafael discovered that he was HIV positive. He was prescribed antiretroviral drugs, but they were very expensive, and the side effects were unpleasant, so he stopped taking them. He seemed to be doing fine, but for the past several weeks he hasn't been feeling well. He seems to have no energy, he often feels nauseated, his appetite is poor, and he's been losing weight. Now he's noticed small white patches on his tongue, so he decides to go to the health care centre for some advice.

1. Describe how you, as a health worker, would go about assessing Rafael's overall medical situation.
2. What treatment plan would you recommend? Describe both its immediate and longer-term goals.
3. Describe the steps you would take in hopes of making it possible for Rafael to return to ARV therapy and remain on it.

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## ADDITIONAL RESOURCES

AVERT: Averting HIV and AIDS. http://www.avert.org/

CDC (Centers for Disease Control and Prevention)

HIV Topics: http://www.cdc.gov/hiv/topics/

Malaria: http://www.cdc.gov/malaria/

Measles: http://www.cdc.gov/measles/

Tuberculosis (TB) Topics: http://www.cdc.gov/tb/topic

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UNAIDS (Joint United Nations Programme on AIDS): http://www.unaids.org/en/aboutunaids/

World Health Organization (WHO) Guidelines:

HIV: http://www.who.int/hiv/pub/guidelines/en

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HIV/AIDS: http://www.who.int/topics/hiv_aids/en/

HIV/AIDS Programme: www.who.int/hiv/en/

Malaria: http://www.who.int/topics/malaria/en/

Measles: http://www.who.int/topics/measles/en/

Pneumonia: http://www.who.int/topics/pneumococcal_infections/en/

Tuberculosis: http://www.who.int/topics/tuberculosis/en/

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# CHAPTER 11

# NUTRITIONAL MANAGEMENT OF DIARRHOEA

*Joy Fraser and Alice N. Brako*

## *Outline*

- Diarrhoeal diseases as a public health problem
- Epidemiological features of diarrhoeal diseases
- Major pathogens associated with diarrhoeal diseases
- Impact of diarrhoeal diseases on nutritional status
- Role of nutrition in the prevention of diarrhoea
- Role of clean water, hand washing, and latrines in the prevention of diarrhoea
- Nutrition and the treatment of diarrhoea

## *Objectives*

After completing this chapter, you should be able to:

- Describe the public health significance of diarrhoeal diseases
- Identify and describe the epidemiology of diarrhoeal diseases, including geographical distribution, risk factors, incidence, seasonality, and duration
- Name the major pathogens associated with diarrhoeal diseases and explain how infectious agents produce disease
- Describe how clean water, hand washing, and latrines help prevent diarrhoea
- Explain how nutritional status affects diarrhoeal illness and how diarrhoea affects nutritional status
- Describe the role of nutrition in the treatment of diarrhoea

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# 1. INTRODUCTION

Diarrhoeal diseases are a major cause of childhood illness and death in developing countries. Nutritional risk factors, such as being underweight and having poor hygiene, are closely associated with diarrhoeal mortality. Diarrhoea is a symptom marked by an increase in stool frequency and decreased consistency, and the cause is usually an infection from a bacteria, virus, or parasite that may be present in animal or human faecal matter or in contaminated food, milk, or water. Researchers have often assigned different definitions to diarrhoea because frequency and consistency of bowel movements in individuals vary greatly depending on age and culture. A widely accepted standard has, however, been established in which diarrhoea is defined as a condition in which three or more liquid stools are passed within any 24-hour period. This definition is less appropriate for infants younger than 2 months, who normally pass stools that are loose and of high frequency. Dysentery is the diarrhoeal condition in which blood is present in watery stools, and persistent diarrhoea is characterized by an episode of diarrhoea that lasts 14 days or longer. A bout of diarrhoea is considered over when an individual experiences three consecutive diarrhoea-free days (Lanata & Black, 2008). Further information on clinical evaluation and case management of diarrhoea can be found in a World Health Organization (WHO) treatment manual (WHO, 2005).

This chapter covers the historical background, epidemiological factors, and development of diarrhoeal diseases; associations between nutritional status, dietary management, and diarrhoeal diseases; and nutritional preventive measures for diarrhoeal diseases.

# 2. PUBLIC HEALTH SIGNIFICANCE OF DIARRHOEA

According to the WHO, diarrhoeal diseases account for an estimated 1.5 million deaths in children each year, and most of these occur in children less than 2 years of age. Recurring bouts of diarrhoea can lead to undernutrition as a result of loss of fluids and electrolytes. Loss of fluid can cause severe dehydration and death.

## 2.1 Historical Background

The conditions associated with diarrhoeal diseases include poverty, poor sanitation and hygiene, inadequate water supplies, and limited education. Current developed countries experienced high infant and child death rates prior to the mid-twentieth century. Summer outbreaks of diarrhoea in infants and children less than 5 years of age were common in large cities such as Paris and London during the latter half of the nineteenth century (Newman, 1906; Woods & Woodward, 1984). Improved sanitation, hygiene, child-feeding practices, water supplies, and education greatly reduced the incidence of diarrhoeal diseases in industrialized countries, and the burden of these illnesses has now shifted to developing countries.

Among diarrhoeal diseases, cholera has been the most widely studied. It is a bacterial infection that is transmitted through contaminated food or water, and it is characterized by acute diarrhoea that can quickly lead to severe dehydration and death. Cholera occurs endemically in south and southeast Asia and parts of Africa, but has also been associated with pandemics that occurred into the twentieth century following human migration and trade routes (Lee, 2007).

# 3. EPIDEMIOLOGY OF DIARRHOEA

## 3.1 Geographical Distribution

Black and Lanata (2002) published a detailed review of the epidemiology of diarrhoea in developing countries. Although diarrhoeal diseases occur globally, they are more prevalent in developing countries, where they are associated with conditions of poverty, inadequate sanitation, poor hygiene, lack of access to clean water, and insufficient education. Diarrhoeal diseases are also widespread in urban slums where there is inadequate housing and overcrowding. Warmer climates promote the growth of pathogenic microorganisms, contributing to increased prevalence. Most diarrhoeal deaths occur in densely populated areas where conditions of extreme poverty and lack of proper health care persist (Parashar et al., 2006).

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### 3.2 Risk Factors

Several risk factors are associated with an increase in diarrhoea morbidity and mortality. Faecal contamination of hands is correlated with increased diarrhoeal incidence. Lack of clean water and poor sanitation are linked to contamination of hands. The temperature of food preparation, how soon food is eaten after preparation, and use of refrigeration affect the levels of bacteria in food. Fruits and vegetables may contain faecal coliforms from sewage-contaminated irrigation water. Bacterial contamination may result from feeding utensils, such as baby bottles, baby bottle nipples, cups and spoons, and food containers (Lanata & Black, 2008). The importance of various risk factors in the control of diarrhoea is explored later in this chapter.

Reports indicate that houseflies may contribute to an increased risk of diarrhoea in developing countries. Evidence of this can be found in the successful reduction of diarrhoeal diseases through the implementation of fly control interventions (Chavasse et al., 1999). Children's contact with vectors such as chicken faeces is thought to be linked to diarrhoea associated with *Campylobacter jejuni.* In addition to environmental factors, there are host factors that influence the development of diarrhoeal diseases. These include undernutrition, micronutrient deficiencies, a previous attack of diarrhoea, hypochlorhydria, and poor immune function (Lanata & Black, 2008).

### 3.3 Incidence

The reported incidence of diarrhoeal disease has fluctuated over the years depending on study design. The use of non-standardized definitions of diarrhoea may be a factor in this. Nevertheless, many epidemiological studies show a pattern of diarrhoea incidence that has remained high since the 1980s. The reported global median incidence rate for diarrhoeal diseases in children less than 5 years of age (reported as episodes per year per child) was 2.6 between 1980 and 1990 (Bern et al., 1992) and 3.2 between 1990 and 2000 (Kosek et al., 2003). Although diarrhoea morbidity remains little changed, there has been a sharp reduction in diarrhoea mortality; this is due to effective treatments such as oral rehydration therapy (ORT). The high rates of diarrhoea are a reflection of persistent risk factors such as limited access to clean water, poor sanitation, and lack of latrines; these factors need to be addressed, particularly for children younger than 2 years of age, in whom the incidence rate is highest.

Most diarrhoea episodes are of short duration and resolve within one week, with a smaller number of cases lasting up to 2 weeks. Persistent diarrhoea that lasts more than 14 days accounts for 3% to 20% of all diarrhoea episodes, the incidence being highest in children less than 5 years of age, and declining with older children (Lanata & Black, 2008).

### 3.4 Seasonality

Diarrhoeal diseases caused by bacterial infections peak during hot or wet months, confirming a faecal–oral route of transmission. On the other hand, Rotavirus infections, which are responsible for a large proportion of childhood diarrhoeal diseases, respond to changes in climate, with the highest number of infections found at the colder and drier times of the year in both temperate and tropical regions. But for other climates, the virus is always present, suggesting that low-level transmission occurs all year round (Levy et al., 2009).

## 4. CLINICAL FEATURES AND PATHOPHYSIOLOGY

The loss of fluid that accompanies diarrhoeal disease leads to dehydration, fever, electrolyte imbalances, anorexia, convulsions, and micronutrient and macronutrient deficiencies.

### 4.1 Major Pathogens Involved in Diarrhoeal Diseases in Children

Most diarrhoeal diseases are caused by bacterial, viral, and protozoan pathogens. In many studies reporting on community-based and hospital-based incidences of diarrhoeal disease, *Escherichia coli* was found to be the major cause of gastro-intestinal infections. Table 11.1 lists the leading causative agents of diarrhoea in children (Lanata et al., 2003).

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**Table 11.1:** Leading infectious causes of diarrhoeal disease in children worldwide

| Pathogen | Pathogen type |
|---|---|
| *Campylobacter jenuni* | Bacterium |
| *Clostridium difficile* | Bacterium |
| *Cryptosporidium parvum* | Protozoa |
| *Entamoeba histolytica* | Protozoa |
| *Escherichia coli* (enterotoxigenic and enteropathogenic strains) | Bacterium |
| *Giardia lambria* | Protozoa |
| Rotaviruses | Virus |
| *Salmonella* | Bacteria |
| *Shigella* types | Bacteria |
| *Vibrio cholera* | Bacterium |
| *Yersinia enterocolitica* | Bacterium |

## 4.2 Pathophysiology

The symptoms of acute diarrhoea depend on whether the infectious pathogen causes disease by producing a toxin or by invading host tissues. Enterotoxic (toxin-producing) diarrhoeas are caused by *E. coli* strains and *Vibrio cholera*. The presence of toxin in the intestinal lumen causes secretion of fluid and electrolytes and subsequent diarrhoea. Rotaviruses infect cells lining the intestinal tract and may result in mucosal damage that impairs lactase activity and absorption of carbohydrates. Enterotoxigenic and viral diarrhoeas are not characterized by inflammation of the intestinal mucosa. Invasive diarrhoeal disease is caused by species of bacteria such as *Shigella*, *Salmonella*, *Yersinia enterocolitica*, *Campylobacter jenuni*, and enteroinvasive *E. coli*, and it is associated with an acute inflammatory process (Keusch, 1983).

## 4.3 Effects of Malnutrition on Mortality

Evidence based on epidemiological studies shows that malnutrition is directly associated with mortality as a result of diarrhoeal disease. The risk of dying for malnourished children is 14 to 24 times higher than that of normally nourished children. Additionally, mortality risk is proportional to the level of malnutrition. For example, a large prospective study reported that the risk of dying increased 1.6 times for each one-unit decrease in weight-for-age Z-score. Mortality rates are also higher when malnutrition is associated with persistent diarrhoea compared to acute diarrhoea. Of the three million annual premature deaths from diarrhoeal diseases, 58% are linked to malnutrition (Wapnir, 2000).

## 4.4 Effects of Malnutrition on Morbidity

Malnutrition has a closer relationship with duration of diarrhoeal morbidity than with increased incidence, especially for infections with *Shigella* and enterotoxigenic *E. coli* pathogens. A three-fold or greater increase in duration of diarrhoeal illness has been observed in undernourished children. The longer period of diarrhoeal illness further compounds the poor nutritional status and may lead to persistent diarrhoea and the likelihood that such children will require hospitalization and longer hospital stays (Black et al., 1984; Black, 1993).

Although the link between undernutrition and diarrhoeal incidence is weaker than that between the duration of illness and poor nutritional status, children with previous malnutrition have a 1.5- to 2.0-fold elevated risk of developing a diarrhoeal episode. Children who are undernourished are also more likely to have recurring diarrhoea episodes, particularly with *Cryptosporidium parvum* infections (Sarabia-Arce et al., 1990).

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### 4.5 Effect of Diarrhoea on Growth of Children

Diarrhoea causes reduced weight gain in children rather than a reduction in height or length gain. The weight shortfall is indirectly related to the duration of a diarrhoeal episode. Since a poor diet seems to be associated with the negative effects of diarrhoea, a normal diet can reverse these effects within 14 to 30 days following a diarrhoeal episode. Plotting the duration of diarrhoeal episodes shows a continuous distribution with skewedness toward long durations. Durations greater than 14 days (persistent diarrhoea), although accompanied by higher risks of dying, are less common, and occur in children in areas with a generally high prevalence of diarrhoea (Black, 1993). An adequate diet is protective against the subsequent nutritional impact of diarrhoea, and infants who are breast-fed suffer less harmful effects with respect to growth.

Evidence shows that both symptomatic and asymptomatic infections have unfavourable effects on growth. In a community-based study conducted with Peruvian children, a reduction in weight gain was observed in children infected with both symptomatic and asymptomatic forms of *C. parvum* (Checkley et al., 1998). Other studies suggest that asymptomatic infections have even greater negative effects on growth than symptomatic ones because of their higher prevalence. According to a review published by Humphrey (2009), large numbers of faecal bacteria colonize the small intestines of children and produce a subclinical condition known as tropical enteropathy. The changes associated with this, such as a hyperpermeable gut, inflammation, and villous atrophy, may result in reduced nutrient intake and absorption and subsequent growth reduction in children aged 2 years or younger.

### 4.6 Effect on Dietary Intake

Diarrhoea illnesses are linked to a reduction in dietary intake during the disease period, and the reduction in energy consumption in infants can be as much as 15% to 20% in non-breast-feeding children. For breast-fed infants, the impact is less, especially if they receive more than half of their energy intake from breast milk. Hospitalized children show a greater reduction in energy intake than those in the community, possibly because of differences in food characteristics, and these children may also have been suffering more severely from the disease, both before and after entering hospital (Lanata & Black, 2008).

### 4.7 Effects on Nutrient Absorption and Intestinal Function

There are several methods by which diarrhoea may reduce intestinal absorption. These include direct intestinal cell damage by a pathogen or its toxins, immune response of the host, accelerated intestinal motility accompanied by reduced transit time, and less bile acids due to faecal losses or breakdown by bacteria. The malabsorption and impaired digestion of macronutrients brought on by these mechanisms result in further build up of fluid and intraintestinal osmotic pressure, worsening the diarrhoea. More often, infections with rotaviruses seem to bring on these conditions (Sack et al., 1982).

## 5. PREVENTION OF DIARRHOEA

### 5.1 Relationship with Nutrition and Immunity

The evidence above demonstrates that undernutrition is a major risk factor for diarrhoea, especially in children. Here we look more closely at specific components of nutrition.

#### *5.1.1 Undernutrition*

Undernourished children have a high risk of infection that may be explained by the link between severe malnutrition and impaired immune response. Studies in developing countries have shown that children with impaired immune responses have a higher incidence of diarrhoeal diseases compared to those who are immunocompetent. This is also the case with persistent diarrhoea where failure to mount a cell-mediated response is associated with an elevated risk of diarrhoea (Shell-Duncan & Wood, 1997).

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### *5.1.2 Vitamin A*

Having diarrhoea predisposes a child to the development of vitamin A deficiency, which is known to impair epithelial integrity and systemic immunity, and in turn further increases the incidence and severity of infections, including diarrhoea (Brown, 2003; Villamor & Fawzi, 2000). The association is particularly strong between severe and persistent diarrhoea and with xerophthalmia or low vitamin A status assessed biochemically. In children with acute *Shigella* diarrhoea, a transient low serum retinol has been observed, probably because of impaired reabsorption of the transport protein that binds to retinol (Mitra et al., 1998). While Villamor and Fawzi's (2000) review showed that vitamin A supplements reduce the severity of diarrhoea in some trials but not in others, they concluded that vitamin A supplements are effective in reducing total mortality; in particular, vitamin A supplements are likely to be more effective in populations suffering from nutritional deficiencies. Similarly, a recent review reported that vitamin A supplementation in community settings reduces diarrhoea specific mortality by 30% in children aged 6 to 59 months (Imdad et al., 2011). It is known that vitamin A deficiency increases the relative risk of dying from diarrhoeal episodes; therefore supplementation is seen as a low-cost intervention for controlling severe and potentially fatal diarrhoeal episodes.

### *5.1.3 Zinc*

Zinc plays a variety of roles in the body, contributing to growth and development, and assisting in immune function. This makes it a key micronutrient in helping children fight infectious diarrhoeal and respiratory diseases. Zinc is available in many foods, especially high-protein foods. Good sources of bioavailable zinc come from meat (Hunt, 2003). Unfortunately, traditional diets in developing countries often fail to meet zinc needs in children, especially if they are plant-based (see Chapter 9).

A detailed review of clinical studies concluded that children who receive a zinc supplement have significantly fewer episodes of diarrhoea, severe diarrhoea, dysentery, and persistent diarrhea, and fewer total days of diarrhoea (Aggarwal et al., 2007). While there is evidence that zinc is effective for preventing and treating diarrhoea, these authors noted various problems associated with the studies, indicating a need for larger, high-quality studies to identify subpopulations most likely to benefit from zinc supplements. Nevertheless, UNICEF and WHO (2009) suggest that zinc is an important nutrient in the prevention of diarrhoeal diseases in children and efforts should be increased to insure its widespread distribution.

Not only is zinc deficiency associated with higher rates of diarrhoea and other infectious diseases, but diarrhoea also results in depletion of zinc stores in the body. Therefore, zinc supplementation is important for both the prevention and treatment of diarrhoea.

### *5.1.4 Other minerals*

Copper is a trace mineral that is a part of several enzymes that participate in the body's natural defence mechanisms. Thus copper deficiency is linked to preventing infectious disease in children, and copper supplements have been shown to relieve persistent diarrhoea. Selenium, another trace mineral, is one of the body's antioxidant nutrients. Infants' requirements for selenium are greater than those for older children; it is therefore especially an essential mineral for infants who are at risk of diarrhoeal disease. The level of selenium may vary in breast milk depending on maternal intake. Studies with animals show that selenium-deficient diets cause an increase in oxidative levels and suppression of the immune response, which are reversed with supplemental selenium (Arthur et al., 2003).

## 5.2 Breast-feeding

Breast-feeding has major health benefits, including greatly reducing the risk of diarrhoea (Chapter 5). With few exceptions, all infants should be exclusively or predominantly breast-fed for at least the first 6 months of their lives. The preventive action of breast milk against diarrhoea has been demonstrated clinically. For example, Bahl et al. (2005) conducted a study of 9400 infants, aged 18 to 42 days, in Ghana, India, and Peru, and found that those who were exclusively or predominantly breast-fed had a significantly lower rate of diarrhoea and acute respiratory illness in comparison with infants who were not breast-fed or were partially breast-fed. Similar findings were made by Arifeen et al. (2001) in a study of infants in slum areas of Dhaka,

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Bangladesh, who were followed from birth for 12 months. Infants who were partially or not breast-fed had a 2.2-fold higher risk of death from all causes, with deaths from diarrhoea 3.9 times more likely, than infants who were exclusively breast-fed. Lawrence and Pane (2007) reviewed 12 studies, most of which examined exclusive breast-feeding versus exclusive formula feeding. They concluded that there is a significant difference in outcomes in terms of diarrhoeal diseases, with clear preventative benefits of breast milk. The WHO and the American Academy of Pediatrics estimate that if infants were exclusively breast-fed until 6 months of age, followed by breast-feeding for up to one year along with eating solid foods, more than one million infant deaths from diarrhoea could be prevented each year (Morrow & Rangel, 2004; Story & Parish, 2008).

## 5.3 Improved Weaning Practices

Even after 6 months, when infants are weaned from breast milk and introduced to other foods, there is a high risk of bacterial contamination, especially in developing countries where the food and water are more likely to be contaminated (ntimely and inadequate weaning implies early and unhygienic introduction of non-human milk and other foods and contributes to diarrhea (Bhutta et al., 2008). Therefore, it is important that adequate, hygienic food is provided to infants when they are going though the weaning phase. Decades ago, researchers identified enteric pathogens, such as *E. coli,* in feeding bottles and traditional weaning gruels in Nigeria, which could be traced to poor bottle hygiene, prolonged precooking, improper food storage, inadequate hygiene in cleaning methods, and/or unsatisfactory feeding practices (Cherian & Lawande, 1985). There is strong evidence that weaning foods are still frequently heavily contaminated with pathogens that cause diarrhoea (Motarjemi et al., 2003) because of unhygienic conditions during preparation.

## 5.4 Use of Safe Water

It has been estimated that poor hygiene, inadequate sanitation, and insufficient and unsafe drinking water account for 7% of the total disease burden and 19% of child mortality worldwide (Prüss-Üstün et al., 2008). The crucial importance of a safe water supply, good hygiene, and good sanitation was recently reviewed (Bartram & Cairncross, 2010; Mara et al., 2010; Hunter et al., 2010). There is clear evidence that supplying safe water and improving sanitation is cost-effective.

The United Nations Children's Fund, in their *The State of the World's Children* report on maternal and newborn health (UNICEF, 2008), identified safe water as an important factor in preventing diarrhoea in children. An adequate supply of clean water helps to encourage proper hand washing and cleaning of eating utensils. These practices can interrupt the spread of infectious agents that cause diarrhoea. Clean water is essential for drinking and for cleaning and preparing food. Unfortunately, much of the world does not have access to clean water; methods to disinfect water therefore need to be made readily available.

Quick et al. (2002) implemented a diarrhoea-prevention intervention in Zambia that consisted of water treatment, safe storage, and community education about the link between water and diarrhoea. They found that households storing water safely increased from 42% (before the intervention) to 89% (after), and this water was significantly less contaminated with *E. coli*. Occurrence of diarrhoeal disease was lowered by 48%. The researchers concluded that in families who lack access to potable water, this intervention is effective in preventing waterborne diseases linked to diarrhoea. Much less success was achieved by Rainey and Harding (2005), who examined the acceptability of solar disinfection of drinking water in a village in Nepal where 40 households were randomly selected and senior women were taught how to disinfect the water. Only 9% of households adopted the intervention. The researchers concluded that although participants became aware of the benefit of treating water to reduce stomach ailments, awareness was not enough to compensate for the barriers of heavy domestic and agricultural workloads, cultural barriers, and lack of knowledge that untreated drinking water causes diarrhoea. The authors suggested that, given the low level of education and the women's work constraints, other options for disinfecting water are needed.

There is clearly an acute need for simple, inexpensive water-filtering or treatment systems in developing countries where access to safe, potable water is limited. Strategies for developing safe water systems must also include public health education about waterborne diseases, source water protection, and a motivational component to achieve implementation and sustained use.

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## 5.5 Hand Washing

In the home and in the community, hands are a major source of transmission of intestinal pathogens. "The hands are the last line of defence against exposure to pathogens which can occur either directly from the hand to the mouth, eye, nose, or other area of the skin, or indirectly by 'handling' of food or water" (Bloomfield & Nath, 2009). Epidemiological studies show that in both developed and developing countries, the burden of infectious and parasitic diseases can be significantly reduced through hand washing. It can reduce gastrointestinal infections (Fewtrell et al., 2005) by anywhere from 26% to 79% in developing countries and by 48% to 57% in developed countries (Bloomfield et al., 2007). Roberts et al. (2000) conducted a randomized, controlled trial of an infection control intervention in child-care centres in an Australian city. After staff members were trained about transmission of infection and hand washing, diarrhoeal episodes were reduced by 50% to 66%, although the impact was confined to children more than 2 years old.

In an extensive review, Bloomfield and Nath (2009) emphasized that a number of factors must be considered for the hand-washing process to be effective, including the use of soap or another material to help detach microbes, parasites, and other substances from the skin, the amount of friction used, the amount and quality of water used to rinse the hands, and the technique used for drying the hands. While UNICEF and WHO (2009) suggest the need to use soap, studies have shown that in many low-income countries, people often use soil, mud, or ash as alternatives (Bloomfield & Nath, 2009). These authors found that although the use of contaminated soil, mud, or ash poses potential microbiological and toxicological risks, in communities that cannot afford soap, the promotion of clean and dried soil and ash is preferable to using no agent, as these substances are effective in removing organisms from the hands. Furthermore, they make the point that people's hygiene behaviours are complex and are moderated by social, educational, cultural, religious, and economic factors. Local issues and contexts must therefore be considered for any activities intended to promote hand washing.

## 5.6 Latrines and Proper Disposal of Human Waste

Kleinau et al. (2004) described several large-scale intervention programmes in developing countries where improvements in the sanitary disposal of faeces had a significant impact on reducing diarrhoeal diseases in young children. They noted that faeces disposal by toddlers in open fields was identified as perhaps the most important contaminant in the environment around households, and therefore the prevention of open defaecation and direct contamination with children's faeces is an important priority. These authors stress the need for health promotion programmes that facilitate the use of nappies (diapers) for young infants and appropriate methods of disposing or washing them, the use of potties for toddlers, and the immediate removal of faeces from the house and its disposal in latrines or by burying in soil away from the house and water source.

A well-maintained latrine is one of the best methods for reducing the risk of diarrhoea, especially when combined with a good water supply and education on hand washing. A latrine is a receptacle for deposition, retention, and, possibly, decomposition of excreta (Cotton et al., 1995). Some latrines are similar to an "outhouse" or toilet, but most are much simpler and less costly to construct. Huuhtanen and Laukkanen (2006) describe different types of latrines, including the specifications and relative costs to construct them, as well as issues associated with their desired location and required maintenance. To be effective in terms of enhancing human health, the excreta must be kept separate from the user, the latrine must be away from water supplies in order to prevent community exposure to excreta through contamination of water, a screen or cover must be used to prevent flies or other harmful animals coming in contact with excreta and transmitting pathogens to humans, and excreta must remain covered and/or pathogens made harmless.

## 5.7 Measles Immunization

Measles immunization is effective at reducing the risk of diarrhoea (Kappor & Reddaiah, 1991). The World Gastroenterology Organisation (2008) stated, "Measles immunization can substantially reduce the incidence and severity of diarrheal diseases. Every infant should be immunized against measles at the recommended age." This is one of the strategies in the 7-point plan recommended by UNICEF and WHO (2009) in their prevention and treatment strategies for diarrhoea.

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### 5.8 Vaccines

As noted previously, rotavirus infection is the most common cause of severe diarrhoeal disease and a leading cause of morbidity and mortality. Glass et al. (2005) and Dennehy (2008) maintain that vaccination would be the most likely intervention to significantly impact the incidence of this disease. An active rotavirus immunization was developed in the 1990s but was taken off the market after a few months because there was a high incidence of undesired side effects (Canadian Paediatric Society, 2003). Two new live oral vaccines licensed in 2006 have been reported to be safe and effective against rotavirus, and are being used in various countries (Dennehy, 2008). Bhutta et al. (2008) caution that there are economic considerations related to the use of vaccines for treating diarrhoeal diseases that have not yet been resolved, especially in countries with limited resources. In addition, they raise a concern that rotavirus and other vaccines might not have much impact in some regions where mucosal vaccines may be less effective, such as Asia. They call for ongoing surveillance of diarrhoeal disease burden after the vaccines have been introduced. These authors agree with Glass et al. (2005) that many challenges remain before any of the vaccines for the prevention of diarrhoeal diseases can be incorporated into full-blown childhood immunization programmes in the developing world. Vaccine efficacy and safety have not been clearly demonstrated in children in poor regions in Africa and Asia. Furthermore, there is a need for financing strategies to ensure that new vaccines are affordable and available in the developing world.

## 6. TREATMENT OF DIARRHOEA

### 6.1 Oral Rehydration Therapy

The treatment of diarrhoeal diseases varies according to the cause and severity of the diarrhoea and the degree of dehydration. The WHO has developed treatment plans based on three categories of dehydration in children: (1) no signs of dehydration, (2) signs of some dehydration, and (3) severe dehydration (WHO, 2005). Cases that fall into category A can be treated at home with plain water or fluids that contain salt. Appropriate drinks include: oral rehydration solution (ORS), salted drinks such as salted rice water or salted yogurt drinks, soup with salt, or other fluids that the mother or caregiver has access to and that the child will drink. Treatment usually begins at home, and all families should be encouraged to have ORS products at home at all times (King et al., 2003) as this is a key feature in the successful treatment of diarrhoea. Oral rehydration therapy (ORT) includes an ORS, which is a mixture of clean water, salt, and sugar that can be safely prepared at home. The solution can also include trisodium citrate and potassium chloride. ORT has been shown to be an effective treatment for diarrhoea in children and adults that is caused by cholera bacteria and other infectious agents (WHO, 2005).

If the child or adult shows some signs of dehydration, the WHO recommends ORT be given in a health facility, to ensure that future dehydration does not occur. Caregivers must be taught when to seek medical care, especially for infants, who need medical evaluation at the first signs of distress because they are much more prone to dehydration than older children. Either the standard WHO ORS solution (with 90 mmol/L of sodium) or the reduced, low-osmolarity (75 mmol/L of sodium) solution may be given (WHO, 2005). However, if the child is less than 6 months old and not breast-fed, the WHO recommends giving an additional 100 to 200 ml of clean water along with the ORS, if the standard WHO ORS solution is used. Regardless of which is used, the amount of ORS solution must be calculated according the child's weight and/or age. While still dehydrated, adults can have as much as 750 ml of ORS per hour and children up to 20 ml per kg body mass each hour (WHO, 2005).

There has been some debate about whether the old ORS solution or the new reduced-osmolarity ORS solution is more effective for the treatment of diarrhoea, especially if it's caused by cholera. However, the latest recommendation from UNICEF and WHO (2009) is that the new reduced-osmolarity formula be provided for all children with acute diarrhoea. Patients with severe dehydration require intravenous rehydration but can also be given ORS solution if they can still drink. ORT should encompass a maintenance phase that includes both ongoing replacement of fluid and electrolytes, and appropriate dietary intake (King et al., 2003).

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## 6.2 Nutritional Management

In addition to ORS, the provision of food for children with diarrhoea helps with the absorption of fluids and further prevents dehydration; continued eating also maintains nutrition and improves the patient's ability to fight infections (WHO, 2005; UNICEF & WHO, 2009). Infants who are breast-feeding should continue to do so, and those who are not should be fed their usual formula. In addition to milk, children more than 6 months old should be given an age-appropriate diet of cereals, vegetables, and other foods that have a high content of energy and provide adequate amounts of essential micronutrients (UNICEF & WHO, 2009). Vegetable oil should be added to cereals to improve caloric intake, and meat, fish, egg, and potassium-rich foods such as bananas, coconut water, and fruit juice should be given if available. Foods high in simple sugars should be avoided. King et al. (2003) suggested that highly specific diets are unnecessarily restrictive and may provide suboptional nutrition. In general, the most appropriate food for the treatment of diarrhoea in children is non-fibrous food that is easily digestible, high in energy, rich in potassium, and, if possible, locally grown (Bhattacharya, 2000).

## 6.3 Mixed Diets

Studies have been made using mixed diets based on locally available staple foods such as potato, pea flour, beans, maize, rice, and milk. Children generally fare at least as well with mixed diets as they do with highly processed formulas (Brown, 2003). Treatment failures due to recurring dehydration are lower for children fed these foods than in those given soy protein infant formulas. Studies have reported that increasing the energy density of staple foods by fermentation, germination, or adding green bananas reduces duration of diarrhoea and results in sustainable weight gain in malnourished children with shigellosis, preventing the loss of protein in the stool normally associated with this illness (Kosek et al., 2010; Rabbani et al., 2009).

## 6.4 Timing of Feeding

The most recent guidelines from UNICEF and WHO (2009) state that for acute diarrhoea with no blood or dehydration, it is important for the child or adult to continue eating their usual diet; food should never be withheld or diluted. While children experiencing bloody diarrhoea may lose their appetite until the diarrhoea subsides, they should be encouraged to eat and offered small feedings every 3 to 4 hours. For children with some dehydration, no food, except breast milk or formula, should be given during the first 4 hours of rehydration therapy, and if the rehydration therapy is successful in preventing further dehydration, children should be given food every 3 to 4 hours immediately after rehydration. Patients with severe dehydration require intravenous (IV) therapy, but until the IV is running, they should be given ORS by mouth if they can drink. All infants should be given ORS solution within 3 to 4 hours, and for older patients within 1 to 2 hours, when they can drink without difficulty. Whether diarrhoea is mild or severe, rapid introduction of usual feedings, whether breast milk, non-human milk, or solid foods, is important for maintaining nutrition and preventing weight loss.

## 6.5 Lactose

Children with mild or no dehydration and those whose dehydration was managed using recommended protocols can be treated as successfully with lactose-containing diets as with lactose-free diets (Brown et al., 1994). There appears to be no justification for routinely diluting milk or using lactose-free milk formulas, especially if the diarrhoea has been managed with ORT and early feeding with solids and milk. However, infants with malnutrition or severe dehydration may recover more quickly with lactose-reduced formulas or, alternatively, cereal-milk mixtures or fermented milk products (Brown et al., 1994). Bhatia and colleagues (2008) recommend avoiding soy-based formulas, but in the rare case that infants have galactosaemia, hereditary lactase deficiency, or are on a vegetarian diet, isolated soy protein-based formulas may be used. However, if breast-feeding, even infants with severe dehydration should continue, because although human milk contains more lactose than does cow's milk, it is much better tolerated by infants and more easily absorbed (Lawrence & Pane, 2007). This is an important reason why breast-feeding should be continued when the mother or the infant has a diarrhoeal infection. If the mother is not breast-feeding, WHO recommends continuing full-

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strength, lactose-containing non-human milk in children with diarrhoea, unless they have severe diarrhoea and simply cannot tolerate it, in which case they should receive medical treatment and be given mixed foods such as potatoes, noodles, or rice.

## 6.6 Dietary Fibre

Companies market formulas containing soy fibre to consumers and physicians. For older infants and toddlers, these formulas may lead to some reduction in the duration of diarrhoea when the problem is associated with antibiotic use (Burks et al., 2001). However, when given to children with acute watery diarrhoea, while soy fibre was reported to reduce stool liquidity overall, stool output was unchanged (Brown et al., 1993). King et al. (2003) suggested that this "cosmetic effect" might be beneficial in terms of reducing nappy (diaper) rash and facilitating an early return to a normal diet. However, overall, there is no good evidence to support the use of soy fibre (King et al., 2003; Canadian Paediatric Society, 2003). In fact, soy fibre has several disadvantages, including reduced absorption of nutrients and antibiotics in the intestine as well as masking the severity of fluid loss into the intestine (Canadian Paediatric Society, 2003).

## 6.7 Probiotics

Probiotics – live microorganisms in fermented foods–purportedly improve the balance of intestinal microflora and inhibit the growth of pathogenic bacteria through immune-stimulating properties (de Vrese & Mateau, 2007). However, Guandalini (2008) reviewed the research on probiotics for diarrhoea in children in different settings, and concluded that they are of limited clinical importance and only for some strains of diarrhoea. De Vrese and Marteu (2007) reported that other clinical trials on the treatment of infectious diarrhoea in children have shown a moderate benefit of mostly *Lactobacillus GG, L. reuteri*, and *Saccharomyces boulardi* in the treatment of acute watery diarrhoea, especially retroviral, in infants and children. However, the effects appear to result in only a short reduction of duration of diarrhoea (just more than 1 day) and mostly when the diarrhoea is due to retrovirus. Furthermore, the beneficial effects are dependent on the strain of probiotics and dose. De Vrese and Marteu (2007) concluded that with the exception of nosocomial infections or antibiotic-associated diarrhoea, the evidence is not sufficient to recommend the use of probiotics for the treatment of diarrhoea.

Others have also come to a rather negative conclusion. In an evaluation of the use of probiotics it was concluded that there is insufficient evidence to recommend their use for preventing or treating *Clostridium difficile*-associated diarrhoea (CDAD), the most common form of nosocomial diarrhoea (Xie et al., 2009). Similarly, Wolvers et al. (2010) and Allen et al. (2010) conducted reviews of the research on the use of probiotics in selected infections, including infectious diarrhoea in children. They stated that firm conclusions cannot be made because there are still only a limited number of studies, and the studies that have been conducted were on different types of infections with different probiotics. Also, there is lack of consistency among studies in terms of design, outcome parameters, and study populations. These authors did note that in terms of infectious diarrhoea in infants, traveler's diarrhoea, antibiotic-associated diarrhoea, and necrotizing enterocolitis, there are data to support the use of certain probiotics, under certain conditions, and in certain populations, but the data are too limited to make any clinical recommendations about this.

A different story emerges when we look at antibiotic-associated diarrhoea. Here, there is solid evidence that probiotics are effective both in prevention and treatment (Hempel et al., 2012).

## 6.8 Prebiotics

Prebiotics are substances that escape intestinal digestion and therefore reach the colon, where they are fermented by intestinal microflora. This results in products that selectively stimulate the growth and/or activity of intestinal bacteria associated with health and well-being (Gibson et al., 2004). Many questions about prebiotics use remain unanswered. Although research on animals has shown promising results, there appear to have been no reports of successful clinical use of prebiotics. For this reason, insufficient evidence exists to recommend their use, either for the prevention or treatment of diarrhoea (de Vrese & Marteau, 2010).

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## 6.9 Short-chain Fatty Acids

Dietary carbohydrates and some dietary fibre escaping digestion/absorption in the small bowel undergo fermentation in the colon and are converted to short-chain fatty acids (SCFA) by bacteria (Roy et al., 2006). SCFA are the primary source of energy for the functioning of colonocytes. Acetate, propionate, and butyrate are the three main acids that stimulate sodium and fluid absorption in the colon and affect the proliferation of colonocytes. Studies in animals have shown that SCFA stimulate the growth of lactobacilli and bifidobacteria, and play a significant role in the physiology and metabolism of the colon (Roy et al., 2006). SCFA production represents an adaptive process for conserving calories, fluid, and electrolytes. Inhibition of SCFA synthesis by the administration of antibiotics or other substances that are not metabolized by colonic microbiota results in diarrhoea (Binder, 2010). Conversely, when starch that is relatively resistant to amylase digestion is added to ORS, there is increased production of SCFA, and this improves the efficacy of ORS in the treatment of acute diarrhoea in children less than 5 years of age (Binder, 2010).

Green bananas (GB) are rich in amylase-resistant starch, some of which escapes digestion and is fermented into SCFA. Rabbani et al. (2009), in a controlled clinical trial with children aged 6 to 60 months who had severe bloody dysentery due to *Shigella* infection, found that when added to a regular diet, GB enhance recovery from persistent diarrhoea. These researchers observed clinically significant improvements in excretion of mucous and blood, stool volume, and stool frequency in children given GB, concluding that the addition of GB is an effective treatment. Rabbani et al. (2010) also studied children with diarrhoea aged 6 to 36 months in rural Bangladesh. Children with both acute and prolonged diarrhoea who were fed cooked GB had significantly faster recovery rates. These findings indicate that the addition of GB to the diet improves clinical severity of diarrhoea, suggesting that it could be an inexpensive and useful adjunct treatment.

## 6.10 Micronutrient Supplementation

Specific micronutrients, in particular zinc and vitamin A, have been evaluated as therapeutic agents in acute diarrhoeal diseases.

### *6.10.1 Zinc*

Research has shown that zinc supplements, given during and just after episodes of acute diarrhoea, provide beneficial effects in terms of reducing stool volume and duration of the problem, while also lowering the incidence of diarrhoea in the following 2 to 3 months (Penny & Lanata, 1995). There are also indications that zinc can help reduce morbidity and mortality from other childhood infections.

Studies of the effects of supplementary zinc on diarrhoea in children less than 5 years of age reported a 15% lower probability of continuing diarrhoea in the trials of acute diarrhoea and a 42% lower rate of treatment failure or death in the trials of persistent diarrhoea (Bhutta et al., 2000). A systematic review concluded that adding zinc to the treatment of severe diarrhoeal diseases can reduce mortality by 23% (Walker & Black, 2010). However, another recent review was more cautious as to the benefits of zinc supplementation in the prevention and treatment of diarrhoea (Patel et al., 2010); this raises questions about the blanket use of zinc in children. Based on the significant variability of responses to zinc seen among the subgroups, Patel et al. (2010) highlight the need to revisit the strategy of universal zinc supplementation. They emphasize the need to better understand and investigate the predictors of the efficacy of zinc in the treatment of children with acute diarrhoea in developing countries, including: the role of disease causality; the type of zinc salts used; the dose, frequency, and duration of supplementation; and the acceptability to the child.

The WHO and UNICEF concluded that there was sufficient evidence to recommend, as part of the clinical management of acute diarrhoea, supplementation with zinc for up to 2 weeks, in conjunction with oral rehydration (WHO, 2005; UNICEF & WHO, 2009). Zinc supplementation is a safe, effective, and low-cost intervention that is critical to the treatment of diarrhoea. The real problem is that it is not readily available in the countries that need it the most.

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### *6.10.2 Vitamin A*

While vitamin A supplementation has been reported to have a preventative effect on diarrhoea, studies to date have provided little evidence of its impact on the treatment of diarrhoea (Brown, 2003). One exception may be infants who are not breast-fed, for which studies show a slight decrease in the number of bowel movements and duration of illness but with no change in the overall rate of diarrhoeal attacks.

## 6.11 Dietary Management of Persistent Diarrhoea

Persistent diarrhoea is defined as an episode of diarrhoea that lasts 14 days or longer (UNICEF & WHO, 2009). The cornerstone of its management is optimal nutritional therapy (Boggs et al., 2007). In a comprehensive review of diarrhoeal diseases and nutrition, Bhutta et al. (2004) maintained that persistent diarrhoea can usually be managed by providing children with diets that include complex carbohydrates, such as rice, maize, legumes, lentils, and bananas, as well as vegetable oil, and milk for protein. Breast milk is recommended but cow's milk (and in some cases soy formula) is also acceptable. Bhutta et al. noted that L-glutamine, nucleotides, corticosteroids, preparations containing growth factors, and immunoglobulins are potentially effective treatments. When milk is not tolerated, protein can be obtained from egg white or chicken.

Enteral protocols used in developed countries that include specialized formulations, such as lactose-free or semi-elemental diets, are not usually appropriate for developing countries because they are too expensive, require continuous administration, and are frequently unpalatable and not acceptable to children. The Integrated Management of the Childhood Illness (IMCI), established by WHO, includes guidelines for the management of persistent diarrhoea, based on a study in six countries (International Working Group on Persistent Diarrhoea, 1996). The WHO concluded that severe cases of persistent diarrhoea can be effectively and safely treated with simple diets prepared from locally available, culturally appropriate foods, vitamin and mineral supplements, and specific antibiotics when required.

# 7. CONCLUSIONS

It is evident that nutrition and diarrhoeal diseases are closely related, and that this relationship is bidirectional: undernutrition is often an underlying cause of mortality from diarrhoea, and, conversely, diarrhoeal diseases also have a negative impact on the nutritional status of children, especially where people have poor access to a nutritious diet. Poor-quality weaning diets may not permit catch-up growth following recovery from diarrhoeal disease. Children who are not well-nourished to begin with not only have a greater risk of infection, but they also tend to have more severe episodes and are at much greater risk of succumbing to this group of diseases.

Of utmost importance for the reduction in the incidence of diarrhoea is the promotion of exclusive breast-feeding for at least 6 months (whenever possible) and timely and adequate weaning with hygienic, nutritious foods. It is well established that early and unhygienic introduction of non-human milk and other weaning foods are predisposing factors to the development of diarrhoea. These risk factors are prevalent in poor countries where the nutritional management of diarrhoea requires the alleviation of poverty and the implementation of social sector support mechanisms.

Environmental factors must also be considered, including access to clean water and strategies to promote sanitation services and proper hand washing. The use of adequate latrine/toilet facilities and proper handling and disposal of excrement is imperative. Latrines, when properly planned, built, used, and maintained, ensure safe and adequate sanitation and provide significant health benefits. However, in order to be effective, technical solutions are not enough; hygiene education is also a vital ingredient. Several nutritional factors have positive effects on the management of diarrhoeal disease; however, dietary therapy using inexpensive, locally available, and culturally relevant foods and safe handling and cooking techniques are appropriate for most developing countries. But, ultimately, as the Mexican nutritionist Joaquin Cravioto long ago observed, we must recognize that the basic origin of distresses of childhood, such as malnutrition and diarrhoeal diseases, "is to be found in the malfunctioning of society as a whole and the accompanying injustices" (cited in Arroyo & Mandujano, 2000): these are what must be addressed.

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## DISCUSSION QUESTIONS AND EXERCISES

1. Discuss the factors that contribute to a high incidence of diarrhoeal diseases in developing countries.
2. Although diarrhoeal morbidity has remained high for many years, diarrhoeal mortality has sharply declined over the same period. Explain why.
3. What is the difference between
   a. enterotoxigenic and invasive infectious diarrhoeal diseases, and
   b. symptomatic and asymptomatic diarrhoeal infections?
4. Discuss the short-term and long-term effects of diarrhoeal illness on children's nutritional status and growth, and indicate particular nutrients that are affected.
5. Discuss the size of the challenge of diarrhoeal diseases in your country/community.
6. How much scope is there for reducing the problem of diarrhoeal diseases in your country or community by improvements in (a) access to clean water, (b) building latrines, and (c) education on hygiene?

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# CHAPTER 12

# NUTRITIONAL MANAGEMENT OF CHRONIC DISEASES

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## *Outline*

- Diabetes mellitus
  - Classification of different types of diabetes
  - Diagnosis
  - Dietary management
  - Treatment with medications
  - Complications
- Cardiovascular disease (stroke and ischaemic heart disease)
  - Risk factors
  - Abnormalities of blood lipids
  - Dietary management
  - Hypertension
  - Dietary and lifestyle recommendations for people at increased risk
- Role of diet in the treatment of cancer

## *Objectives*

At the completion of this chapter you should be able to:

- Demonstrate a good understanding of the classification of diabetes mellitus, cardiovascular disease, and lifestyle-related cancers
- Describe the best dietary treatment for diabetes
- Describe the best dietary treatment for the management of risk factors related to cardiovascular disease (stroke and ischaemic heart disease)
- Describe appropriate dietary recommendations for patients with cancer
- Plan a regime for dietary management of nutrition-related chronic diseases

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## *Abbreviations*

| | |
|---|---|
| CDL | chronic diseases of lifestyle |
| CVD | cardiovascular diseases |
| DM | diabetes mellitus |
| HDL-C | high-density lipoprotein cholesterol |
| IHD | ischaemic heart disease |
| LDL-C | low-density lipoprotein cholesterol |
| MUFA | monounsaturated fatty acids |
| OGTT | oral glucose tolerance test |
| PUFA | polyunsaturated fatty acids |
| SFA | saturated fatty acids |
| TC | total cholesterol |
| TE | total energy |
| TG | triglyceride |

# 1. INTRODUCTION

According to the World Health Organization (WHO), the overnourished population of the world is now 1.2 billion people (WHO, 2008); this is roughly the same as the undernourished population. Globally, there are more than one billion adults who are overweight or obese. The increase in obesity is associated with escalating prevalences of the metabolic syndrome, type 2 diabetes mellitus (DM), and cardiovascular diseases (CVD) in developing countries (Misra & Khurana, 2008). This is especially true for underprivileged people residing in urban areas (Misra et al., 2001). The main reasons believed to be responsible for this trend are increasing urbanization, reduced physical activity, and the nutrition transition. Indeed, programmes aimed at undernourished children may exacerbate the problem, particularly since perinatal undernutrition and early stunting have been closely associated with the adult onset of type 2 DM and the metabolic syndrome (Misra & Khurana, 2008).

These diseases are known as *chronic diseases of lifestyle* (CDL), which is the term used in this book. Another commonly used term is *non-communicable diseases*.

The growth of CDL in low- and middle-income countries has become an epidemic in terms of prevalence and cost to treat. The good news, however, is that lifestyle modification can delay or prevent the majority of CDL, including obesity, type 2 DM, CVD, and several major types of cancer. For that reason, lifestyle modification should be introduced for the prevention of these diseases. In particular, there is a great need for large-scale community intervention programmes that focus on physical activity and a healthier diet (Misra & Khurana, 2008).

This is all explained in detail in this chapter and Chapter 13. The major focus of this chapter is the management of DM (both type 1 and type 2), CVD, and several major types of cancer. In the next chapter we examine the role of diet and other lifestyle factors in the prevention of cancer, CVD, type 2 DM, and obesity.

# 2. DIABETES MELLITUS

## 2.1 Introduction

Diabetes mellitus (DM) is considered to be the most common endocrine disorder around the world (Bastaki, 2005). In 2010, among adults aged 20 to 79 years, the prevalence in sub-Saharan Africa was in the range of 2.2% to 4.7%; in Asia, 3.2% to 11.6%; in the Middle-East crescent, 3.0% to 16.8%; and in Europe and North America, 3.6% to 10.3%. On average, the world DM prevalence is currently 6.4%; it is expected to increase to 7.7% by 2030 (see Table 12.1). The largest proportional increase from 2010 to 2030 is expected for the African region, followed closely by the Eastern Mediterranean and Middle-East (EMME) region (Shaw et al.,

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2010). Overall, the increase in the number of adults with DM will be much greater in developing countries than in developed countries.

**Table 12.1:** Current and projected prevalence of diabetes among adults, by world region, 2010 and 2030

| | 2010 | | | 2030 | | | 2010 to 2030 |
|---|---|---|---|---|---|---|---|
| | **Total adult population (000s)** | **No. of adults with diabetes (000s)** | **Diabetes prevalence (%)** | **Total adult population (000s)** | **No. of adults with diabetes (000s)** | **Diabetes prevalence (%)** | **Increase in the no. of adults with diabetes (%)** |
| Africa | 379 | 12.1 | 3.8 | 653 | 23.9 | 4.7 | 98.1 |
| EMME* | 344 | 26.6 | 9.3 | 533 | 51.7 | 10.8 | 93.9 |
| Europe | 646 | 55.4 | 6.9 | 659 | 66.5 | 8.1 | 20.0 |
| North America | 320 | 37.4 | 10.2 | 390 | 53.2 | 12.1 | 42.4 |
| South and Central America | 287 | 18.0 | 6.6 | 382 | 29.6 | 7.8 | 65.1 |
| South Asia | 838 | 58.7 | 7.6 | 1200 | 101.0 | 9.1 | 72.1 |
| Western Pacific | 1531 | 76.7 | 4.7 | 1772 | 112.8 | 5.7 | 47.0 |
| World | 4345 | 284.8 | 6.4 | 5589 | 438.7 | 7.7 | 54.1 |

* EMME = Eastern Mediterranean and Middle-East region

*Source: Shaw et al., 2010.*

The major contributing factors responsible for these trends are believed to be urbanization, sedentary lifestyles, poor diet, obesity, and increased longevity (Shaw et al., 2010). The role of diet and other aspects of lifestyle in the causation and prevention of DM is examined in Chapter 13.

## 2.2 Definition

DM is a collection of various metabolic disorders. In particular, there is an increased blood glucose concentration (hyperglycaemia) as a result of either decreased amounts of insulin, defective insulin action, or both.

## 2.3 Classification

### *2.3.1 Type 1 diabetes*

Type 1 diabetes is an autoimmune reaction in which the pancreas islet beta-cells are completely destroyed. As a result, daily insulin injections are required. The disease typically appears during childhood or early adulthood. Although patients with type 1 DM are mostly thin or underweight, obesity may occur in rare cases (ADA, 2009a; Daneman, 2006; Bastaki, 2005).

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### *2.3.2 Type 2 diabetes*

Type 2 DM, accounting for about 90% of those with diabetes, is associated with insulin resistance and decreased insulin production (ADA, 2009a, 2009b). It is mostly lifestyle related, with a gradual onset. Type 2 diabetic patients are typically older, overweight or obese, and inactive. Diet, weight loss, and physical activity are imperative for blood glucose control. Oral glucose-lowering agents or insulin can be used for further control (ADA, 2009a; Bastaki, 2005).

### *2.3.3 Insulin resistance and glucose intolerance*

Insulin resistance is also known as prediabetes. People with this condition have raised glucose concentrations, but not as high as those in people formally diagnosed with type 2 DM (ADA, 2009a). People with insulin resistance will mostly have fasting plasma glucose (FPG) concentrations between 5.6 and 7.0 mmol/ℓ (100–126 mg/dl) and 2-hour post-prandial values during the oral glucose tolerance test (OGTT) between 7.8 and 11.1 mmol/ℓ (140–200 mg/dl) (ADA, 2009a).

### *2.3.4 Gestational diabetes*

Gestational diabetes is defined as the presence of increased blood glucose concentrations during pregnancy. Dietary changes and/or insulin treatment is crucial, depending on blood glucose concentrations. Blood glucose concentrations sometimes stay elevated after delivery (ADA, 2009a). In the years following the pregnancy there is a high risk of developing DM (Franz, 2012). It is therefore important that women with this condition maintain a reasonable body weight and healthy lifestyle (Bastaki, 2005).

## *2.4 Diagnosis*

The criteria used for the diagnosis of DM by the American Diabetic Association (ADA) and the Society of Endocrinology and Metabolic Disorders in South Africa (SEMDSA) are as follows (ADA, 2009a, 2009b; Levitt et al., 2009; Cerielo, 2008):

1. Symptoms of DM + random plasma glucose >11.1 mmol/l (200 mg/dl)
2. Fasting plasma glucose >7.0 mmol/l (126 mg/dl)
3. 2-hour plasma glucose >11.1 mmol/l (200 mg/dl) during OGTT
4. Hypoglycaemia; plasma glucose <4 mmol/l (72 mg/dl)

Symptoms are similar in all types of DM but differ in intensity and speed of onset. Symptoms indicating hyperglycaemia include polyurea (excessive urination), polydipsia (excessive thirst), polyphagia (excessive eating), unexplained weight loss, sweating, fatigue, blurred vision, and increased infections. Symptoms indicating hypoglycaemia (low blood glucose) can be very similar and thus confusing to the patient. They include anxiety, sweating, shaking, blurred vision, fatigue, and sleepiness. Depending on the presence of complications, other specific symptoms can also be experienced (Bastaki, 2005).

## 2.5 Dietary Management

Chronic exposure to hyperglycaemia leads to secondary complications including blindness, kidney failure, limb amputations, and damage to the heart and blood vessels (ADA, 2009b; Bastaki, 2005). DM requires continuing medical and nutritional care and effective patient education to manage acute complications (hyper- and hypoglycaemia) and to reduce the development of long-term complications (ADA, 2008).

The primary treatment goal is control of blood glucose in order to keep the concentrations within the normal range. Food and medication that reduce the rise in post-prandial (after-meal) blood glucose concentrations are important to such treatment. The blood glucose response following a meal is dependent on the rate of digestion and absorption of glucose from the food and its clearance from the blood circulation. Insulin is normally secreted by the endocrine system to keep blood glucose within its normal range, but in individuals with DM, defects in insulin management hamper effective glucose control (ADA, 2008).

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In type 1 DM, insulin therapy is the most important treatment modality, whereas in type 2 DM, the key aspects of treatment are diet, oral medication, and lifestyle modifications (Franz, 2012; Bastaki, 2005). Insulin therapy can also be employed in type 2 patients if blood glucose concentrations cannot be successfully controlled by diet and oral medication.

### *2.5.1 Diet*

Diet remains the cornerstone of the management of DM. Intensive therapy, consisting of a combination of medication, diet, and physical activity, effectively delays the onset of DM, manages existing DM, and slows the development and progression of complications in patients with insulin-dependent DM (ADA, 2008). It is important to emphasize that the diabetic diet is not a special diet in the true sense of the word, but rather a balanced eating pattern that should be followed by the whole family. The goals of nutrition intervention in diabetic patients are summarized in Table 12.2.

**Table 12.2:** Goals of nutrition intervention in diabetic patients

| |
|---|
| - Establish and maintain euglycaemia (normal glucose concentrations) |
| - Promote a reasonable body weight |
| - Improve blood lipid concentrations in order to reduce the risk for CVD |
| - Achieve and maintain blood pressure levels within a normal range |
| - Prevent, or delay the onset of complications |
| - Treat, complications |
| - Maintain normal growth and development in children and adolescents |
| - Provide adequate nutrition for pregnant and lactating women |
| - Encourage healthy eating habits |
| - Encourage physical activity |

*Sources: ADA, 2005, 2008, 2009b.*

Successful medical nutrition therapy has been proven through clinical trials to result in decreased glycosylated haemoglobin (HbA1c) and reduced low-density lipoprotein cholesterol (LDL-C) concentrations (ADA, 2008). It is recommended that the HbA1c level should be <7%, which indicates long-term blood glucose control (Levitt et al., 2009; ADA, 2009b; Nathan, 2009; Cerielo, 2008).

Various dietary recommendations for the management of DM have been proposed by many associations around the world. The following table provides a summary of the essence of the recommendations, though different countries vary somewhat in some details (see Table 12.3).

*Energy.* Achieving weight loss and maintaining a reasonable body weight should be the first goal of the treatment plan. Long-term weight loss is achieved with programmes that emphasize lifestyle changes, including education, individualized counselling, reduced dietary energy and fat intake, regular physical activity, and frequent patient contact (ADA, 2005, 2008; Franz, 2012; Mann, 2006). Strategies to achieve weight loss are examined in Chapter 13.

*Carbohydrate and Fat.* Various contributions of these macronutrients to total energy (TE) are proposed, ranging from the conventional high carbohydrate (45% to 65% of TE), low fat (<30% of TE) to a combined carbohydrate and monounsaturated fat (MUFA) intake of 60% to 70% of TE. The various approaches are dependent on the individual patient response to carbohydrate intake and blood glucose and lipid control (ADA, 2005, 2008; Franz, 2012; Mann, 2006).

Irrespective of the percentage contribution of carbohydrates, the aspect that all agree upon is the importance of a diet rich in complex carbohydrate and fibre. The benefits of a high fibre intake for blood glucose and lipid control has been proven, and one should aim for an intake of 14 g/1000 kcal or 20 to 40 g/day. Emphasis should be placed on including sources of *soluble* fibre – e.g., fruit, oats, dried beans, and legumes. Soluble fibre is also known as viscous fibre.

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**Table 12.3:** Dietary recommendations for individuals with diabetes

| Nutrient | Prescription |
|---|---|
| Energy | Individualized |
| | Goal is to achieve weight loss and maintain a reasonable body weight |
| Carbohydrates | Make up 45% to 65% of TE |
| | Carbohydrate and MUFA are 60% to 70% of TE |
| | must be >130 g carbohydrate per day |
| | Fibre is 20 to 40 g/day or 14 to 25 g/1000 kcal/day |
| | Approximately 50% of fibre should be soluble |
| | Low glycaemic index (GI) foods are encouraged |
| | Sucrose and other sugars are <10% of TE, with sucrose <50 g/day |
| Proteins | Make up10% to 20% of TE |
| | Total 0.8 g/kg in the case of nephropathy (kidney disease) |
| Fats | Make up 20% to 35% of TE |
| | Saturated fat and *trans* fats are 7% to 10% of TE |
| | PUFA are 10% of TE |
| | MUFA are 10% to 20% of TE |
| | Limit cholesterol to 200 to 300 mg/day |
| | Emphasis is on omega-3 fatty acids |
| | Allow 2 g/day sterols and stanols |
| Vitamins and minerals | There is no evidence that warrants supplementation if a balanced diet is followed; an individualized approach may, however, be beneficial |
| Salt | Maximum 3000 mg/day salt or 2300 mg/day if hypertensive |

*Notes: MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; TE = total energy.*
*Sources: ADA, 2005, 2008; Franz, 2012; Mann, 2006.*

The relationship between the digestibility of carbohydrate foods and their glycaemic response is indicated by the glycaemic index (GI). Low-GI diets have produced significant improvements in blood glucose control and lipid metabolism. Hence foods with a low GI are recommended for people with DM (ADA, 2008; Mann, 2006; Wheeler & Pi-Sunyer, 2008; Ceriello, 2008).

*Protein.* Dietary protein does not affect blood glucose concentrations directly but does increase insulin responses. Protein intake should be 10% to 20% of TE. Children and adolescents need about 12% to 20% of TE as protein, or 0.9 to 2.2 g/kg body weight. During pregnancy an additional 10 g protein should be consumed per day, and during lactation an additional 15 g of protein per day during the first 6 months and 12 g/day thereafter. Half of protein intake should be of high biologic value, that is, containing all nine essential amino acids (ADA, 2008; Mann, 2006).

*Micronutrients.* Although certain micronutrients may affect glucose and insulin metabolism, no convincing evidence exists to date documenting the role of micronutrients in the development of DM (ADA, 2008). It is also likely that the response of patients to micronutrient supplements is determined by a patient's micronutrient status, such that only people with micronutrient deficiencies will respond to supplements favourably. Therefore, routine supplementation of micronutrients and antioxidants in people with DM is not

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recommended (ADA, 2008; Mann, 2006; Bastaki, 2005). However, in people following an energy-restricted diet, including pregnant or lactating women, strict vegetarians, or the elderly, a multivitamin supplement may be needed (ADA, 2008). The supplement should not exceed nutrient intakes in excess of the Dietary Reference Intake (DRI). Eating a balanced diet and obtaining all the nutrients through natural foods should always be the first priority (ADA, 2008; Mann, 2006).

### *2.5.2 Meal distribution*

It is important that every diabetic patient maintains a balance between his or her food intake and the type or amount of medication at all times, in order to maintain euglycaemia.

Meals should be eaten at more or less the same time each day. The total energy, and specifically carbohydrate distribution, must be taken into account when determining actual meal size and the meal distribution for the day. Thus in order for a patient with DM to prevent blood glucose fluctuations, dietary manipulation of meal size and the timing thereof is necessary; this must coincide with the peak action of the various medications prescribed (ADA, 2008). There is therefore no standard dietary prescription regarding food distribution other than the three basic meals that need to be consumed each day. The size of the meals and the intake of snacks must be individualized according to the medication that the patient receives.

### *2.5.3 Sweeteners and sucrose*

Several alternative sweeteners are available for use by individuals with DM. They are categorized as nutritive (energy containing) and non-nutritive (non–energy-containing) (see Table 12.4). They are all considered safe provided intake falls within the intake levels established by the Food and Drug Administration (FDA) (ADA, 2008; Wheeler & Pi-Sunyer, 2008).

**Table 12.4:** Nutritive and non-nutritive sweeteners

| Nutritive | Non-nutritive (approved by the FDA) |
|---|---|
| - Fructose<br>- Sugar alcohols, e.g., sorbitol, xylitol, maltitol, erythritol, isomalt, lactitol, mannitol, tagatose, and hydrogenated starch hydrolysates | - Saccharin<br>- Aspartame<br>- Acesulfame potassium<br>- Neotame<br>- Sucralose |

*Sources: ADA, 2008; Wheeler & Pi-Sunyer, 2008.*

The use of nutritive sweeteners by diabetic patients should be evaluated on the basis of the individual's blood glucose and lipid control, as well as in the overall context of the diet. Moderation in the consumption of nutritive sweeteners would appear to be prudent as they may be involved in the aetiology of diabetic complications (ADA, 2008; Bastaki, 2005).

If a patient with DM wishes to use sweeteners, a combination of sweeteners should be ingested so as to minimize any possible risks. A modest intake of sucrose and other refined sugars is allowed, contingent on metabolic control and body weight. If sucrose is included in the diet, it should form part of a high-carbohydrate, high-fibre, low-fat diet and should not exceed 50 grams per day or be more than 10% of TE. Randomized controlled trials have found that glycaemic and lipid control are not adversely affected by such amounts of sugar (ADA, 2008; Wheeler & Pi-Sunyer, 2008).

### *2.5.4 Alcohol*

People with DM need to be aware of the physiological effects of alcoholic beverages. The consumption of alcohol can result in hypoglycaemia. Because the absorption of alcohol is delayed by food, it should always be ingested together with a meal, not on an empty stomach (ADA, 2008). Alcohol intake should not exceed

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one drink per day for women or two drinks for men (Bastaki, 2005). Alcohol consumption is contra-indicated in DM patients with hypertriglyceridaemia, uncontrolled hypertension, peripheral neuropathy (disease of peripheral nerves), or those on medication that interacts with alcohol (ADA, 2008; Bastaki, 2005). Alcohol is discussed in more detail in Chapter 13.

### *2.5.5 Diet during pregnancy*

It is of the utmost importance for a mother and baby's health that the mother's blood glucose is kept between 4 and 6 mmol/ℓ. This can be achieved with either diet therapy alone or with insulin therapy (basal bolus), with or without snacks. The mother should, if possible, test her blood sugar levels 6 times per day (before meals and 2 hours after meals) and provide the results to the dietitian/doctor. Decisions such as whether to include snacks should be based on these readings and the type of medication used (ADA, 2008).

## 2.6 Physical Activity

One of the most important goals in the treatment of DM today is to give the patient a chance to live as normal a life as possible. This includes being physically active and able to participate in different sports and leisure-time activities. Regular physical activity has several benefits for health; people with DM share these benefits as well. Such benefits include better glycaemic control, the prevention or delay of cardiovascular complications, weight maintenance, and psychological benefits (Bastaki, 2005). Physical activity is therefore an important component in the treatment of patients with DM (ADA, 2008).

Regular activity of 150 minutes/week or 30 to 45 minutes/day, 3 to 5 days per week initially, is recommended (ADA, 2005, 2008, 2009b; Mann, 2006). Daily exercise should be gradually increased in duration and frequency to 60 to 75 minutes of moderate-intensity activity (e.g., walking) or 35 minutes of vigorous activity (e.g., jogging) (ADA, 2005, 2009b).

## 2.7 Medications

### *2.7.1 Oral medications*

The aim of treating type 2 DM with an oral medication is to decrease peripheral insulin resistance and to increase pancreatic insulin secretion. The main objective of these drugs is to correct the underlying disorder, namely either decreased secretion of insulin by the pancreas or impaired insulin function (i.e., peripheral insulin resistance). The drugs are prescribed in combination with diet and lifestyle modifications (Bastaki, 2005). The oral hypoglycaemic agents can be divided into insulin secretagogues (sulphonylureas) and insulin sensitizers (biguanides, thiazolidenediones) (Bastaki, 2005). Table 12.5 indicates the mechanisms of action and other differences of the oral agents (Bastaki, 2005; Levitt et al., 2009; Nathan et al., 2009).

### *2.7.2 Insulin*

Patients requiring insulin therapy have an absolute insulin deficiency and therefore need exogenous insulin injections to mimic physiological insulin delivery. A slow basal insulin secretion is necessary to control hepatic glucose production, while bolus, post-prandial secretions are needed to control peripheral glucose uptake (Bastaki, 2005; Daneman, 2006; Levitt et al., 2009). Because the duration of action and more specifically the peak action of the different insulin preparations differ, meal distributions will vary according to each treatment. Table 12.6 indicates the different insulin therapies available and their nutritional effects (Daneman, 2006; Bastaki, 2005).

Individuals using fixed daily insulin dosages need a consistent intake of carbohydrates in terms of time and amount, whereas individuals using rapid-acting insulin by injections or insulin pumps can adjust their meal and snack insulin amount based on the carbohydrate content of the meal or snack (ADA, 2008).

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**Table 12.5:** Oral hypoglycaemic medications used in the treatment of type 2 diabetes

| Classification | Side effects | Contraindications | Nutritional effects | Function |
|---|---|---|---|---|
| **Insulin sensitizers** *Biguanides*, Metformin (taken with or directly after meals) | Gastro-intestinal tract side effects, including heartburn, reflux, diarrhoea, or constipation (one or more of these may occur) | Pregnancy and lactation<br>Renal dysfunction | Does not increase insulin levels; only 3 meals per day are needed (unless otherwise decided) | Improves insulin resistance |
| Pioglitazone, Rosiglitazone (taken with or directly after meals) | Weight gain<br>Oedema | Childhood<br>Hypersensitivity to pioglitazones<br>Impaired liver function<br>Cardiac failure<br>Pregnancy and lactation<br>Type 1 DM<br>Ketoacidosis | Does not increase insulin levels; only 3 meals per day are needed (unless otherwise decided) | Improves insulin resistance |
| **Insulin secretogogues** *Sulphonylureas*, Gliclazide, Glibenclamide, Glimepiride (taken 30 minutes before meals) | Hypoglycaemia might occur | Hypersensitivity to gliclazide<br>Renal dysfunction<br>Liver impairment<br>Type 1 DM<br>Ketoacidosis<br>Pregnancy and lactation<br>Childhood | Three meals are needed; some patients with hypoglycaemic symptoms might need a snack 2 hours after taking the tablet | Stimulates the beta-cells of the pancreas to produce insulin |

**Table 12.6:** Insulin therapies and their nutritional effects

| Classification | Product names and manufacturers | Administration | Nutritional effects |
|---|---|---|---|
| Rapid insulin (ultra-short working) | Novorapid (Novo Nordisk), Humalog (Lilly), Apidra (Sanofi-Aventis) | Directly before a meal | Duration is about 3 hours and peak after one hour, snacks in-between are therefore unnecessary and might lead to increased blood sugar (unless patient experiences hypoglycaemia). |
| Short-acting insulin | Humalin R (Lilly), Actrapid (Novo Nordisk) | 30 minutes before meals | Duration is about 3–6 hours and peak time is after 1–3 hours, snacks 2 hours after administration are essential. |
| Intermediate-acting | Protophane (Novo Nordisk), Humalin N (Lilly) | At bedtime | Duration is about 18–20 hours and peak time occurs after about 90 minutes after administration. A single snack 2 hours after administration is important. |

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| | | | |
|---|---|---|---|
| Long-acting | Humalin L (Lilly), Lantus (Sanofi-Aventis), Levemir (Novo Nordisk) | Once per day, before bedtime, or twice per day | Duration is approximately 16–20 hours (might vary slightly from each other). Because there is no peak, no snacks are needed, unless hypoglycaemia is experienced. |
| Premix | Humalog Mix 25 (Lilly), Humalog Mix 50 (Lilly), Humalin 30/70 (Lilly), Novomix 30 (Novo Nordisk) | Immediately before breakfast and supper (except for Humalog 30/70, which must be taken 30–60 minutes before breakfast and supper) | Duration is approximately 14–18 hours (might vary slightly from each other) and peak is 1–8 hours after administration. Snacks approximately 2 hours after administration are imperative to avoid hypoglycaemia. |

## 2.8 Acute Complications

Both hypoglycaemia and diabetic ketoacidosis are extremely dangerous and should be treated immediately. Frequent self-monitoring of glucose concentrations is vital in preventing these complications, especially for diabetic patients on insulin treatment. Diabetic persons should therefore be encouraged to obtain a glucometer (from pharmacies or government institutions). The diabetic person and their family and friends should also be trained in these acute situations regarding prevention and treatment.

### *2.8.1 Hypoglycaemia*

Hypoglycaemia occurs when blood glucose concentrations drop below 4 mmol/ℓ (72 mg/dl). Those with frequent hypoglycaemia might lose the ability to recognize the symptoms. Hypoglycaemia is more frequent with insulin therapy and to some degree sulphonylureas. It can occur when too much insulin is injected, when not enough or no food is consumed with insulin, during exercise, or when excessive alcohol is consumed (ADA, 2009b; Daneman, 2006; Bastaki, 2005).

If hypoglycaemia is suspected, it must be tested for immediately by measuring blood glucose. If hypoglycaemia is confirmed, a fast-energy release carbohydrate (e.g., sugar, honey, or syrup) as well as a slow-energy release carbohydrate (such as whole-wheat biscuit or a sandwich) must be consumed immediately. Blood glucose concentrations should increase within 10–15 minutes. This should be followed up with a meal to prevent the recurrence of hypoglycaemia (ADA, 2008, 2009b). Fatty foods and chocolate must be avoided under these circumstances because the fat will delay the absorption of glucose. An unconscious person should not be given something to eat or drink because this might cause choking. Sticky glucose, such as syrup, must be smeared on the inside of the cheek, where glucose is rapidly absorbed (ADA, 2008, 2009b; Bastaki, 2005).

### *2.8.2 Diabetic ketoacidosis*

Diabetic ketoacidosis (DKA) is a severe and acute complication caused by a lack of insulin or a failure to follow dietary restrictions. The main symptoms are similar to hyperglycaemia (polyuria, polydipsia, weakness, weight loss). Nausea and vomiting can also occur. The combination of hyperglycaemia, ketonuria, and metabolic acidosis is highly indicative of DKA (Van Zyl, 2008).

DKA can leave the person comatose. The situation demands immediate reaction and treatment, which consist of fluid replacement, insulin treatment, potassium and phosphorus corrections, and administration of biphosphonates. Blood glucose concentrations and urine must be tested hourly (Van Zyl, 2008).

## 2.9 Long-term Complications

The major long-term complications of DM can be divided into macro- and microvascular complications (see Table 12.7).

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**Table 12.7:** Classification of complications in diabetes

| Classification | Description |
|---|---|
| Macrovascular complications | Ischaemic heart disease |
| | Stroke |
| | Peripheral vascular disease |
| Microvascular complications | Retinopathy |
| | Nephropathy |
| | Neuropathy |

The most important risk factor for the development of the complications of DM is, apart from poor glycaemic control, the duration of the disease. Since the latter cannot be controlled, it is important to focus treatment on control of glycaemic levels. Even though the relationship between glycaemic control and the incidence of complications has been much debated, the latest emerging evidence shows that the incidence of complications can be reduced by up to 70% with good glycaemic control (Franz, 2012).

### *2.9.1 Macrovascular complications*

Cardiovascular disease (CVD) accounts for approximately 80% of total mortality resulting from DM (Daneman, 2006; ADA, 2009b). The majority of this mortality is the consequence of ischaemic heart disease (IHD), and the remaining results from stroke as well as peripheral vascular disease. Atherosclerosis is the dominant underlying pathological process. Dyslipidaemia is common amongst these patients and is characterized by elevated concentrations of triglyceride (TG), very low-density lipoprotein cholesterol (VLDL-C), and reduced high-density lipoprotein cholesterol (HDL-C). The elevated TG concentration is closely related to the atherogenic changes in the level of low-density lipoprotein cholesterol (LDL-C) particles that increase the risk of IHD. The level of HDL-C is *inversely* related to IHD and is thought to have a protective effect twice that of the atherogenic effect of LDL-C (Ceriolo, 2008).

The management of dyslipidaemic patients involves blood glucose control together with the treatment of lipid abnormalities, hypertension, smoking, and obesity. Regular exercise is an important component of the treatment regimen. Dietary strategies include energy restriction to attain weight loss and an adaptation of the fat content of the diet according to the specific lipid abnormality present. The restriction of total fat to <30% of the TE, with saturated fat (including *trans* fatty acids) <10%, PUFA 10%, and MUFA 10% to 20%, should be the first approach. If, after a 6-month period, a significant improvement of the dyslipidaemia has not been achieved, or if there is pre-existing CVD, the total fat content should be further reduced to 20% to 25% of the TE, with saturated fat <7% (ADA, 2005, 2009b). This decrease in the fat content of the diet will mean an increase in the total carbohydrate content.

### *2.9.2 Microvascular complications*

*Retinopathy.* Retinopathy (disease of the retina resulting in vision impairment or loss) occurs in all types of DM, with a prevalence of more than 90% after 20 years. The development of this condition is dependent primarily on the duration of the disease (Daneman, 2006; ADA, 2009b; Cerielo, 2008).

*Nephropathy.* Diabetic nephropathy (damage to or disease of the kidney) is the most common cause of renal failure in the developed world (Daneman, 2006). Nephropathy occurs in 35% to 45% of type 1 DM patients and in less than 20% of type 2 patients. The most important risk factors for the development of this condition are duration of DM and HbA1c levels, ratio of LDL-C to HDL-C, and waist-to-hip ratio (i.e., abdominal obesity) (Daneman, 2006; ADA, 2009b). Concurrent CVD in the majority of these patients makes nephropathy the complication with the highest mortality.

In the presence of diabetic nephropathy, dietary protein should be restricted to 10% of TE or 0.8 g per kg body weight (Mann, 2006; ADA, 2008).

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*Neuropathy.* The most important risk factors for the development of neuropathy (nerve damage) are the duration of DM and poor blood glucose control (Shakil et al., 2008). The risk is increased by the presence of hypertension, hypercholesterolaemia, and obesity. More than 70% of diabetic patients suffer from one or more gastro-intestinal symptoms, which may be related to autonomic neuropathy. This condition affects gastric and intestinal motility. Table 12.8 lists the most common symptoms associated with autonomic neuropathy.

**Table 12.8:** Gastric and intestinal symptoms of autonomic neuropathy

| |
|---|
| - Dysphagia |
| - Heartburn |
| - Anorexia, nausea, vomiting |
| - Gastric distension / bloating |
| - Delayed gastric emptying (gastroparesis diabeticorum) |
| - Abdominal pain |
| - Constipation alternating with diarrhoea |

*Sources: ADA, 2009b; Shakil et al., 2008.*

The symptoms indicative of gastric retention are collectively known as gastroparesis, and their treatment focuses on the relief of the individual symptoms (Shakil et al., 2008). A diet consisting of 6 small meals per day, in conjunction with intensive therapy to improve glycaemic control, may be helpful. Drugs that regulate intestinal motility are very effective. Difficulty in maintaining euglycaemia and the presence of alternating hyper- and hypoglycaemia are typically seen in patients with delayed gastric emptying, because the latter affects the absorption of nutrients in an unpredictable way.

Chronic diarrhoea, commonly occurring at night, occurs in up to 85% of patients who have had poor blood glucose control for 2 to 5 years. Treatment consists of glycaemic control as well as antidiarrhoeal agents, and antibiotics in the case of proven bacterial overgrowth (Shakil et al., 2008).

Constipation, which often occurs intermittently with diarrhoea, can be treated with high-fibre foods. In the presence of gastroparesis, however, soluble fibre can be counter-productive because it will further impair gastric emptying. Insoluble fibre, administered post-pylorically, is thought to be beneficial (Shakil et al., 2008).

# 3. CARDIOVASCULAR DISEASE

## 3.1 Introduction

Cardiovascular disease (CVD) encompasses a range of diseases, the dominant ones being stroke (cerebrovascular disease) and ischaemic heart disease (IHD; also known as coronary heart disease).

It is estimated that of the 58 million annual deaths globally, 30% can be attributed to CVD (WHO, 2007). This has been the leading cause of death for several decades. Also, about 85% of these deaths occur in low- and middle-income countries (see Table 12.9) (WHO, 2002, 2003). Each year an estimated 32 million heart attacks and strokes occur around the world (Mathers et al., 2002). Research indicates that in sub-Saharan Africa and the Caribbean, fatalities from stroke are much higher than in developed countries (Walker et al., 2000), mainly because of limited health-care facilities, untreated risk factors, and an increase in the incidence of atherosclerotic diseases.

The major focus of this section is the management of risk factors for CVD, especially IHD. In particular, we look at abnormalities of blood lipid concentrations (dyslipidaemia) and of hypertension. In Chapter 13, we look more generally at the prevention of CVD.

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**Table 12.9:** Global cardiovascular disease mortality, for 2001 (in thousands)

| | African region | American region | European region | South-East Asia region | Western Pacific region | Eastern Mediterranean region |
|---|---|---|---|---|---|---|
| Stroke | 307 | 454 | 1480 | 1070 | 1926 | 218 |
| Ischaemic heart disease (IHD) | 333 | 967 | 2423 | 1972 | 963 | 523 |
| Hypertensive heart disease | 54 | 131 | 175 | 138 | 285 | 91 |
| All CVDs | 985 | 1979 | 5042 | 3797 | 3745 | 1037 |

*Source: WHO, 2002, table 1.*

## 3.2 Assessment of Risk of IHD and Diagnosis of Lipid Abnormalities

Most of the burden of IHD is caused by one or more cardiovascular risk factors, especially hypertension (high blood pressure), smoking, dyslipidaemia, lack of exercise, and abdominal obesity (large waist circumference) (WHO, 2002, 2003). The presence of DM is an especially important risk factor for IHD. Each of these risk factors is preventable. Two other important but unpreventable risk factors for IHD are increasing age and family history of IHD.

There is much overlap between IHD and the major risk factors for stroke, which include smoking, hypertension, lack of exercise, the presence of DM, and greater age. However, abnormalities in the concentrations of blood lipids are of much greater importance for IHD than for stroke. The desirable blood lipid concentrations are as follows:

- Total cholesterol (TC) <5.0 mmol/L
- LDL-C <3.0 mmol/L
- HDL-C >1.2 mmol/L
- TC to HDL-C ratio <6
- TG <1.5 mmol/L

Treatment recommendations for IHD are based on the level of risk of the patient (McPherson et al., 2006): as the number of risk factors increases, so does the level of risk. A relatively low-risk patient – in comparison with other patients at significant risk of IHD – may have one or two risk factors. Treatment can begin when LDL-C >5 mmol/L or TC/HDL-C>6. A moderate-risk patient may have three or so risk factors. Treatment can begin when LDL-C >3.5 mmol/L or TC/HDL-C >5. A high-risk patient has even more risk factors, especially when he or she has already shown clinical signs of IHD.

Clearly, categorizing patients and selecting treatment criteria is a value judgement. It is especially important to assess the overall level of risk rather than be overly concerned by one particular risk factor. The available of drugs and other resources is a major consideration.

Most patients with dyslipidaemia who are at low or moderate risk should receive dietary treatment for a minimum period of 3 months, as described below. If after that period the blood lipids have not reached target values, drug treatment can then be administered. Patients at high risk of IHD should receive drug treatment earlier, and they need medical supervision.

## 3.3 Screening and Global Risk Assessment

The WHO developed a range of risk assessment charts that can be used in various countries – both developed and developing – to determine CVD risk (WHO, 2007). Furthermore, screening is recommended by the Canadian Cardiovascular Society for the following people (McPerson et al., 2006):

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- Men over 40 years of age and women over 50 years of age and/or who are post-menopausal (screening recommended every 1 to 3 years)
- Children with a family history of severe hypercholesterolaemia
- Adults with dyslipidaemia, DM, current or recent tobacco smoking, hypertension, abdominal obesity, or family history of premature IHD.

Of course, abiding by these guidelines is only feasible in countries where the medical system has ample resources and/or for affluent patients.

## 3.4 Dietary Management of Dyslipidaemia

The focus of this section is the dietary management of dyslipidaemia with the goal of preventing IHD, especially in those at relatively high risk of IHD.

### *3.4.1 Overview of dietary management*

The first step in the treatment of dyslipidaemia is to implement lifestyle changes. In this regard, dietary intervention is of major importance and preferably is done with the support of a dietitian. Cultural, ethnic, regional, and religious differences in dietary practices and food choices should be taken into account.

The key objectives of dietary intervention are

- to achieve and maintain the desired blood concentrations of TC, LDL-C,HDL-C, and TG, and
- to achieve and maintain appropriate body weight by balancing energy intake and energy expenditure.

The diet prescribed for those with dyslipidaemia should

- provide enough energy to help achieve and maintain body weight goals;
- include a wide variety of food to ensure that macro- and micronutrient needs are met;
- be low in saturated fatty acids (SFA);
- be very low in or contain no *trans*-fatty acids;
- contain polyunsaturated fatty acids (PUFA) and monounsaturated fatty acids (MUFA) to replace SFA;
- include foods high in fibre, especially soluble fibre;
- provide enough protein to build and maintain body tissues;
- limit alcohol intake to around 0.5 to 1 drink per day for a woman or 1 to 2 per day for a man (those with high TG concentrations should avoid alcohol); and
- keep sodium to a maximum of about 2000 mg sodium or 5 grams salt per day.

### *3.4.2 The role of diet in the management of dyslipidaemia*

*Weight control and energy intake***.** Obesity has been shown to be an independent risk factor for cardiovascular morbidity and total mortality (McGee, 2005). Obesity is also associated with other risk factors, such as raised blood pressure, glucose intolerance, DM, and dyslipidaemia (Haslam & James, 2005). Research indicates that weight loss induced by a weight-reducing diet and regular exercise reduces TC, LDL-C, and blood pressure, and increases HDL-C (Avenell et al., 2004; Aucott et al., 2005). A body mass index (BMI) of between 18.5 and 25 is regarded as healthy for adults. Obese people (BMI >30) and those who are overweight (BMI 25–30) should be strongly encouraged to reduce their weight. Persons with increased abdominal fat (waist circumference of >102 cm in men or >88 cm in women) should also be encouraged to lose weight (De Backer et al., 2003). An appropriate target is a waist circumference of <94 cm for males and <80 cm for females. Cut-off levels should be lower for people of South Asian or East Asian ancestry (McPherson et al., 2006). Weight-loss strategies are discussed in Chapter 13.

*Total fat.* Total lipids (total fat) consists of different types of fatty acids, such as SFA, MUFA, and PUFA, as well as other components, such as cholesterol. The type of fat consumed is of far more importance to the

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development of IHD than the total amount of fat consumed. This is because the different types of fatty acids affect the blood lipids and lipoproteins differently (Sanders, 2009).

The following discussion on dietary fats applies not only to the management of those with dyslipidaemia, but also to the primary prevention of IHD.

A total fat intake of at least 20% of total energy (20% TE) is regarded as consistent with good health, and women of reproductive age need at least 20% TE from fat (WHO, 2003). In the United States, a total fat intake of 25% to 35% TE is recommended as part of the Therapeutic Lifestyle Changes (TLC) dietary goals recommended by the National Cholesterol Education Program (NCEP) of the Adult Treatment Panel (ATP) III for the prevention of CVD (Krummel, 2008).

*Saturated fatty acids.* A high consumption of SFAs raises total cholesterol and LDL-C, although different types of SFAs have different effects (Sanders, 2009). The major sources of SFA are dairy and meat foods that have a high fat content. Another important source of SFA is tropical oils, namely palm kernel oil and coconut oil. Tropical oils, therefore, are best avoided. In many countries the presence of these vegetable oils is stated on food labels. However, removing these oils from the diet can be problematic as they are an important source of low-cost food energy for poor people in many countries (WHO, 2003).

An SFA intake of <10% TE is recommended by the WHO for the prevention of IHD (WHO, 2003). The TLC dietary goals, which are directed at people with elevated LDL-C concentrations, recommend that SFA intake should be reduced to <7% (Krummel, 2008).

*Trans-fatty acids.* PUFAs are partially hydrogenated in order to increase the shelf-life of foods containing these fatty acids and improve the texture. This process leads to the formation of trans-fatty acids. These fats are mostly found in retail fats (such as hard margarine), spreads, deep-fried fast foods, and baked goods. Naturally occurring trans-fatty acids are found in small amounts in dairy products and in meat from ruminants. Research indicates that trans-fatty acids increase the risk of IHD because they elevate LDL-C and decrease HDL-C (Mozaffarian et al., 2009). Trans-fatty acids are now recognized as the most dangerous type of dietary fat in terms of increasing the risk of IHD. The intake of trans-fatty acids should therefore be minimized, and should be under 1% TE (Krummel, 2008; Lloyd-Jones et al., 2010).

*Mono- and polyunsaturated fatty acids.* MUFAs contain one double bond in the carbon chain. Many foods contain MUFAs, but olive oil is an especially rich source of oleic acid, a MUFA. PUFAs contain two or more double bonds in the carbon chain. There are two families of PUFAs in the diet, the omega-6 (n-6), of which linoleic acid (LA) is the parent fatty acid, and the omega-3 PUFAs (n-3), of which α-linolenic acid (ALA) is the parent fatty acid. Both omega-6 and omega-3 fatty acids are referred to as essential fatty acids because they are required for various body functions but cannot be formed in the body and must therefore be consumed as part of the diet.

*Omega-3 fatty acids and fish oil.* The three most important types of omega-3 fatty acids are ALA, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). Rich sources of EPA and DHA are fatty fish and fish oil. Sources of ALA include flaxseed oil, canola (rapeseed) oil, and walnuts.

Consuming omega-3 fatty acids from fish or fish oil has beneficial effects on cardiovascular risk factors and the prevention of IHD (Zheng et al., 2012; Mozaffarian & Wu, 2011). The effect of ALA on risk of CVD is less clear and is probably much weaker. Omega-3 fats from fish have several actions in the body that are believed to protect against CVD; these include antiarrhythmic effects, lowering TG and blood pressure, reducing platelet function/aggregation, improving vascular function, and decreasing inflammation potential (Micallef & Garg, 2009).

Based on this evidence, an intake of 400–500 mg/day EPA plus DHA is recommended for the prevention of IHD (Hill et al., 2009; Lloyd-Jones et al., 2010). Omega-3 fats should ideally come from fatty fish. An appropriate intake is 2 servings per week of fatty fish, such as salmon, sardines, herring, tuna, and mackerel (Hill et al., 2009). An intake of 1 g/day, in total, of EPA and DHA is recommended for patients with IHD (Hill et al., 2009). If the use of fish oil capsules is considered, this should occur under medical supervision, because large amounts of fish oil from supplements could interact with medications and result in bleeding.

*Recommended essential fatty acid intake levels.* Table 12.10 describes MUFAs and PUFAs in terms of their main food sources and their effect on blood lipids.

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**Table 12.10:** Sources of fatty acids and effect on blood lipids

| Fatty acid type | Fatty acid name | Major food sources | Effect on risk factors for CVD |
|---|---|---|---|
| MUFA | Oleic acid | Olive oil<br>Canola oil<br>Nuts | ↓ TC*<br>↓ LDL-C*<br>↓ TG |
| omega-6 PUFA | Linoleic acid | Soya bean oil<br>Sunflower seed oil | ↓ TC<br>↓ LDL-C<br>↓ TG |
| omega-3 PUFA | Eicosapentaenoic acid (EPA) | Fatty fish | ↓ Blood pressure<br>↑ Cardiac function<br>↑ Arterial compliance<br>↑ Endothelial function<br>↑ Vascular reactivity ↑Antiplatelet effects<br>↑ Anti-inflammatory effects |
| | Docosahexaenoic acid (DHA) | Fatty fish | |
| | | | |

** Effect occurs when MUFA replaces SFA in the diet, and is much lower than with PUFA.*
*Source: Kris-Etherton & Innis, 2007; WHO, 2003; Riediger et al., 2009.*

An intake of 2.5% TE from LA and 0.5% TE from ALA is recommended in order to meet essential fatty acid requirements (Elmadfa & Kornsteiner, 2009). The requirement for LA translates to about 2.8 g /1000 kcal (4200 kJ) and for ALA to at least 0.6 g/1000 kcal. However, based on the Dietary Reference Intake (DRI) levels, recommended intake for LA in North America is about twice as high. A total PUFA intake of 6% to 11% TE is recommended for the prevention of chronic disease (Elmadfa & Kornsteiner, 2009).

*Dietary cholesterol.* The risk of IHD probably rises with an increase in dietary cholesterol, but observational evidence for this association is contradictory. Cholesterol in the blood and tissue comes from either the diet (from egg yolk, organ meat, and dairy fat) or from hepatic synthesis. The evidence regarding the impact of dietary cholesterol on the risk of IHD is contradictory.

It is recommended that the intake of dietary cholesterol be restricted to <300 mg/day for the general public, and on the Therapeutic Lifestyle Changes (TLC) diet an intake of <200 mg/day is recommended (Krummel, 2008).

*Carbohydrate.* A carbohydrate intake of 55% to 60% TE from a variety of sources – cereals, fruit, and vegetables – is recommended. An increase in refined carbohydrate intake may raise TG concentrations, especially in the short term (Jenkins et al., 2004). However, more fibre in the diet may counteract this undesirable effect. This is one reason, among many, for recommending unrefined rather than refined carbohydrates.

*Dietary fibre.* Dietary fibre is a combination of polysaccharides and lignin, which cannot be broken down by intestinal enzymes. There are two types of fibre: soluble fibre, such as pectins, gums, mucilages, and hemicelluloses, and insoluble fibre, such as cellulose and some hemicelluloses. Fibre can help lower TC and LDL-C and is linked to reduced risk of IHD (Anderson & Hanna, 1999; Truswell, 2002; Rimm et al., 1996).

While the optimal dietary intake of fibre is uncertain, an intake of approximately 25 to 35 g/day can be recommended for adults. The diet should therefore contain a generous amount of foods high in soluble fibre, such as whole grainss, legumes (especially dry beans), fruit, and vegetables.

When fibre is added to the diet, its intake should be increased gradually and accompanied by an adequate fluid intake. An excessively high intake of dietary fibre may induce gastro-intestinal side effects, and it may interfere with the absorption of nutrients such as calcium.

*Plant sterols.* Dietary plant sterols, such as sitostanol, inhibit cholesterol absorption by up to 50%, thereby reducing blood lipids (Lichtenstein & Deckelbaum, 2001; Micallef & Garg, 2009). An intake of 2 to 3 g/day has been shown to decrease TC and LDL-C concentrations (Krauss et al., 2000). An intake of 25 g (5 teaspoons) of sterol-enriched margarine per day will provide 2 to 2.5 g of plant sterol and can be used to help lower TC. Foods with added plant sterols are widely available, although the effectiveness of these products still needs to be tested in long-term clinical studies.

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*Portfolio diet.* The portfolio diet is a diet strategy that aims to maximize the decrease in LDL-C. It is a vegetarian diet that includes plant sterols and soluble fibre, primarily from oats, barley, and psyllium, in addition to soy protein and almonds. This represents a radical dietary change that many patients may find difficult to sustain. A decrease in LDL-C of around 30% has been achieved when the diet has been used for 4 weeks and patients were strictly supervised (Jenkins et al., 2003), but the benefits were considerably weaker when patients were instructed to follow the diet on their own for a full year (Jenkins et al., 2006). The portfolio diet could be an effective option to control lipid levels if individuals are well motivated.

*General diet.* The management of patients at risk of IHD demands a generally healthy diet, especially with respect to aspects of the diet linked to risk of the disease. This is discussed in more detail in Chapter 13.

## 3.5 Hypertension

Raised blood pressure is a major risk factor for CVD: it is responsible for 62% of all strokes and 49% of all IHD events (He & MacGregor, 2009; Strazzullo et al., 2009).

Hypertension indicates that blood pressure is seriously elevated and has passed a particular cut-off point. Drug treatment is a widely used and effective approach in dealing with this common problem of middle-aged and older adults. Dietary factors play a major role in raising blood pressure and leading to hypertension. A dietary approach is an effective way to both prevent and treat high blood pressure.

There is a strong evidence of an association between sodium intake and high blood pressure (Aburto et al., 2013; He et al., 2013). Intake of salt (sodium chloride) is also strongly linked to risk of both IHD and stroke (Aburto et al., 2013). It is estimated that mean salt intake is about 8 to 10 grams per day in Western countries, but this figure may be much higher in many Eastern European and Asian countries (Strazzullo et al., 2009). The WHO recommends a salt intake of less than 5 grams (about one teaspoon) per day, which yields <2000 mg sodium per day (WHO, 2003). Patients with hypertension and elderly people should aim for a sodium intake of not more than 1500 mg/day (Ayala et al., 2009). Pooled data from a meta-analysis estimated a significant fall in systolic and diastolic blood pressure of 5.4/2.8 mmHg in hypertensive patients and 2.4/1.0 mmHg in normotensive patients, respectively, with a modest reduction in salt intake for 4 weeks or longer (He et al., 2013).

In developed countries, approximately 80% of salt in the diet originates from processed food, fast food, and food consumed away from home (He & MacGregor, 2009). A much smaller amount of salt, about 15%, comes from salt added to food after it has been purchased, either in the kitchen during food preparation or by the person eating the food (He & MacGregor, 2009).

Based on these figures, therefore, a major reduction in salt intake requires a major decrease in the salt content of processed food National strategies to encourage the food industry to work towards that goal have been implemented in countries such as the UK and Australia; other countries should follow this example (He & MacGregor, 2009).

A stepwise approach in reducing the salt content of processed food could be the key to achieving recommendation goals without consumer resistance. It has been shown that a 5% reduction per week in the sodium content of bread, for 6 weeks, could be achieved without losing consumer acceptance, and it resulted in a one-quarter reduction in the sodium content of bread, a major source of sodium in the diet (Girgis et al., 2003).

The Dietary Approaches to Stop Hypertension (DASH) diet is designed to lower blood pressure (Sacks et al., 2001). The DASH diet has increased amounts of fruit, vegetables, low-fat dairy, wholegrain cereals, legumes, fish, and poultry with a reduction in sugar and fat (Appel et al., 1997). Research indicates that this diet regime decreases blood pressure (Appel et al., 1997) as well as TC and LDL-C (Obarzanek et al., 2001; Svetkey et al., 1999). The DASH diet can be combined with a lowered salt intake for even greater effectiveness.

Several other dietary and lifestyle factors also play an important role in hypertension. Obesity is the most important one, followed by lack of physical activity. An excessive intake of alcohol is also harmful in this respect. All of these factors are further discussed in Chapter 13.

Hypertension is a serious and widespread problem and plays a major role in CVD, both for IHD and stroke. However, it must be stressed that an elevated blood pressure, even if well below the range classified

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as "hypertension," is still an important risk factor for CVD. For that reason, the management of risk factors for CVD should include the implementation of the above dietary strategies for patients at risk of CVD, even if they have not been diagnosed with hypertension.

## 3.6 Management of Patients at Risk of Ischaemic Heart Disease: A Summary

Table 12.11 summarizes the key dietary recommendations for the management of patients at increased risk of IHD.

**Table 12.11:** Recommendations for the management of patients at risk of ischaemic heart disease

| Food or food component | Recommendation | Specific advice |
|---|---|---|
| Saturated fatty acids (SFAs) | <7% TE (total energy) | Consume less animal fat high in SFAs.<br>Replace high fat with low-fat meat and dairy products.<br>Replace fatty red meat and meat products with chicken without skin, fish, and legumes (pulses).<br>Avoid use of palm kernel oil and coconut oil. |
| Trans-fatty acids | <1% TE | Use soft (not hard) margarine. |
| Polyunsaturated fatty acids (PUFAs) | 10%TE | Use vegetable oils, which are good sources of PUFA.<br>Use these oils in moderation. |
| Monounsaturated fatty acids (MUFAs) | Use to replace saturated fat | Use olive oil and canola oil. |
| Omega-3 fatty acids | 2 servings of fatty fish per week (ideally, 1 g/day omega-3 fatty acids) | Good choices are salmon (both farmed and wild), sardines, herring, tuna, trout, and mackerel. |
| Cholesterol | <200 mg/day | |
| Fruit and vegetables | 400 to 500 g/day | |
| Fibre | 25 to 35 g/day | Incorporate oat bran and legumes, especially dry beans, into the diet (in addition to fruit and vegetables). |
| Plant stanols/sterols | 2 g/day | Note that this is obtained from certain brands of margarine, and it has not yet been properly tested. |
| Salt (sodium) | 3.8 g/day (1500 mg/day) | Requires action by the food industry. |

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In addition to the above dietary recommendations, the following are several other important recommendations for the management of patients at increased risk of IHD:

- Smoking is a major risk factor for IHD and stroke. No one should smoke.
- Treat overweight and obesity. Aim for a BMI of <25 and a waist circumference of <94 cm for males and <80 cm for females.
- Encourage regular, moderate physical activity on most days (at least 4 or 5) each week. Ideally, this activity should consist of 30 minutes of moderate exercise; alternatives are 60 minutes of light exercise or 20 minutes of vigorous exercise.
- Try to achieve normal levels of blood lipids. Aim for TC <5 mmol/L; LDL-C <3.0 mmol/l; HDL-C >1.2 mmol/L; and TG <1.5 mmol/L. Use medicinal drugs when appropriate. Today, statins are the most commonly used drugs used in the medical treatment of hypercholesterolaemia. Low-dose aspirin (75 mg daily) is also recommended for patients at high risk of CVD and is far cheaper than statins.
- Control blood glucose. Aim for a fasting blood glucose level of <7 mmol/L. Diabetics require medical treatment.
- Maintain normal blood pressure, or lower blood pressure if it is high. Those with high blood pressure require medical treatment.

### 3.7 Patient Counselling

An individual with dyslipidaemia should be referred to a dietitian for dietary intervention. Dietitians are encouraged to follow a quantitative approach, especially with high-risk individuals. An individual with high TG needs specialized dietary intervention and should be referred to a lipid clinic. An initial intervention visit should be succeeded by follow-up visits to ensure long-term compliance with dietary guidelines. Practical adaptation of the habitual dietary intake of the patient to meet these guidelines forms the basis of successful dietary management. This requires close co-operation between the individual with dyslipidaemia and the dietitian.

## 4. CANCER

### 4.1 Introduction

Cancer is a group of approximately one hundred specific diseases that share certain basic characteristics, including abnormal cell growth, division, and differentiation (Alters & Schiff, 2006; WCRF/AICR, 2007). It is projected that the number of people diagnosed with cancer will double by the year 2030, with most of the increase occurring in the middle- and low-income countries (WCRF/AICR, 2007). Many of the risk factors associated with cancer are modifiable, especially tobacco smoking, alcohol consumption, and poor diet. It can be predicted that, owing to urbanization and changing food systems, the prevalence of lifestyle-related cancers will continue to increase. This will result in a huge economic and social cost.

This section presents information on the most common cancers in various countries. The focus then turns to the role of diet in the treatment of cancer. In Chapter 13 we examine the role of diet and other lifestyle factors in the prevention of cancer.

### 4.2 Prevalence Rates of the Most Common Cancers

Middle- and low-income countries, especially those in Africa, Asia, and Latin America, generally have higher incidence rates of cancers of the upper aerodigestive tract (mouth, pharynx, larynx, nasopharynx, and oesophagus), stomach, liver, and cervix. In contrast, the higher-income countries and urbanized and industrialized areas of middle- and low-income regions and countries have an increased rate of colorectal cancer and hormone-related cancers (breast, ovary, endometrium, and prostate). Lung cancer is globally the most common cancer, mostly because of high rates of tobacco smoking (Curado et al., 2007).

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## 4.3 Carcinogenesis

The process of carcinogenesis – the initiation of cancer development – takes place over many years. Carcinogenesis occurs in four stages (Arab & Steck-Scott, 2004) as follows:

1. Initiation: Initial changes in the genetic make-up of the cell occur (DNA mutations). These can either be inherited or be due to exposure to specific lifestyle factors over many years (Key, 2005). Initiation leads to unregulated cell growth or damage to tumour suppressor genes. Some chemicals in food, such as aflatoxins and heterocyclic amines, are known mutagens that also cause initiation.
2. Promotion: Initiated cells are changed into populations of altered cells. Although these tumour promoters do not affect DNA directly, they increase cell replication and growth.
3. Progression: The promoted cancer cells develop into an invasive tumour, a stage which is characterized by a variety of abnormalities in the DNA.
4. Metastasis: Cancerous cells migrate to other areas in the body causing secondary growths

## 4.4 Cancer Treatment

It is essential that cancer is diagnosed as early as possible because this greatly improves the chances of a cure. Various procedures are in use for screening people for early-stage cancer. For example, the Pap test is commonly used for detection of precancerous changes of the cervix.

Different treatment regimens and a combination thereof can be used to treat cancer. The main three regimens are surgery, radiotherapy, and chemotherapy. Surgery is an option if no metastases have occurred and the cancer is still localized. This treatment can have long-term negative effects depending on the cancer site (for instance, surgery for stomach cancer can cause gastro-intestinal problems) (Alters & Schiff, 2006). Radiation, as with surgery, is mostly used in cancer sites where no metastases have occurred. It is often used for cervical and prostate cancer (Alters & Schiff, 2006). Radiation is focused on a specific area in the body, and any side effects will therefore be concentrated at that location (Gregory & Tutt, 2003). Chemotherapy is mostly employed when metastases have occurred, and it can be used in conjunction with either surgery or radiation (Alters & Schiff, 2006). Chemotherapy is an aggressive treatment and may have severe side effects (see Table 12.12).

Side effects and symptoms experienced during cancer treatment might be due to either the tumour itself or the treatment (Broadley, 2003). These symptoms can include nausea, vomiting, loss of appetite, and a dry mouth. Table 12.12 discusses the most common side effects, and their causes and treatment.

**Table 12.12:** The causes and treatment of the most common side effects of cancer treatment

| Side effect | Cause | Treatment |
|---|---|---|
| Anorexia | Decreased taste and smell of food, early satiety | Small frequent meals |
| Cachexia[a] | Changes in carbohydrate, protein, and liver metabolism<br>Decreased appetite<br>Nausea and vomiting<br>Bowel obstruction | Small frequent meals<br>Dry food or biscuits<br>Avoiding fatty foods |
| Fatigue | Electrolyte disturbances<br>Hypercalcaemia<br>Poor nutrition<br>Cardiac failure<br>Chemotherapy<br>Radiotherapy | Activities suited to ability<br>Rest<br>Balanced diet<br>Psychological support<br>Correction of anaemia<br>Correction of electrolyte imbalances |

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| | | |
|---|---|---|
| Dysphagia (difficulty swallowing) | Pain<br>*Candida*<br>Obstructive lesion<br>Radiotherapy | Management of pain<br>Treat *Candida*<br>Liquidizing normal food<br>Adding food supplements<br>Employing temporary nasogastric feeding |
| Xerostomia (dry mouth) | Decreased saliva<br>Mouth breathing<br>*Candida* infection | Artificial saliva<br>Mineral water |
| Decreased saliva | Drugs<br>Surgery<br>Radiotherapy<br>Damaged or absent salivary glands | Saliva substitutes<br>Sugar-free gum<br>Good oral hygiene |
| Mucositis (inflammation of a mucous membrane) | Chemotherapy<br>Radiotherapy | Good mouth care<br>Enough fluid intake<br>Good nutritional intake<br>Brushing teeth twice a day<br>Gargling with aspirin or saline solution<br>Avoiding mouthwashes containing alcohol<br>Treating *Candida* infection with Nystatin<br>Avoiding drinking spirits (alcohol) and smoking |
| Enteritis | Reduced bowel mobility | Ensuring enough fluid and electrolyte intake<br>Reducing intake of green vegetables |
| Nausea and Vomiting | Hypercalcaemia<br>Uraemia<br>Raised intracranial pressure<br>Drugs<br>Chemo- and radiotherapy<br>Constipation<br>Bowel obstruction<br>Pain<br>Anxiety | Small frequent meals<br>Dry food or biscuits (Provita etc.)<br>Avoiding fatty foods |
| Cramps, distension, and diarrhoea | Gastric surgery | Eating slowly<br>Small frequent meals\<br>Taking liquids between meals<br>Avoiding food items high in sugar |
| Early satiety (fullness) | Gastric surgery | Small frequent meals |
| Milk intolerance | Gastric surgery | Lactose-free milk and products |
| Constipation | Medication used and antiemetics<br>Hypercalcaemia | Regular laxatives<br>Stimulators such as senna<br>Avoiding bulk-forming laxatives |
| [a] On cachexia, see Evans et al. (2008); the condition is defined as “a complex metabolic syndrome associated with underlying illness and characterized by loss of muscle with or without loss of fat mass” (2008, p. 794). | | |

*Sources: Broadley, 2003; Brown et al., 2001 (for cramps, distension, diarrhoea, early satiety, and milk intolerance); Gregory & Tutt, 2003 (for mucositis and enteritis); Tisdale, 2001 (for the cause of anorexia).*

Small, frequent meals might be better tolerated than less frequent, larger meals during cancer treatment. Food items given must be appetizing, easy to chew and swallow, and easily digestible. The most important nutritional

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goal is to provide adequate energy. If available, nutrient-dense commercial shakes are an appropriate food (Brown et al., 2001).

### 4.5 Supplementary Treatment

Physical activity and diet can be employed for the supplementary treatment of cancer. Even small amounts of physical activity, such as walking, can improve a person's quality of life and help the person deal with side effects of cancer treatment, such as fatigue. Physical activities increase muscle mass, lessen anxiety, improve the appetite, and stimulate digestion (Brown et al., 2001).

A healthy, balanced diet is recommended, and homemade drinks as well as commercially available products (e.g., Ensure, Nutren) can be used to increase nutrient consumption if eating a balanced meal is not possible (Brown et al., 2001). A single multivitamin can be taken after active treatment. However, high consumption of single vitamins and minerals may weaken the immune system. Similarly, consumption of antioxidants during active treatment might decrease the effectiveness of the treatment because cancer treatment often makes use of an oxidative effect to kill the cancerous cells (Brown et al., 2001).

Some cancer survivors follow alternative dietary regimens, such as fasting therapy (to deprive the tumour of nutrients for growth), juice therapy (consumption of large amounts of fruit and vegetable juices), or a macrobiotic diet (a type of vegetarian diet). There is, however, no evidence that any of these alternative dietary regimens are effective (Brown et al., 2001).

### 4.6 Summary

The cancer patient's diet, whether he or she is currently being treated or post-treatment, should be reviewed on an individual level. Each patient should be treated according to type and severity of symptoms. Over and above being treated at a dietary level, it is important to remember that quality of life is always an important consideration. Not only is nutritional information vital, but constant care, attention, and emotional support are also important.

The most prevalent cancers globally are associated with lifestyle and are therefore preventable. This vital aspect of cancer is examined in Chapter 13. Cancer can be beaten in many cases, if people are aware of how the disease can be prevented, if cancer is diagnosed early, and if the necessary care is provided.

## DISCUSSION QUESTIONS AND EXERCISES

1. What type of snacks would you recommend for low-income diabetic patients?
2. Discuss the short- and long-term advantages of optimal blood glucose control.
3. Plan a 5-day menu for a type 2 diabetic patient taking Diamicron (MR).
4. Plan a 5-day menu for an urban, male, type 2 diabetic patient taking Humalin L.
5. Plan a 5-day diet for a female patient who has a TC of 8 mmol/L, LDL-C of 5 mmol/L, and a normal HDL-C.
6. Suggest three dietary changes that could be suggested for a patient with hypertension to help with his or her condition.
7. Suggest appropriate dietary adaptations that can be made to treat the most common side effects of cancer treatment.

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# CHAPTER 13

# NUTRITION AND CHRONIC DISEASE

## Looking at the Big Picture

*Norman J. Temple*

### *Outline*

- Chronic diseases of lifestyle in developing countries: the size of the problem
- The role of diet in the causation and prevention of cancer, ischaemic heart disease, cardiovascular disease, type 2 diabetes, and obesity
- The treatment of obesity
- The design of prevention programmes
- Major causes of death and disease in developing countries
- Dietary advice for maintaining health

### *Objectives*

At the completion of this chapter you should be able to:

- Describe the size of the disease burden in developing countries that is caused by chronic diseases of lifestyle
- Discuss the role of diet, and of other lifestyle factors, in cancer, ischaemic heart disease, cardiovascular disease, type 2 diabetes, and obesity, with respect to both in causation and prevention
- Describe appropriate methods for the treatment of overweight and obesity
- Discuss the design of programmes for the prevention of ischaemic heart disease, type 2 diabetes, and obesity
- State the major causes of death and disease in developing countries
- Discuss the most appropriate dietary advice for maintaining health

### *Abbreviations*

| | |
|---|---|
| CDL | chronic diseases of lifestyle |
| CVD | cardiovascular disease |
| DALYs | disability-adjusted life years |
| DM | diabetes mellitus |
| IHD | ischaemic heart disease |
| TG | triglyceride |

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# 1. CHRONIC DISEASES OF LIFESTYLE IN DEVELOPING COUNTRIES

Over recent decades, chronic diseases of lifestyle (CDL; often referred to as chronic non-communicable diseases) have become major health problems in many developing countries. The previous chapter covered several aspects of this growing concern: the management of diabetes mellitus (DM); the prevention and control of elevated blood lipids, hypertension, and other risk factors that can lead to cardiovascular disease (CVD); and the role of diet in the treatment of cancer. The dramatic rise in the prevalence of CDL in developing countries is best understood from the perspective of the nutrition transition, a subject discussed in Chapter 4. In the present chapter we take a broader view of the role of diet, and other lifestyle factors, in CDL. The main focus of this chapter is the prevention of cancer, ischaemic heart disease (IHD), type 2 DM, and obesity.

A detailed analysis of CDL in developing countries was undertaken by Abegunde and colleagues from the World Health Organization (Abegunde et al., 2007). They analyzed disease statistics for 2005 in twenty-three low-income and middle-income countries. Several of these countries are quite well developed, including Poland, Russia, Mexico, Argentina, and Brazil. Most, however, are located in Africa and Asia and are firmly in the camp of "developing" countries.

Here are key findings from that study:

- 80% of deaths from chronic disease worldwide occurred in low-income and middle-income countries.
- In the twenty-three countries examined, chronic diseases were responsible for 61% of all deaths.
- This proportion was lower for those under the age of 70: only 46% of all deaths.
- The majority of these deaths were due to the following causes: CVD and DM (21%), cancer (12%), and chronic respiratory disease (5%). In other words, in these countries, a total of 38% of all deaths of people under the age of 70 were caused by this handful of major diseases. (Note: For the purposes of their study, the authors combined CVD and DM. CVD is itself the combination of heart disease, mainly IHD, and stroke.)

Chronic diseases are playing a steadily more important role as a cause of death. For people under 70 years of age, they accounted for 46% in 2005, but this figure is projected to rise to 53% in 2030.

The actual number of deaths is also rising. However, most of this increase reflects population growth and the ageing of the population (risk of chronic diseases rises sharply with age). At the same time real increases (i.e., age-adjusted death rates) are expected to occur for DM (owing to the epidemic of obesity) and for both chronic obstructive pulmonary disease (COPD) and lung cancer (owing to the tobacco epidemic). But there may be some decrease in CVD death rates because of improved control of risk factors, especially blood pressure and blood cholesterol.

Death rates from chronic diseases are now higher in many low-income and middle-income countries than in high-income countries: they are 54% higher for men and 86% higher for women. The data are adjusted for the age distributions of the different populations (Abegunde et al., 2007).

Mortality rates do not tell the whole story: diseases often cause disability rather than death. One way to measure this is to estimate the number of disability-adjusted life years (DALYs) lost. This is the total of years of life lost as a result of premature death plus years of life lived with disability. One DALY corresponds to one lost year of healthy life. The total number of lost DALYs is known as the "burden of disease."

In the twenty-three countries studied by Abegunde et al. (2007), chronic diseases were responsible for 50% of DALYs lost in 2005. Of these, 12% (i.e., about one quarter) were from CVD and DM, 5% from cancer, and 4% from chronic respiratory disease. However, a much lower figure was reported for South Africa, where these diseases were estimated to be responsible for only 12% of the total burden of disease (Mayosi et al., 2009).

Other studies have documented high rates of deaths from stroke in many developing countries, including India, Pakistan, China, and much of sub-Saharan Africa (Mensah, 2008a; Strong et al., 2007). Indeed, the age-adjusted mortality is often similar to or even higher than in high-income countries. Hypertension is also common; the prevalence is often more than 20% to 25% among adults, with higher rates in urban areas than rural areas (Mensah, 2008a).

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A large body of hard evidence collected during the 1950s documented the rarity of IHD among black Africans. However, this situation has changed dramatically: IHD is now the eighth leading cause of death in sub-Saharan Africa and is projected to become the leading cause in 2030 (Mensah, 2008b).

The obesity epidemic emerged in Europe and North America in the 1970s but has now spread to all parts of the world (Prentice, 2006). In South Africa obesity was formerly seen mainly among the relatively affluent white population, but the condition is now common among all groups of the population (Goedecke et al., 2006). Indeed, women in South Africa have now overtaken American women as having the world's highest level of obesity (Finucane et al., 2011). China also illustrates the problem: 6-year-old children at the 95th percentile (i.e., near the upper end of the weight range of Chinese children) are now significantly heavier than American children at the 95th percentile of American children (Popkin, 2010). Thus, in a dramatic turnaround from the situation a mere 30 years ago, overweight Chinese children are now more overweight than overweight American children!

The previous chapter gave more specific information on the distribution of diabetes, CVD, and cancer around the world.

## 2. THE PREVENTION OF CANCER

In the previous chapter we looked at aspects of diet relevant to the treatment of cancer. We also listed the most common types of cancers. Here we summarize the most effective strategies for the prevention of cancer.

### 2.1 Diet

Diet and different food items and their effects on cancer have been studied over many years. Some of the research is still controversial, and further research is therefore imperative. Since the 1990s, more emphasis has been given to performing systematic reviews and meta-analyses to better understand, judge, grade, and interpret cancer research evidence. Strong evidence now exists that diet has a major effect on the risk of most types of cancer: foods contain many substances that either increase risk or are protective. A collaboration of leading researchers and experts from several countries developed global recommendations for the prevention of cancer (WCRF/AICR, 2007). These are based on an extensive review of the published evidence. Much of this section is based on their conclusions.

#### *2.1.1 Fruit and vegetables*

Based on several hundred epidemiological studies we can assert that an increased consumption of a variety of fruit and non-starchy vegetables is protective against a diverse assortment of cancers, including lung, stomach, mouth, throat, larynx, and oesophagus (WCRF/AICR, 2007). The likely explanation for this is that the assorted substances present in these foods, including vitamins, minerals, phytochemicals, and fibre, are protective. In some cases the protective association is especially strong with one type of food. Examples include: food rich in lycopene (the red substance in tomatoes and watermelon) with prostate cancer; foods containing folate with cancer of the pancreas; and onion and garlic with stomach and colorectal cancer.

While many studies have reported an inverse relationship between intake of fruit and vegetables and risk of cancer, the extent of this protective benefit seems quite small. This was shown in the EPIC study, an especially large cohort study carried out in ten countries spread across Europe. In all the study included nearly 480,000 subjects (143,000 men and 336,000 women). Subjects were followed for almost 9 years, during which time 30,600 subjects developed cancer (9600 men and 21,000 women). The findings indicate that for each extra 200 grams per day of fruit and vegetables, the risk of developing cancer was reduced by only 4% (Boffetta et al., 2010).

A great many laboratory-based experiments have been conducted that investigated how different phytochemicals might block the pathways that lead to cancer. However, as yet, little has been firmly established.

#### *2.1.2 Fibre*

Diets high in fibre have been associated with a reduced risk of colorectal cancer (WCRF/AICR, 2007). Various mechanisms have been proposed for this relationship, including how fibre increases stool bulk, speeds up transit time, and lowers intraluminal pH (Key, 2005).

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It is important to recall the fundamental rule in epidemiological studies: association does not mean causation. In other words, merely because many studies have reported an inverse *association* between intake of fibre and risk of colorectal cancer, we must be very hesitant before concluding that fibre actually *prevents* the disease. We are on much more solid ground if instead of stating that "fibre prevents colorectal cancer," we say that "foods rich in fibre prevent colorectal cancer." This means that vegetables, fruit, and wholegrain cereals likely help to prevent colorectal cancer, although the extent of this action is uncertain. It is difficult to determine whether this connection is due to the fibre content of these foods or to other substances found in them.

### *2.1.3 Fat and meat*

There is no significant correlation between a high fat intake and cancer. However, there is convincing evidence that consumption of red meat and processed meat increases the risk of colorectal cancer by about 20% (WCRF/AICR, 2007).

### *2.1.4 Tea and coffee*

Green tea contains a class of phytochemicals called catechins. These are a type of chemical called polyphenols, and they are strong antioxidants. Numerous reports have stated that drinking green tea may reduce cancer risk. However, the supporting evidence is not entirely consistent (Boehm et al., 2009); any protective benefit seems to require eight or more cups per day, an amount commonly consumed in parts of Asia.

Coffee consumption appears to pose a negligible risk of causing cancer (WCRF/AICR, 2007).

### *2.1.5 Alcohol*

Alcohol consumption has been identified as a risk factor for various cancers, including cancers of the colorectum, breast, oesophagus, mouth, throat, and larynx (WCRF/AICR, 2007). As with tobacco, the risk increases in proportion to intake. For all types of cancer combined, a significant risk is seen starting at an alcohol intake of 2 drinks per day; persons consuming 4 drinks per day have a 22% increased risk of cancer compared with non-drinkers (Bagnardi et al., 2001).

### *2.1.6 Vitamin D*

It is well known that overexposure to sunshine increases the risk of skin cancer. However, a lesser-known story is that sunshine is beneficial for protection against cancer (Grant, 2012). The mechanism of action is the boosting of body levels of vitamin D. Strong evidence has emerged in recent years that when vitamin D concentrations are optimal, the risk of cancer is significantly reduced, perhaps by around one quarter (Scragg, 2011). The evidence is strongest for colon cancer. The possible benefits of supplemental intake are examined later in this chapter.

### *2.1.7 Dietary supplements*

Vitamin D appears to be the only dietary supplement for which there is strong supporting evidence of a cancer-protective action, at least for colon cancer. As a rule, dietary supplements should not replace whole foods. It is quite possible that there is a synergistic interaction between the different nutrients and phytochemicals contained in foods that cannot be replicated by supplements. The problem of the marketing of dietary supplements is further discussed in Chapter 26.

## 2.2 Possible carcinogens in food

Several substances present in food can act as mutagens or can generate mutagens that cause direct damage to the DNA of cells (Key, 2005). Mutagens can therefore act as carcinogens. Here we briefly examine some examples.

A number of fungi can grow on grains, nuts, and dried fruit during hot and humid conditions (Key, 2005). They can contaminate food with aflatoxins. These substances can cause tissue necrosis, haemorrhage, and

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degeneration of the liver that eventually leads to liver cancer (Arab & Steck-Scott, 2004).

It is speculated that nitrate, which occurs in vegetables, is converted to nitrite, which is then changed to nitrosamines, a potentially carcinogenic group of substances. These chemical reactions may occur in the food before it is eaten. Vitamins C and E and phenolic compounds can inhibit the change from nitrate to nitrite, counteracting the risk posed by the nitrate (Steinmetz & Potter, 1996).

Cooking has several possible links to the production of carcinogens. Polycyclic aromatic hydrocarbons (PAH) are mutagens formed when fats drips into the fire during the grilling of fish and meat. PAH are associated with cancers of the stomach and colorectum (Arab & Steck-Scott, 2004). Similarly, heterocyclic amines, another group of highly mutagenic substances, are formed when meat is cooked under high temperatures. They may be related to the development of colorectal cancer (Key, 2005) but this is not clear (Arab & Steck-Scott, 2004).

Starchy food items, including bread, cereals, and fried potatoes, may contain relatively high levels of acrylamide when cooked at high temperatures. Whether acrylamide is carcinogenic to humans is still under investigation. The International Agency for Research on Cancer (IARC) classifies acrylamide as a "probable carcinogen" (Key, 2005; WCRF/AICR, 2007).

Questions have often been raised as to whether pesticides and herbicides may pose a risk of causing cancers in humans. However, there is no epidemiological evidence that this is in fact the case (WCRF/AICR, 2007). Another suspect group of substances is hormonal anabolic agents that are used in some countries to stimulate milk production in cows. Their use is allowed in some countries, such as the United States, but they are banned in the European Union. Some suspect that these hormones may subsequently be consumed with the milk and then act as carcinogens. However, there is little epidemiological evidence to support this suspicion (WCRF/AICR, 2007).

Last, but by no means least, we consider salt. As we discuss later in this chapter, salt is added to food in relatively large amounts. It is believed to be an important causative factor in stomach cancer (WCRF/AICR, 2007; D'Elia et al., 2012).

## 2.3 Physical Inactivity

Physical activity has been linked to reduced cancer risk, especially risk of breast cancer in post-menopausal women and of cancer of the colorectum and endometrium (WCRF/AICR, 2007). Physical activity may also help prevent cancer indirectly by retarding the development of obesity. Lack of physical activity should therefore be viewed as a cancer risk. These findings are yet one more reason why everyone, especially children, should be encouraged to engage in at least 30 minutes (preferably 60 minutes) of moderate-intensity physical activity per day (Kushi et al., 2006).

## 2.4 Obesity

Obesity has been identified as a risk factor for several cancers, especially of the colorectum, pancreas, endometrium, oesophagus, kidney, and (in post-menopausal women) of the breast (WCRF/AICR, 2007).

## 2.5 Cancer Prevention Recommendations

Much about the relationship between diet and cancer is still unclear. However, on the basis of the most reliable evidence, we can now summarize the approach to diet and lifestyle that is associated with a much reduced risk:

- Keep body weight in check. Ideally, adult body mass index (BMI) should be between 21 and 23, depending on the normal range for different populations.
- Eat mostly foods of plant origin:
  - Limit intake of red meat; eat very little if any processed meat.
  - Eat at least five servings (at least 400 grams or 14 ounces) of a variety of fruit and non-starchy vegetables every day.
  - Eat relatively unprocessed cereals (grains) and other foods that are good sources of dietary fibre, such as legumes (pulses).

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    - Limit intake of refined cereals.
- Limit alcoholic drinks.
- Limit consumption of salt.
- Avoid mouldy cereals or pulses (legumes).
- Be physically active as part of everyday life.
- Do not smoke. Tobacco plays a major role in many types of cancer and numerous other diseases. It is therefore crucially important that any strategy intended to prevent cancer give serious attention to this lifestyle factor.

# 3. THE PREVENTION OF CARDIOVASCULAR DISEASE

In Chapter 12, we provided information on the numbers of deaths from CVD around the world. The main focus of that chapter was the management of risk factors for CVD, especially abnormalities of blood lipid concentrations (dyslipidaemia) and hypertension. Here we summarize the most effective approach to the prevention of CVD, especially of IHD but also of stroke. (IHD and stroke account for the majority of cases of CVD. IHD is also known as coronary heart disease.)

## 3.1 Dietary and Lifestyle Factors that Affect the Risk of IHD

The components of the diet and of other aspects of lifestyle that are of greatest importance in *increasing* the risk of IHD are as follows:

- Saturated fatty acids; For the major food sources of this fat and the others listed here and below, see section 3.4 of Chapter 12.
- *Trans*-fatty acids
- Smoking; This is a major risk factor that doubles the risk of IHD.
- Hypertension; This is a condition strongly related to lifestyle that, like smoking, doubles the risk of IHD.

Dietary and other lifestyle factors of greatest importance in *preventing* IHD are as follows:

- Polyunsaturated fatty acids (PUFA); These fats should be used to replace saturated fats.
- Omega-3 fatty acids; These are one type of PUFA.
- Monounsaturated fatty acids (MUFA); These fats are another replacement for saturated fats.
- Fruit, vegetables, nuts, and whole grains; Much evidence has accumulated showing that a generous intake of these foods is associated with a significantly reduced risk of IHD (Mozaffarian et al., 2011). The key active ingredients are probably the variety of micronutrients, antioxidants, fibre, and potassium that these food items contain. One class of substance that has been much studied in recent years is phytochemicals, which are non-vitamin organic substances in plant foods. There are thousands of different phytochemicals.
- Exercise; Aerobic exercise is strongly protective against risk of IHD. A reasonable amount is around 30 minutes of vigorous walking on most days of the week. Its impact on risk of IHD is similar to that of smoking, hypertension, and high blood cholesterol but in the preventative rather than causative direction.

An important mechanism by which the above dietary and other lifestyle factors either increase or decrease the risk of IHD is their effect on blood lipid levels. In addition, these lifestyle factors have multiple other effects, including their impact on blood pressure and body weight.

Low to moderate alcohol consumption decreases the risk of IHD, regardless of the source (wine, beer, or spirits). This subject is discussed more fully later in this chapter. A maximum of one alcoholic drink per day for women and 2 drinks per day for men is recommended.

Drinking 3 or 4 cups of coffee per day appears to have a negligible effect on the risk of CVD (Sofi et al., 2007). By contrast, there is fairly strong evidence that 3 or more cups per day of black tea are modestly protective against IHD (Gardner et al., 2007).

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### 3.2 Dietary Patterns and IHD

It is important for nutritionists and dietitians to be aware of the relationship between the individual components of the diet and their effect on risk of IHD. However, recent trends have placed increasing focus on dietary patterns. This was shown most clearly in a recent analysis of several dozen cohort studies; these were studies in which large numbers of healthy subjects had their diets recorded and were then followed for a number of years until many of them developed IHD. The investigators looked at the relationship between, on the one hand, a wide array of dietary components (saturated fat, fibre, etc.), foods (meat, fish, etc.), and dietary patterns and, on the other hand, risk of IHD (Mente et al., 2009). The strongest associations were found for dietary patterns. In particular, two dietary patterns stood out – the "Mediterranean" diet and the "Western" diet.

The Mediterranean diet (Sofi, 2009) varies between different countries located around the Mediterranean but typically has a generous content of vegetables, fruit, legumes, wholegrain cereals, poultry, fish, nuts, cheese or yogurt, and MUFA (usually from olive oil). It is also low in red meat and saturated fat. The diet often includes wine. In contrast, the Western diet has a high content of processed meat, red meat, butter, high-fat dairy products, eggs, and refined cereals. The Mediterranean diet was associated with a 37% reduction in risk of IHD, whereas the Western diet was associated with a 33% increase in risk.

### 3.3 How Much Do Diet and Lifestyle Affect the Risk of IHD and Stroke?

The various lifestyle factors that increase the risk of IHD are cumulative. Thus a person who leads an unhealthy lifestyle in several different ways has a greatly increased risk of IHD compared with a person who leads a generally healthy lifestyle. This was convincingly demonstrated in the Nurses' Health Study (Stampfer et al., 2000). This was a cohort study of 84,000 female American nurses who were aged 34 to 59 years at the start of the study. The researchers analyzed the relationship between lifestyle and risk of IHD over 14 years. They identified the nurses who led a low-risk lifestyle based on smoking, BMI, exercise, and seven dietary variables. By this means they identified the 3% of nurses who were at the lowest risk. These nurses had six times less risk of IHD than the others.

In another report from the Nurses' Health Study, this time with 24 years of follow-up, the investigators looked at the relationship between lifestyle and risk of death from CVD. They focused on the same risk factors as in the previous study – smoking, a BMI over 25, lack of exercise, and eating a poor diet. In this analysis they examined the relationship between the number of risk factors in each nurse's life and her risk of death from CVD. In comparison to nurses whose lifestyle contained no risk factors, risk steadily increased with the number of risk factors: it was 1.4, 2.4, 4.0, and 6.9 times higher with 1, 2, 3, or 4 risk factors, respectively (van Dam et al., 2008).

Lastly, mention can be made of a particularly informative study from Poland. As a result of the severe economic and political crisis during the 1980s and into the 1990s, there was a sharp decrease in availability of animal products. This meant that people had much less saturated fat in their diets. This was followed by an astonishing 40% drop in mortality from CVD during the period from 1990 to 2002 (Zatonski & Willett, 2005). Other contributing factors were an increase in consumption of fruit and vegetables and a decrease in smoking.

In addition to the three studies described above, many others have been reported over the years. This large body of research convincingly demonstrates the potential for lifestyle change to prevent most cases of CVD.

## 4. THE PREVENTION OF TYPE 2 DIABETES

In Chapter 12, we presented information on the global distribution of DM and the key features of the different types of DM. Here we focus on the prevention of type 2 DM.

If one disease is closely linked to overnutrition, it is type 2 DM. The presence of obesity has been repeatedly shown to cause a huge increase in risk of type 2 DM. For example, data from the Nurses' Health Study revealed that the risk of DM is 20-fold greater for obese women (BMI 30 to 35) as compared with slim women (BMI less than 23) (Hu et al., 2001). Even being at the high end of normal may carry an elevated risk: women with a BMI of 23 to 25 are 2.7 times more likely to develop DM than those with a BMI less than 23 (Hu et al., 2001).

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An epidemic of obesity has swept the world since the 1980s, and it is associated with a parallel rise in the prevalence of type 2 DM (Mokdad et al., 2001). This problem is now affecting younger age groups. The former name of type 2 diabetes was adult-onset diabetes. Contrary to what this name implies, the disease is now occurring with increasing frequency in teenagers. It is therefore a safe bet that the prevalence of DM around the world will continue its upward trajectory for the next several decades.

Some evidence suggests that the distribution of body fat may be a more reliable predictor than BMI of the risk of developing DM. Several studies indicate that a large waist circumference or a high waist-to-hip ratio (i.e., an "apple" shape) is an important risk factor for DM (Chan et al., 1994; Boyko et al., 2000). Waist circumference is generally considered a more useful parameter than waist-to-hip ratio, because it is easier to measure and has good predictive ability.

Physical activity has repeatedly been shown to be protective against DM (Hu et al., 2001). DM therefore resembles several other conditions, such as IHD, hypertension, and colon cancer, in that physical activity is protective while risk is increased by obesity.

Much research has been conducted into the relationship between diet and DM. The strongest and most consistent relationship has been observed for intake of dietary fibre. The research has been of two major types – epidemiology and experimental studies. For reasons that are unclear, the two types of study have produced inconsistent findings (Steyn et al., 2004). Epidemiological research, namely large cohort studies, has shown that cereal fibre (which is rich in insoluble fibre) has a much stronger protective association with DM than does soluble fibre. This type of research reveals only that cereal fibre is *associated* with reduced risk, not that the fibre is actually protective. The true protective factor might be other substances present in foods rich in cereal fibre (i.e., whole grains). Experimental studies tell a different story: giving people extra amounts of soluble fibre (also called viscous fibre) improves glycaemic control, but insoluble fibre has a much weaker effect. This benefit is seen for supplements of both soluble fibre and for foods rich in this type of fibre, and it is seen in both healthy people and those with type 2 DM. Foods rich in soluble fibre include fruit, oats, dried beans, and legumes.

So should nutritionists recommend an increase in cereal fibre or of foods rich in soluble fibre as one way to help lower the risk of DM? Fortunately, there is no need to decide which type of evidence is most believable. The message from this chapter, which will be summarized later, is that the diet should be plentiful in sources of *both* types of fibre.

Another aspect of diets linked to risk of DM is glycaemic index (GI): foods with a high GI appear to increase the risk (Steyn et al., 2004). Supporting evidence has come from both epidemiology and experimental studies. Many experts have incorporated detailed advice on GI into dietary recommendations. However, many others, including this author, have chosen to disregard GI because the resulting dietary advice can be confusing but without adding much useful information.

Later in this chapter, we turn our attention to intervention programmes that have succeeded in preventing DM.

## 5. THE CHALLENGE OF OBESITY

As Shakespeare observed, "They are as sick that surfeit with too much as they that starve with nothing" (*Merchant of Venice,* Act I, scene 2). Overweight and obesity are important risk factors for most of the disorders discussed in this chapter (and for several others not discussed here). Indeed, there is a strong interrelationship between many of these disorders and risk factors. It has been observed many times that several of the risk factors for these conditions cluster together (i.e., a person who has one of these risk factors has a high chance of having others). The major risk factors that are closely associated with each other are: a large waist circumference, a raised blood level of glucose and triglyceride (TG), elevated blood pressure, and a low blood level of HDL-C (Gupta & Gupta, 2010). This group of risk factors is known as the metabolic syndrome. Not surprisingly, its presence denotes an especially high risk of CVD and type 2 DM.

### 5.1 The Causes of Obesity

Obesity is a completely unnatural human condition. Dozens of studies from around the world have convincingly shown that obesity is absent when people eat the traditional diet for their region. The disorder appeared when people began to adopt a more modern, Westernized lifestyle. We see something similar with

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animals. In the wild they do not overeat and become obese; deer do not overeat vegetation, and lions do not overeat their prey.

So why do so many humans become obese? The epidemic of obesity can be completely explained in terms of energy balance. If a woman gains 454 grams (one pound) of body fat, this came about because she consumed 3500 kcal of food energy in excess of the quantity that she metabolically converted into heat energy. The real question, therefore, is the following: Why is much of the world's population eating more food energy than they burn up? Decades of research have given us a reasonably good answer to this question. Here we focus on the major drivers of the obesity epidemic.

A major factor leading to obesity is reduced physical activity. This occurs as a result of the combination of urbanization and labour-saving machinery. A few decades ago, the majority of people in developing countries lived in villages and engaged in agricultural work or other occupations that require much physical labour. Over recent decades, many tens of millions have relocated to cities. Most jobs today require far less expenditure of energy. At the same time, thanks to the availability of cars and buses, people today typically walk much less than people used to.

Another major cause of obesity is the widespread availability of highly palatable, energy-dense food (i.e., high quantity of kcal per gram). A large amount of accumulated evidence demonstrates how such food leads to excess intake of food energy – in other words, overnutrition. Such foods have four key features:

- a high fat content,
- a high refined sugar content,
- a low fibre content, and
- a high energy density.

These features of the modern, Western diet should not be viewed singly: they act synergistically.

Let us start with dietary fat. Many studies using experimental animals have revealed that they gain body fat when fed a high-fat diet. Although some conflicting observations have been reported, the majority of human studies indicate that a high-fat diet induces excessive energy intake and hence weight gain (Hooper et al., 2012). This has been repeatedly shown in both epidemiological and experimental investigations. One study that illustrates this was the Women's Health Initiative Dietary Modification Trial, for which 49,000 post-menopausal women were recruited. The study's aim was to investigate whether a low-fat diet reduces the risk of cancer. Accordingly, half the women were instructed to lower their intake of fat, but were not advised to lose weight or to take exercise. The investigators discovered that when women lowered their fat intake by 11% (e.g., from 40% of energy to 29%), their weight decreased over the following year by about 1.4 kg (Howard et al., 2006). To sum it up: "fat on the lips becomes fat on the hips."

The next villain in the obesity epidemic is sugar. In particular, sugar-sweetened beverages have a similar effect on energy balance as does dietary fat: consuming these drinks leads to spontaneous overconsumption of food energy (Te Morenga et al., 2012; Malik et al., 2013). Several obesity experts have suggested that a major cause of the obesity epidemic among American children and teenagers over the past 30 years is the greatly increased consumption of soft drinks (Malik et al., 2013). With respect to weight control fruit juices, as far as is known, have no advantage over soft drinks.

Another important dietary component with respect to obesity is fibre. Fibre has the opposite action in the body of sugar and fat; the presence of fibre in foods tends to induce satiation (a feeling of fullness), thereby bringing about a halt to eating. This can be illustrated by comparing a slice of whole wheat bread, a slice of white bread, and 170 mL of cola drink (about half a tin). They each have 170 kcal. Compared with whole wheat bread, the white bread has only half as much fibre, and cola is devoid of fibre altogether. This difference is clear when these foods are eaten: white bread can be eaten more quickly than whole wheat bread and produces less satiation. The cola can be consumed even more quickly and produces minimal satiation.

The role of fibre in retarding the development of obesity is supported by strong epidemiologic evidence: numerous studies have reported that intake of dietary fibre is inversely associated with body weight and body fat (Slavin, 2005).

Detailed comparisons have been made between the satiating effects of the major components of food. In general, fat has the least satiating action, next is carbohydrate, then protein, while fibre has the most (Holt et al., 1995).

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An important factor that determines the satiating ability of a particular food is its energy density (Drewnowski, 1998). Foods with more concentrated energy (more kcal per gram) have less satiating power (i.e., little appetite satisfaction relative to energy consumed), and they are therefore more likely to lead to overconsumption of food energy. This may be a major reason why food fat causes weight gain: because fat has more than twice as much energy per gram as either protein or carbohydrates, fat-rich foods tend to be energy dense. Conversely, foods with a high water content have a low energy density and can therefore satiate the appetite before much food energy has been consumed. Many types of fruit and vegetables, such as apples, melon, carrots, and cabbage, have a high water content and are therefore particularly good at satisfying the appetite.

We can summarize as follows: Doughnuts and biscuits (cookies) are a mixture of fat, sugar, and refined flour, with a minimal content of water and fibre. They are the type of food that readily causes people to overeat and become overweight. In stark contrast, no one ever became overweight by eating too many carrots or by drinking too much tomato soup!

One more factor deserves mention in a discussion of the causes of obesity is portion sizes. These have been steadily expanding for the past 40 years. For example, plates in restaurants are significantly larger now than they were a few decades ago. In the case of bottle sizes for cola drinks, these are now three or four times larger. These observations are based mainly on studies in the United States. But trends that start in that country frequently spread to many other countries. This is potentially important because evidence shows that when people have more food placed in front of them, they eat more. This problem appears to be additive when combined with increased energy density (Rolls et al., 2006).

An accepted wisdom concerning obesity is that most people who try to lose weight fail, and of those that do lose weight, most regain it. By comparison, avoiding obesity in the first place is a much easier goal to accomplish. As the saying goes, an ounce of prevention is worth a pound of cure. Clearly, in the case of obesity, this is especially true. Later in this chapter, attention is turned to intervention programmes that aim to translate these ideas into practice.

## 5.2 The Treatment of Obesity

As mentioned above, attempts to lose weight (i.e., body fat) usually achieve little success. This has led to the creation of an enormous weight-loss industry. There are huge numbers of books as well as dietary supplements that promise to "shrink the waistline." Alas, the majority of treatments, especially those that offer "quick and easy" weight loss, are worthless. Indeed, weight-loss treatments are one of the biggest forms of health fraud. This topic is discussed in Chapter 26.

It is important that people wishing to lose weight have realistic goals. An appropriate goal is to lose between 200 and 900 grams per week, or 10% of body weight over 6 months. Setting more ambitious goals is a recipe for disappointment. Moreover, rapid weight loss increases the odds of later regaining the weight. Many overweight people dream of achieving a shape that requires losing 30% of their weight. When they fail to achieve this, they feel they have failed. In reality, losing 10% of body weight is a success because it results in significant improvement to long-term health, such as a decrease in blood pressure or blood cholesterol, or an improvement in ability to walk quickly.

The first step in losing weight is the adoption of an energy-reduced diet. An appropriate target is to cut energy intake by 500 to 1000 kcal per day.

It is of prime importance to recognize the major causes of obesity and put these into reverse. In other words, a person should follow a healthy lifestyle that includes a diet that has a generous content of fibre-rich foods, is moderate in fat, is low in sugar, and has a low energy density. Exercise is especially important. There is much evidence that achieving weight loss – and long-term avoidance of weight regain – requires around 60 or 90 minutes of exercise every day, such as walking at a brisk pace. If the intensity is greater, as in the case of jogging for example, then the time required is reduced to 30 to 45 minutes per day.

The National Weight Control Registry, based in the United States, collects information on more than 4000 adults who have lost at least 13.6 kg and kept it off for at least a year (Wing & Phelan, 2005). The members have lost an average of 33 kg and have maintained the minimum weight loss (13.6 kg) for an average of more than 5 years. These people therefore represent the small minority who are successful at both losing weight

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and at keeping it off. What is their secret? Members report that engaging in high levels of physical activity (approximately 1 hour per day), eating a low-calorie, low-fat diet, eating breakfast regularly, self-monitoring weight, and maintaining a consistent eating pattern across weekdays and weekends. Moreover, weight loss maintenance may get easier over time; after individuals have successfully maintained their weight loss for 2 to 5 years, the chance of longer-term success greatly increases.

Here are additional rules that are helpful for people trying to lose weight:

1. Eat small portions.
2. Eat breakfast every day.
3. If a person wishes to have sweet-tasting beverages, then replace sugar with synthetic sweeteners.
4. Avoid buying foods that encourage overeating, and don't have the "wrong" foods easily accessible. If you can't resist chocolate, then keep chocolate out of easy reach.
5. Stay away from buffets or other locations where overeating is made easy.
6. Try to identify factors that trigger overeating. For example, many people react to stress by overeating. Reducing stress is one example of changing behaviour so that overeating is avoided.
7. Buy a pedometer. These devices count the number of steps walked. An appropriate goal is 10,000 steps per day.
8. Join a group that actively supports weight loss, increased fitness, and healthful eating. This could be, for example, a commercial organization or a group of friends.
9. And perhaps most important of all: be determined!

## 6. PROGRAMMES FOR THE PREVENTION OF CHRONIC DISEASES OF LIFESTYLE

We can summarize a sensible approach to CDL as follows: Better to build a fence at the top of the cliff than park an ambulance at the bottom.

A number of programmes have been developed for the prevention of CDL. This is a significant subject that we examine only briefly here. In Chapter 15 we consider this from the perspective of nutrition education. In this section we look at several programmes that have worked toward preventing CDL.

### 6.1 Obesity

In an earlier section of this chapter we discussed the major causes of obesity. These help us understand how obesity can be prevented. But, unfortunately, we are now confronted by a major obstacle: as various countries adopt an increasingly Westernized lifestyle and move further along in the nutrition transition, their populations find themselves living in a society that seems as if it had been designed to make them obese. Consider the following:

- Most people clearly prefer fattening foods over traditional foods. Major reasons for this include taste and image. This is not an accident: the modern food industry has carefully designed its products to make them as appealing as possible. As a result, everyone living in locations where modern foods are sold is constantly exposed to fattening foods. For that reason, most people can only avoid becoming overweight by exerting much self-control.
- Information given in Chapter 19 shows that a healthy diet is significantly more expensive than a diet that is unhealthy and fattening. This means that the cost of different types of food acts as a driver to pressure people – especially poor people – to eat fattening food.
- When children are at school, they generally have easy access to fattening food, either in the school itself or within the distance of a short walk.
- Education directed at children regarding healthy eating is usually massively outweighed by advertising for unhealthy foods.

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- A combination of computers and TV has seduced millions of children away from physical activities, such as football.

These factors compel us to conclude that the basic cause of obesity is that the environment in which we live is "obesogenic."

How should a nutritionist confront this reality? The starting point for an anti-obesity strategy is to recognize that because many factors work together to cause obesity, the goal of reducing obesity therefore requires a multicomponent counter-attack. This was recognized in a 2007 report by senior scientists working for the UK government (Foresight, 2007):

> The obesity epidemic cannot be prevented by individual action alone and demands a societal approach. Tackling obesity requires far greater change than anything tried so far, and at multiple levels: personal, family, community and national. Preventing obesity is a societal challenge, similar to climate change. It requires partnership between government, science, business and civil society.

Several important aspects of an anti-obesity strategy are beyond the work of a community nutritionist and require government action. These aspects are discussed in Chapter 19. But it is entirely possible for a community nutritionist to carry out a community-based programme. Unfortunately, few such programmes have been carried out with the aim of countering obesity. Here we look at one of the rare successful examples.

Starting in 1992, children in schools in two towns in France received nutrition education (Romon et al., 2008). This expanded somewhat after 1997 to the adult population of the towns. From 1999 on, there was even wider community activity in support of more physical activity and a healthier lifestyle. At the same time, there was much media interest. The impact of the intervention was assessed in 2004 by measuring the BMI of children aged 5 to 12 years. These data were compared with two other towns in which no intervention was done. The intervention children had a lower BMI: 15.7 versus 16.5. The proportion of children who were overweight or obese was also reduced: 7.4% (intervention) versus 19.4% (non-intervention) for boys, and 10.4% versus 16.0% for girls. This is a remarkable degree of success.

## 6.2 School Interventions

Many interventions have been conducted in schools with the aim of improving diet and other aspects of lifestyle. A review was published that covered 85 school-based interventions that included a nutrition component (Steyn et al., 2009a). Key factors generally associated with improved behaviour appeared to be

- a nutrition-based curriculum offered at the school by trained teachers,
- interventions that included a physical activity programme or component,
- a parental/family component,
- a grounding in a firm theory of behaviour (such as stages of change), and
- a food service component.

## 6.3 Interventions at Worksites

Another approach to the prevention of CDL has been to have interventions for employees at their worksites. A review of such projects reported significant success (Carnethon et al., 2009). Indeed, this can actually be cost-effective from the perspective of the employer, in terms of reduced sickness and improved efficiency. The authors estimated that each dollar spent on the programme generates between $3 and $15 in economic benefits. This may be especially relevant in developing countries where productivity is often poor because of malnutrition.

## 6.4 Community Programmes

Many community programmes have been carried out in Western countries with the goal of preventing CVD. A systematic review was performed in which thirty-six programmes were assessed, each of which targeted risk factors for CVD across an entire community (Pennant et al., 2010). Every programme used mass media

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(radio, TV, print media) to deliver their message. Other commonly used interventions included screening for risk factors, counselling (either individually or for groups of people), and environmental changes. Seven of the studies reported changes in CVD mortality; while the trends were all favourable, only one study achieved a statistically significant reduction in risk of death from CVD. Twenty-two of the studies reported changes in terms of risk factors. There were small favourable trends for blood pressure, blood cholesterol, and smoking; for example, systolic blood pressure on average decreased by 2.9 mmHg, and smoking prevalence decreased by 1.7%. The researchers estimated the effect of these changes in risk factors on the 10-year risk of CVD: the risk decreased by approximately 9% compared to the baseline level of risk (i.e., approximately one case in every eleven would be prevented). This means that one case of CVD would be prevented for every 154 subjects that were exposed to the intervention for 10 years.

## 6.5 Preventing CDL by Changing the Environment

The point was made above that the environment in which we live may be obesogenic. In a broader sense, the same is generally true for CDL: it is the environment that is the real cause of CDL. For this reason, a truly effective prevention strategy needs to tackle CDL on a broad front. In addition, the proposed strategy will need active government support. The following are two examples of this strategy in action.

### *6.5.1 Finland*

In the 1960s, Finland had the unenviable distinction of having the world's highest rates of IHD, especially among men. In response, the North Karelia Project was launched in 1972 (Puska, undated), a preventive intervention designed to reduce the risk factors in the population of the Province of North Karelia. Emphasis was placed on changing diets and reducing smoking. Comprehensive activities were used, involving health and other services, schools, innovative media campaigns, local media, supermarkets, the food industry, and various other organizations. After a few years, these interventions were extended to the rest of Finland. Over time, important improvements in lifestyle occurred, such as a major decrease in smoking rates (for men), and people switching from butter to vegetable oils. One outcome was a reduction of about 17% in the mean serum cholesterol level of the population. Elevated blood pressures were brought under control. Over the 25 years from 1970 to 1995, mortality rates for men aged 35 to 64 fell by a remarkable 73% for IHD, 71% for lung cancer, and 49% for all-cause mortality.

### *6.5.2 Mauritius*

One of the few examples of a national intervention programme in a developing country took place in Mauritius. This island nation in the Indian Ocean experienced rapid industrialization and general improvement in living standards during the 1970s and 1980s. But, as in many other developing countries, this was followed by an epidemic of CVD and DM. In 1987, the government of Mauritius responded by instituting a national intervention programme aimed at the prevention of CDL (Dowse et al., 1995). The goal was to reduce levels of risk factors related to CDL, including glucose intolerance, hypertension, hyperlipidaemia, obesity, cigarette smoking, alcohol misuse, and physical inactivity. Interventions included extensive use of the mass media, fiscal and legislative measures, and widespread community, school, and workplace health education activities. These components were intended to promote healthy nutrition and increased amounts of exercise and to reduce alcohol intake. There was also a comprehensive antitobacco campaign that used mass media, advertising bans, and increased taxation.

A survey conducted in 1992, 5 years after the programme had been implemented, revealed much success, namely reductions in population blood pressure and blood lipid concentrations, increased amounts of leisure exercise, and decreased smoking and alcohol consumption. The dramatic fall in blood cholesterol levels was probably mainly due to a large decrease in the saturated fat content of cooking oil, achieved by switching from palm oil to soya bean oil. There were, however, some disappointments: the prevalence of obesity and DM both increased.

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### 6.6 Diabetes

Several randomized control trials have been carried out to determine whether a lifestyle approach, typically involving improved diet, weight loss, and exercise, can arrest the development of type 2 DM. These trials had substantial sample sizes and periods of intervention (Gillies et al., 2007; Steyn et al., 2009b). The subjects in these studies had impaired glucose tolerance and were therefore at high risk of DM. The trials demonstrated that a lifestyle intervention reduces by 50% the number of subjects who develop DM over the next few years.

This and much other evidence clearly demonstrate that type 2 DM is a preventable disease. This applies to the general population; in other words, most cases of DM can be prevented by a healthy lifestyle. Prevention programmes should therefore be directed to not only individuals at high risk, but also to families, workplaces, schools, and communities (Bazzano et al., 2005).

### 6.7 Comment

The most successful campaigns for the prevention of CDL are those that have made serious and wide-ranging efforts to change the environment that causes CDL. Such a strategy needs not only broad support from across the community, but also active government support. The campaigns carried out in Finland and Mauritius were excellent models of this. In Chapter 19 we discuss this in more detail.

Many programmes for the prevention of CDL do not require government support and can be set up and implemented within communities. These can be done in specific locations, such as in schools or worksites, or across an entire community. The WHO published a systematic review of the evidence concerning the effectiveness of diet and physical activity interventions to prevent chronic CDL (WHO, 2009b). The types of interventions considered were those targeting schools, worksites, and primary health care. The authors concluded (page 1):

> Multi-component interventions that are adapted to the local context were found to be the most successful. Interventions that used the existing social structures of a community, such as schools or the weekly meetings of older adults, reduced barriers to implementation. Effective interventions invariably involved participants in the planning and implementation stages, such as involving the workers themselves in workplace interventions, and community leaders in community and religion-related programmes.

Another form of intervention is to target those at high risk of a particular chronic disease, as with the interventions designed to prevent type 2 DM. This strategy can be highly effective because people in the target group are aware of their health status and are therefore more likely to be willing to make lifestyle changes than are people at lower risk of disease. This means that a community nutritionist will likely achieve much more – in terms of amount of disease prevented – by focusing on high-risk subjects than by working across an entire community. However, there is a negative side to this strategy: most cases of CDL occur in people who are not at a particularly high risk. Therefore, to be really effective, it is the entire community that needs to be targeted. Moreover, because CDL develops over many years, starting in childhood, it makes good sense to encourage healthy lifestyles in all age groups.

## 7. THE CAUSES OF CHRONIC DISEASES OF LIFESTYLE

In the previous chapter we examined the major dietary factors related to elevated blood cholesterol and hypertension, while in this chapter we have explored the causes of cancer, IHD (and more generally of CVD), type 2 DM, and obesity. Taken as a whole, this evidence identifies the major dietary factors that cause CDL. This same information tells us how to prevent CDL. In this section we now summarize the relative importance of each of these factors. Based on that assessment we can formulate overall dietary advice.

### 7.1 Identifying the Major Causes of Disease

Table 13.1 presents information on the major causes of death and of lost DALYs (disability-adjusted life years). DALYs lost indicate the burden of disease, as discussed in Section 1. Information is given only for middle-income and low-income countries. The actual WHO (2009a) report also presents data for high-income countries.

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**Table 13.1:** Major causes of death and DALYs lost in middle- and low-income countries (as percentages of total)

| | Middle-income countries | | Low-income countries | |
|---|---|---|---|---|
| | **Causes of death*** | **Causes of DALYs lost** | **Causes of death** | **Causes of DALYs lost** |
| High blood pressure | 17.2 | 5.4 | 7.5 | 2.2 |
| Tobacco use | 10.8 | 5.4 | 3.9 | |
| Overweight and obesity | 6.7 | 3.6 | | |
| Physical inactivity | 6.6 | 2.7 | 3.8 | |
| Alcohol use | 6.4 | 7.6 | | 2.1 |
| High blood glucose | 6.3 | 3.4 | 4.9 | 1.9 |
| High cholesterol | 5.2 | 2.5 | 3.4 | |
| Low fruit and vegetable intake | 3.9 | | | |
| Indoor smoke from solid fuels | 2.8 | | 4.8 | 4.0 |
| Urban outdoor air pollution | 2.8 | | | |
| Childhood underweight | | | 7.8 | 9.9 |
| Unsafe sex | | 3.0 | 6.6 | 6.2 |
| Unsafe water, sanitation, hygiene | | 2.0 | 6.1 | 6.3 |
| Suboptimal breast-feeding | | | 3.7 | 4.1 |
| Vitamin A deficiency | | | | 2.4 |
| Zinc deficiency | | | | 1.7 |

** Only the ten leading causes of death or DALYs lost are shown for each column. Countries are grouped by gross national income per capita per year: low income is less than US$ 825; middle income is US$ 825 to 10,066.*
*Source: WHO, 2009a*

The data in Table 13.1 reveal the relative importance of various factors. There are very different patterns in middle-income versus low-income countries. In middle-income countries factors closely associated with CDL account for the eight leading causes of death as well as seven of the eight leading causes of DALYs lost. Of particular note, high blood pressure and tobacco use together cause 28% of all deaths in middle-income countries. These factors are of much less importance in low-income countries, where several factors closely associated with poverty are important causes of health problems. These include (1) unsafe water, sanitation, and hygiene, (2) indoor smoke from solid fuels, and (3) certain nutritional problems that mainly affect infants and children, including suboptimal breast-feeding, childhood underweight, and deficiencies of vitamin A and zinc. In total these factors are responsible for 22.4% of deaths and 28.4% of DALYs lost in low-income countries.

## 7.2 Factors that Cause or Prevent Disease

We now look at the role of specific factors that explain the connections between lifestyle and disease.

### *7.2.1 Tobacco use and physical inactivity*

Smoking is a major cause of chronic respiratory disease, CVD (both IHD and stroke), and several types of

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cancer. This explains why tobacco use is one of the leading causes of both death and lost DALYs in middle-income countries, though it plays a much lesser role in low-income countries (see Table 13.1).

Physical inactivity is also of major importance in several diseases. Exercise has a strong protective benefit against several disorders, most notably CVD, DM, obesity, and some types of cancer. A general recommendation for health is 30 minutes of exercise on most days of the week. This needs to be moderately vigorous, such as brisk walking. This level of exercise will achieve most of the benefits of exercise. However, much evidence informs us that more is better: both higher intensity (i.e., vigorous exercise, such as jogging) and more time spent exercising (say, one hour per day).

### *7.2.2 Diet: seeing the big picture*

Diet plays a major role in CDL. But how do we make sense of so much information? There are two concepts that allow much complex information to be seen in simple terms, which makes it easy to see the big picture rather than getting lost in the details.

1. A healthy diet should have low energy density, as measured by kcal per gram. This is particularly important to help with avoiding excess energy intake and thence obesity, i.e., overnutrition. In practice, this means that much of the diet should consist of food with a high content of water and fibre, and a low content of fat and sugar.
2. A healthy diet should have a high nutrient density, as measured by its content of nutrients relative to energy. Fat and sugar add energy to the diet but do not add micronutrients. For this reason, foods rich in fat and sugar have a low nutrient density while fruit and vegetables have a high nutrient density.

It must be noted that despite a great many epidemiological and experimental studies, we still have little direct evidence linking the total amount of fat in the diet to CVD, cancer, or other diseases. The major rationale for reducing the amount of fat (where the diet content is high) is because of its contribution to obesity. But with sugar, especially sugar-sweetened beverages, the evidence is now quite solid. These foods are strongly linked to excessive weight gain as was mentioned earlier. They also increase the risk of both DM and IHD (Malik et al., 2010; de Koning et al., 2011, 2012; Fung et al., 2009).

A practical definition of *junk food* is food with a high energy density and a low nutrient density. Examples are soft drinks, cookies, French fries, and white bread with margarine or butter. *Healthy foods* are the opposite: they have a low energy density and a high nutrient density.

Based on the above two concepts, a healthy diet should include generous amounts of wholegrain cereals, beans (or other legumes/pulses), fruit, and vegetables, and have a low content of fatty foods, sugar, and refined cereals. Extending this approach to milk and meat, we see that low-fat milk is preferred over full-fat milk and lean meat over fat-rich meat. The type of fats to reduce consumption of are those found in animal products, tropical oils (palm oil and coconut oil), and hard margarine. Unsaturated fats are important for health; good sources include vegetable oils, soft margarine, and fish.

Where does meat fit into this dietary pattern? Lean meat can make a valuable contribution to the intake of protein and several micronutrients, particularly zinc, iron, and vitamin $B_{12}$ (Zanovec et al., 2010). This can be especially useful for particular population groups: children in the case of protein and zinc, and premenopausal women for iron. However, a well-designed vegetarian diet can be nutritious and lead to excellent health.

For older adults, meat can have a more negative than positive effect on health. A major study, conducted in the United States, of men and women aged more than 50 years reported that those who ate more red meat (i.e., beef and pork) and processed meat (such as bacon, ham, sausages, and salami) had a higher risk of death (Sinha et al., 2009). People in the top 20% in terms of meat consumption had about a 20% to 30% increased risk of deaths over the following 10 years, in comparison with those in the bottom 20% of meat consumption. The extra deaths were divided between CVD and cancer. (Earlier in this chapter we mentioned that eating meat is a risk factor for colorectal cancer.) The study also observed that chicken, turkey, and fish were not associated with an increased risk of death.

As pointed out earlier, fish, especially fatty fish, is protective against IHD. It follows, therefore, that for people who wish to eat animal products, fish is the best choice. Chicken would be the second choice. There is also a serious environmental aspect to the issue of consuming meat, a topic that is addressed in Chapter 27.

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Simply put, meat production plays an important role in both the destruction of rainforests and climate change. For reasons of both health and protecting the environment, it therefore makes good sense if less beef and pork were eaten and more legumes eaten instead. Another important factor to consider is that world fish stocks are being rapidly depleted. Fish from the sea may therefore be in short supply in future years. However, fish farming seems to hold much promise.

With respect to vegetables, fresh ones are generally preferable. However, they are not always available. In that case, frozen vegetables are a good choice because they are quickly frozen and therefore usually contain the same amount of vitamins and minerals as fresh vegetables. Canned vegetables and fruit can also be consumed; however, some vitamins may be lost as a result of the high temperatures involved in the canning process.

If these simple rules listed above are followed, then we are already more than half way to formulating a diet that will prevent CDL.

### *7.2.3 Sodium*

The intake of sodium in most countries is excessive, typically in the range 3000 to 4000 mg per day (equivalent to about 8 to 10 grams of salt per day) per person. Both developing countries and Westernized countries fall into this intake range (Brown et al., 2009). Evidence referred to in this chapter and Chapter 12 shows that a high intake of salt poses a substantial risk of hypertension and CVD, and is also linked to stomach cancer.

A reasonable goal is to reduce salt intake to no more than 6 grams (roughly 2300 mg sodium) per day. A lower amount – 1500 mg sodium – is preferable. However, achieving this goal at a societal level requires the collaboration of the food industry. A sensible strategy would be the implementation of government policy requiring that the salt content of processed foods be cut by at least half (see Chapter 19).

### *7.2.4 Vitamin D*

Humans get vitamin D from their diet and from dietary supplements, but the most important source is skin synthesis upon exposure to sunlight, specifically ultraviolet B radiation (UVB) (Holick, 2007; Tavera-Mendoza & White, 2007). A common misconception is that vitamin D deficiency is only a problem for people living at latitudes distant from the equator, places where average levels of sunshine are low. However, there may be a high prevalence of vitamin D deficiency in many developing countries even when they are located in zones that have sufficient sunlight for vitamin D synthesis for most if not all of the year (Arabi et al., 2010). Indeed, a number of studies have reported widespread prevalence of low blood vitamin D levels in people living in Iran, Jordan, and India, countries that have bright sunshine for much of the year (Hashemipour et al., 2004; Arya et al., 2004; Mishal, 2001; Harinarayan, 2005). Vitamin D deficiency is also reported to be highly prevalent in China, sub-Saharan Africa, and Latin America (Arabi et al., 2010). A poor intake of the vitamin is most common in elderly people, neonates, preschool children, people with dark skin, and those who expose little skin to the sun (usually women).

An impressive body of evidence has emerged in recent years suggesting that vitamin D has an important protective benefit against several common chronic health conditions. Randomized controlled trials have reported that in older adults, supplemental vitamin D is protective against both falls (Bischoff-Ferrari et al., 2009a) and fractures (Bischoff-Ferrari et al., 2009b). In the case of fractures, the presumed mechanism is taking vitamin D in tandem with calcium to help prevent osteoporosis. An especially important development in recent years has been findings indicating that vitamin D may have a strong protective association with the risk of colon cancer. This was discussed earlier in this chapter. The evidence suggests that vitamin D supplements have the potential to lower the risk of colon cancer in people who have poor exposure to the sun (Scragg, 2011). Other evidence suggests that vitamin D helps reduce the risk of cardiovascular disease, DM, total mortality, and also depression ( Chowdhury et al., 2014; Lavie et al., 2011; Scragg, 2011). Low levels of vitamin D have also been linked to faster cognitive decline in older adults (Llewellyn et al., 2010). Pregnancy is another stage in life when low levels of vitamin D are harmful (see Chapter 5).

The ideal dose for prevention of vitamin D deficiency is much higher than the Dietary Reference Intake (DRI), which is currently 15 µg (micrograms) or 600 IU per day for ages up to 70 and 20 µg or 800 IU per day for ages over 70. While we still need to see the findings from long-term clinical trials, accumulating evidence

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suggests that a higher vitamin D intake is more effective for the prevention of several diseases, including cancer as well as bone disorders. For this reason, a supplemental dose of 20 to 25 µg (or 800 to 1000 IU) per day is indicated for those whose vitamin D status is likely to be suboptimal. This is most common in such groups as elderly people, people with dark skin, and those who expose little skin to the sun (Giovannucci et al, 2006; Johnson & Kimlin, 2006).

### *7.2.5 Alcohol*

Table 13.1 shows that in middle-income countries, alcohol is responsible for a vast amount of death and disability: it is one of the leading causes of death and is the leading cause of lost DALYs. However, it is much less of a problem in low-income countries.

In this discussion we refer to alcoholic "drinks." A drink contains approximately 12 grams of alcohol, though the definition varies somewhat between countries. This quantity of alcohol is approximately the amount in 350 mL (12 oz.) of regular beer, 120 mL (4 oz.) of wine, or 30 to 35 mL (1.0 to 1.2 oz.) of whisky or other spirits.

The relationship between alcohol and health has been reviewed by Temple (2012). Alcohol can lead to much harm, mainly due to drunkenness and chronic alcohol abuse. This plays a major role in accidents (especially traffic accidents), violence, and suicide. Years of alcohol abuse eventually leads to chronic health and nutritional problems, including liver disease. Drinking during pregnancy is especially harmful and can cause foetal alcohol syndrome (FAS) (see Chapter 5). Alcohol also increases the risk of several types of cancer. Four drinks per day increases overall cancer risk by about 22%, as discussed earlier in this chapter. This level of intake also increases the risk for hypertension, stroke, some forms of heart disease, poor erectile function (impotence), and impaired cognitive function (brain damage). As intake rises, so does risk.

Much evidence has accumulated demonstrating that a moderate intake of alcohol – around 0.5 to 1 drink per day for a woman or 1 to 2 per day for a man – is protective against IHD. Risk may be decreased by as much as 20% to 40%. This protective effect is linked to alcohol itself; there is no good evidence that one type of alcohol, such as red wine, is of greater benefit. Moderate levels of alcohol consumption also seem to be protective against several other conditions, including hypertension, DM, and the decline in cognitive ability with aging.

The benefits of alcohol are most apparent in middle-aged and elderly people. This is because alcohol reduces the risk of IHD and stroke, two of the leading causes of death after age 50. The net effect of alcohol on total mortality is a J-shaped curve with minimum mortality associated with a moderate intake of alcohol but with a rising curve as consumption increases (Lee et al. 2009). But for people under the age of 40, especially men, alcohol at any level increases the risk of death because of its close association with accidents and violence.

Most of the harmful effects of alcohol can be avoided by drinking only in moderation. It is also important to avoid binge drinking (drinking a large quantity of alcohol in a single drinking session), or drinking when driving. The consumption of alcohol is best avoided for persons with a family history of alcoholism, hypertriglyceridaemia, pancreatitis, liver disease, heart failure, or uncontrolled hypertension, or who are taking certain medications (Pearson, 1997). However, for people in middle age and above who can drink sensibly, alcohol can be of considerable benefit. Like so much else in life, it's a matter of balance.

## 7.3 What Is the Best Diet?

The diet advice given above has been summarized into an easy-to-use food guide, namely the Traffic Lights Food Guide. This is described in Section 3 of Chapter 14.

## 7.4 Dietary Supplements

One other question is whether dietary supplements should be recommended, a topic explored in some detail in Chapter 9. Supplements are of little or no value for the majority of people eating a nutritious diet (Fortmann et al., 2013; Guallar et al., 2013). However, there are some specific groups for whom a supplement is advised. These include the following:

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- Vitamin D supplements may be of value for the many people who are lacking the vitamin (discussed earlier in this chapter).
- People with other specific deficiencies, such as iron or iodine, also require supplements.
- Supplements of particular micronutrients may be needed during pregnancy (see Chapter 5). Folic acid is particularly important for women who are pregnant or who may become pregnant.
- People with various infections may also need particular micronutrients (see Chapter 9).

Dietary supplements have turned into a big industry. Alas, a great deal of the marketing is dishonest, a subject explored in Chapter 26.

## DISCUSSION QUESTIONS AND EXERCISES

1. The minister of health of your country is alarmed over the rising levels of overweight in schoolchildren. She therefore asks all community nutritionists to visit schools and give talks about this problem and about how children can change their diet. Comment on how effective this strategy is likely to be.
2. In this chapter we referred to interventions that have successfully prevented type 2 diabetes in around half of people at high risk of developing the disease. Do you consider this an appropriate strategy to reduce the prevalence of diabetes in the population of your country?
3. Look at the data in Table 13.1. What are the major causes of death in your country? How does this distribution of causes compare to the data in the table?
4. Based on observed or expected changes in diet and other aspects of lifestyle in your country, which diseases do you expect to become more or less important as causes of death over the next 10 years? Explain your reasoning.
5. How common is excessive alcohol consumption in your country?
6. What commercial organizations that help people to lose excess weight are active in your country? What methods do they use? Do you believe they achieve much success?
7. What are the major types of fats and oils used in food preparation in your country? Are there better choices available for helping to prevent IHD? What could be done to encourage people to use the healthier fats and oils?
8. Consider the health intervention programmes conducted in France (for the prevention of obesity) and Mauritius (for the prevention of CDL). Do you think there would be support for launching similar programmes in your country? Discuss what modified versions of these programmes might receive support from those with power to make decisions.
9. Describe four lifestyle-related risk factors for each of the following types of cancer: breast (post-menopausal), colorectal, and stomach.

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# PART 4

## FROM FOOD GUIDES TO NUTRITION EDUCATION

# CHAPTER 14

# DIETARY RECOMMENDATIONS, FOOD GUIDES, AND FOOD LABELS

*Norman J. Temple and Lesley T. Bourne*

## *Outline*

- Dietary guidelines, including food-based dietary guidelines
- Food guides
- Tables of recommended intake of nutrients, such as Recommended Dietary Allowances (RDA)
- Food labels

## *Objectives*

At the completion of this chapter you should be able to:

- Explain the purpose and content of dietary guidelines
- Discuss dietary guidelines that are based entirely on foods (food-based dietary guidelines) and that include recommendations on nutrients
- Describe the key design features of food guides
- Discuss the challenges in developing a national food guide
- Describe the key features of tables that give recommendations for the intake of nutrients
- Discuss the special challenges that apply to the formulation of various types of dietary recommendations for use in developing countries
- Describe and critically evaluate the key design features of food labels


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# 1. INTRODUCTION

In the previous chapter we discussed the key features of a healthy diet. But in order for this information to be properly implemented, it must first be packaged into a practical format that serves its intended use. In this chapter we examine the various types of recommendations concerning the diet. They are all designed to improve public health and are evidence-based and authoritative.

Different sets of dietary recommendations have emerged since the late 1960s. They are of two main types:

- Dietary guidelines give advice on specific areas of the diet, especially on aspects of the diet where much of the population needs to make dietary improvements. The recommendations may be on particular foods (for example, "choose wholegrain foods") or on food components ("no more than 10% of energy from saturated fat").
- Food guides are sets of advice on how to select a diet. They specify how many servings should be consumed from each food group (for example, "eat five servings a day of fruit and vegetables"). They are written for the general population with the aim of being user-friendly.

We also describe recommendations concerning the quantities of essential nutrients that people should consume. Finally, we look at food labels.

The major goal for readers of this chapter is to understand the various types of dietary recommendations and food labels, including the advantages and disadvantages of the designs used in different countries. The reader then needs to apply these lessons to his or her own country.

# 2. DIETARY GUIDELINES

Around the world, different agencies publish sets of dietary guidelines that are aimed at the improvement of population diets. Here we look at some examples.

## 2.1 The World Health Organization and the Food and Agriculture Organization

In 2002, the World Health Organization (WHO) together with the Food and Agriculture Organization of the United Nations (FAO) published their dietary guidelines (Nishida et al., 2004). The focus here is on nutrient intakes rather than dietary intake. The recommendations for total fat and carbohydrate are 15% to 30% and 55% to 75% of energy, respectively. The upper limit of 75% for carbohydrate, which is a high figure, reflects the fact that the target populations for WHO and FAO include the populations of developing countries, who typically consume large amounts of high-carbohydrate staple foods, such as rice. Other recommendations. as a percentage of total energy, are 10% to 15% protein, <10% sugars (including those present in fruit juice), 5% to 8% polyunsaturated fatty acids, 1% to 2% omega-3 fatty acids, <10% saturated fatty acids, and <1% trans-fatty acids. Salt intake should be <5 grams/day. There is no specific recommendation for dietary fibre but rather a general recommendation for fruit and vegetables to total at least 400 at least 400 grams/day, plus wholegrain foods.

## 2.2 Dietary Guidelines in the USA

In highly developed countries the primary goal of dietary guidelines is to serve as a tool to help reduce the impact of chronic diseases of lifestyle (CDL). This is illustrated by dietary guidelines from the USA, such as those from the American Heart Association (AHA, 2006) and the *Dietary Guidelines for Americans* (USDA, 2010). For the most part, these guidelines are similar to the WHO/FAO guidelines. One notable exception is that the *Dietary Guidelines for Americans* sets a higher level of acceptable intake for fat (20% to 35% of energy versus 15% to 30%). It also recommends that intake of alcohol be no more than one drink a day for women and two per day for men. A new version of *Dietary Guidelines for Americans* is scheduled for release in late 2015.

The above dietary guidelines include several recommendations that focus on nutrients, such as setting a target for salt intake of <5 grams/day. Recommendations of this type are intended mainly for health professionals. However, the aim is that the advice is disseminated to the general population.

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### 2.3 Food-based Dietary Guidelines

Other sets of dietary guidelines are based entirely on foods rather than nutrients; they are therefore referred to as food-based dietary guidelines (FBDG). They are written in clear, simple language, are non-quantitative, and can be understood by the general public. They are culturally sensitive and take the customary dietary pattern of consumers into account. This approach to formulating dietary recommendations has been widely recommended (WHO, 1998; Mozaffarian & Ludwig, 2010). The FAO has compiled a website that gives the FBDG used in many countries around the world (FAO, 2010). Here are some examples.

The dietary guidelines used in the UK are called *Eight Tips for Healthy Eating* (NHS, 2010):

1. Base your meals on starchy foods.
2. Eat lots of fruit and vegetables.
3. Eat more fish.
4. Cut down on saturated fat and sugar.
5. Eat less salt.
6. Get active and maintain a healthy weight.
7. Don't get thirsty.
8. Don't skip breakfast.

In contrast to the dietary guidelines used in the UK, those used in developing countries often contain statements such as, "Drink lots of clean, safe water," "Foods consumed should be safe and clean," and "Use only iodized salt." Here are the FBDG used in Namibia, which are typical of those from developing countries:

1. Eat a variety of foods.
2. Eat vegetables and fruits every day.
3. Eat more fish.
4. Eat beans or meat regularly.
5. Use wholegrain products.
6. Use only iodized salt, but use less salt.
7. Eat at least three meals per day.
8. Avoid drinking alcohol.
9. Consume clean and safe water and food.
10. Achieve and maintain a healthy body weight.

We can summarize the merits and purpose of the two types of dietary guidelines – nutrient-based and food-based – as follows. FBDG are clearly superior for transmitting nutrition advice to the general public because the information is easy to understand and put into practice. Providing dietary guidelines that include recommendations on nutrients, such as sodium, sugar, omega-3 fatty acids, and *trans*-fatty acids, is also useful, but for the specific purpose of helping nutrition professionals to evaluate diets and design healthier diets. A central element of all dietary guidelines is that the recommendations are consistent with our research knowledge concerning the relationship between diet and disease.

## 3. FOOD GUIDES

Numerous countries have published food guides that provide advice on the overall diet for the general public. All such guides promote a healthy balanced diet. Several of these were reviewed by Kaufer-Horwitz and colleagues (2005). While the various food guides have many differences in their designs, they all share the underlying aim that dietary guidelines need to be expressed in terms of foods and in clear, simple language. Food guides tend to centre on a coloured diagram or poster. Several examples are described below.

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## 3.1 United States

Until 2005 the official food guide for the general public in the USA was the Food Guide Pyramid. As the name suggests, food groups were arranged in the shape of a pyramid: the foods to be consumed in largest quantities covered the most area and formed the base; such items as fats and oils occupied a small area at the peak. It was a simple matter to look at this one-page document and determine how many servings should be eaten from each food group.

From 2005 to 2011 the food guide used in the USA was MyPyramid. Unlike the Food Guide Pyramid, MyPyramid required the use of the Internet. The user entered his or her profile (sex, age, and physical activity) and then received a set of individualized diet recommendations. What probably killed this food guide was the realization that while people are generally willing to read a simple, printed food guide, many of them are not prepared to go to the additional trouble of consulting a website, especially if they do not own a computer or have an internet connection.

In 2011, MyPyramid was replaced by an easy-to-understand pictorial design called MyPlate (USDA, 2011). The diet is depicted as a plate with food sectors. Unlike the previous food guides it places little emphasis on how many servings should be eaten from each food group each day. Instead it focuses on types of recommended foods and the proportions of each group that should make up each meal.

## 3.2 Canada's Food Guide

*Canada's Food Guide* (Health Canada, 2007) is based on a chart and is simple to use. There are several notable features. The recommended number of servings of fruit and vegetables (which are combined together in one food group) exceeds that for grains. Supplements are specifically recommended for particular groups. Because Canada has a northern location and a cold climate, lack of vitamin D is a major concern. For that reason, people over age 50 are advised to take 400 IU (10 μg) per day of the vitamin. In addition, a multivitamin containing folic acid is recommended for women who could become pregnant and those who are pregnant or breast-feeding.

Anyone wishing to use this food guide should request a printed copy, as this is much easier to read than via the Internet. Copies can be requested from Health Canada, for example via their website: www.hc-sc.gc.ca/fn-an/food-guide-aliment/index-eng.php.

## 3.3 United Kingdom

The UK's Eatwell Plate is a pictorial food guide (NHS, 2011). It shows the proportion and types of foods that are needed to make up a healthy balanced diet. The food guide is depicted as a plate with food sectors, similar to MyPlate in the USA. It resembles the Canadian guide in that fruit and vegetables are combined into one group. Fatty and sugary foods are included in the pictorial representation.

## 3.4 Challenges in Developing a Food Guide

We have now looked at a few of the food guides that are available. If followed, then a diet based on any of these food guides will almost certainly provide all required nutrients in amounts that meet recommendations. One problematic nutrient is vitamin D, which is discussed in Chapter 13. There are several other issues in the design of food guides, demonstrated by the differences between the various food guides. Unfortunately, in most cases there are no obvious right or wrong solutions.

An important difference concerns the use of quantitative recommendations. These are included in the food guides used in some countries, such as Canada, but several food guides used in different countries, including the new MyPlate (USA) and the Eatwell Plate (UK), give very little attention to numbers of servings. Many would argue that specifying the recommended numbers of servings might assist consumers in selecting a healthier diet. However, to what extent people actually follow the recommended amounts is not known.

Fruit and vegetables are grouped together in some guides, such as those from Canada and the UK, but are in separate groups in others, such as the USA. Potatoes go with other vegetables in the USA and Canada, but in some countries potatoes and other root vegetables are given their own group distinct from other vegetables. Several countries include potatoes with grains. Placing potatoes separately from other vegetables is probably

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sensible as potatoes are poor in phytochemicals, have a high glycaemic index, and are often consumed as French fries (chips) and may therefore have a high content of oxidized fat.

Another inconsistency is in the placement of legumes. In Canada, beans are included with meat, hence the name of that food group: "meat and alternatives." MyPlate, by contrast, allows beans to be counted with either "protein foods" or with vegetables. This schism in the placement of legumes reflects the fact that legumes are a low-fat, protein-rich alternative to meat but are also a good source of fiber and various nutrients such as folate.

The American and Canadian food guides emphasize that grain products should be made from whole grains rather than from refined grains. This welcome trend has emerged in recent years. However, the food guides could still be improved by stating this more strongly.

One problem with food guides is that manufactured products often contain mixtures of diverse foods, along with added sugar or salt. This can make it confusing for users to categorize foods. For example, ham and pineapple pizza contains wheat (a grain) plus a modest amount of meat and fruit along with an excess of salt. The food therefore belongs in three separate food groups while also requiring that a person who eats this food should be aware of the salt content.

Nutritionists who are involved in developing a food guide need to carefully assess the above issues and determine what makes most sense in the specific conditions of their particular country. A food guide needs to have the following features:

- It is written in clear, simple language so that most people in the target population can easily understand it.
- It is based on foods that are widely available in that country.
- Its design and key messages must be acceptable to the target population.
- It must be sufficiently flexible so that it caters to different groups within the population, such as vegetarians or ethnic minorities who have different food preferences.
- It is designed to deal with the major nutrition problems of that country, whether these be undernutrition, overnutrition, or both.

As national diets around the world continue their rapid evolution, the food guides also need to evolve.

## 3.5 Traffic Lights Food Guide

The Traffic Lights Food Guide was developed by the authors of this chapter (Temple & Bourne, 2010) and is based on a traffic light design. It is intended to be simple to use and has major differences from the food guides discussed above.

Food guides typically categorize foods into two broad classes: (1) those that are recommended and (2) those that should be eaten only in limited quantities. But nutrition science informs us that many foods belong somewhere in between. For that reason, the Traffic Lights design divides food into three classes. Within each food group, foods are categorized as follows:

- Green – eat freely within the limits indicated,
- Amber – eat in limited amounts, or
- Red – these are treats; eat little or none.

The food guide is a logical development of Traffic Lights food labels, which have been adopted by some supermarket chains in the UK and other countries (Food Standards Agency, n.d.). The food guide, which is shown in Figure 14.1, could be adapted for developing countries. Unfortunately, little research has been done to determine whether the Traffic Lights design will lead to people eating a healthier diet. It is therefore a matter of speculation as to whether this design has advantages in comparison with the type of food guides discussed earlier.

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| Eat a mixture of foods from the different food groups while carefully following the rules given below: | | | |
|---|---|---|---|
| **Food Group** | **Green** (eat freely within the limits indicated) | **Amber** (eat in limited amounts) | **Red** (eat little or none) |
| **Fruit and vegetables** | Nearly all fruits and vegetables | Potatoes, fruit juice | Chips (French fries) |
| **Grain products** | Whole grains, such as whole-wheat bread, oats, dark rye bread, and popcorn | Refined cereals, such as white rice, white bread, and corn flakes | Biscuits, cakes, popcorn with salt and/or butter |
| **Milk products** | Skim and 1% milk, fortified soy milk | 2% milk, low-fat cheese | Whole milk, regular cheese, cream cheese, ice cream |
| **Meat, fish, beans, nuts** | Fish, beans, lentils, nuts | Lean beef, chicken | Bacon, red meat (all beef and pork products unless labeled as lean), eggs |
| **Oils, fats** | Most vegetable oils, soft margarine (preferably from canola oil or soy oil) | | Hard margarine, butter |

**Key Rules for a Healthy Diet**

1. Eat only enough to satisfy your appetite. If you are gaining excess weight or you wish to lose weight, then eat less, and exercise more.
2. Eat 5 to 10 servings per day of grain products. Of this, at least 3 servings (preferably more) should be whole grains. One serving is equal to a slice of bread, a cup of breakfast cereal, or half a bagel.
3. Eat 5 to 10 servings per day of whole fruit and vegetables. One serving is equal to an apple, a banana, a cup of salad, or half a cup of other vegetables. In addition, up to 1 cup of juice (2 servings) may be consumed. Aim for a mixture of different types of fruit and vegetables. Fresh or frozen is better than tinned (canned).
4. Consume 2 or 3 servings per day of milk products (more for adolescents and women who are pregnant or breast-feeding). One serving is equal to 1 cup of milk or yogurt or 45 grams of cheese.
5. Consume 1 to 3 servings per day of meat, fish, beans, peas, lentils, and nuts. A serving is equal to 90 grams of fish or meat or half a cup of cooked beans.
6. Aim for about 3 teaspoons per day of margarine, oils, and salad dressing, or double that if you eat little or no other sources of polyunsaturated fats, such as nuts or fish.
7. Minimize your consumption of sugar. This includes sugar in coffee and soft drinks. Also minimize your consumption of foods rich in both fat and sugar, such as biscuits and cakes.
8. Cut down on salt. Remember, most salt in the diet comes from processed foods, such as most types of bread, margarine, and tinned foods.
9. It is OK to consume alcohol provided that this is done responsibly. Never drink and drive, never drink if pregnant, and don't get drunk. An acceptable intake is 1 drink per day for women and 2 drinks per day for men.

**Figure 14.1:** Traffic Lights Food Guide
*Source: Temple & Bourne, 2010. Reproduced by permission.*

## 4. RECOMMENDATIONS FOR NUTRIENT INTAKE

Numerous countries produce tables of the recommended intake of nutrients. These are intended primarily for health professionals.

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### 4.1 United States and Canada

The Recommended Dietary Allowances (RDAs) are estimates of the daily amounts of nutrients considered necessary to meet the needs of most healthy people. The RDAs have been in use in the USA for several decades. In the late 1990s, a new set of recommendations was formulated, called the Dietary Reference Intakes (DRIs). DRIs were developed jointly by the USA and Canada. The RDAs are now part of the DRIs. For those nutrients for which there is insufficient information to establish a RDA, less exact estimates are made, known as Adequate Intakes (AIs). Values of RDAs and AIs are given for fourteen vitamins, fifteen minerals, energy, carbohydrates, essential (omega-3 and omega-6 polyunsaturated) fatty acids, protein, dietary fibre, and water. Tables are broken down by age and sex. Specific recommendations are given for women who are pregnant or lactating. A simplified version of these tables is given in Appendix III. For the full tables, go to http://fnic.nal.usda.gov and then click on "Dietary Guidance." This is the website of the Food and Nutrition Information Center (FNIC) which is part of the U.S. Department of Agriculture.

### 4.2 Other Countries

Other countries use variations of the above system. Often only one set of values are given for nutrient intake recommendations, the equivalent of RDA, although different terms are used by different agencies. The FAO, together with the WHO, uses the term *Reference Nutrient Intake* (RNI), which it defines as "the daily intake which meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population" (FAO/WHO, 2004).

### 4.3 Comment

The values given for the recommended intake of nutrients reach the public in different ways. In particular, they are at the heart of national dietary recommendations. This means that food guides are designed so that a person who follows them should obtain enough of every nutrient. Of course, vast numbers of people in developing countries, and many people in developed countries, eat a diet that falls well short of dietary recommendations. As a result. nutrient intakes are frequently far below the recommended intake for numerous nutrients. In order to investigate this, findings from diet surveys can be interpreted by comparing actual intake of nutrients against recommended values. By this means a nutritionist/dietitian can determine whether deficiencies of particular nutrients pose a problem. Such an analysis is crucial for making a proper assessment of the dietary status of both individuals and populations. The findings can then serve as the basis for planning nutrition interventions.

Nutrient intake recommendations also play an important role in creating food labels, which help consumers determine how much of a particular nutrient is present in a serving of a particular food. This is discussed below.

## 5. APPLICATION OF VARIOUS TYPES OF DIETARY RECOMMENDATIONS

We have now examined various types of dietary recommendations. Each type serves a specific function. We will now briefly summarize them:

- Recommendations concerning the intake of vitamins and minerals have been in use for several decades. They are important when evaluating diets.
- Dietary guidelines are intended to help improve population diets. Some dietary guidelines focus on nutrients, such as that salt intake should be <5 grams/day. Dietary guidelines of this type are mostly intended for use by health professionals.
- It is now increasingly recognized that a focus on the intake of nutrients tells only part of the story: we eat food, not vitamins and minerals. Trying to design a diet based on values for recommended intake of nutrients is extremely complex. It is important, therefore, to look at the diet as a whole. Food-based dietary guidelines (FBDG) are developed after carefully evaluating the major dietary problems in a country

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and then formulating general advice on key aspects of the diet. The main goal of FBDGs is the improvement of population health, such as the prevention of chronic diseases. They must be written in clear, simple language and be readily understood by the general public.

- Food guides go one step beyond FBDG and tell people how to eat a healthy diet.

# 6. FOOD LABELS

## 6.1 The Use of Food Labels

Many countries have regulations that specify what labels must be affixed to a package of food when it is sold. Generally, the labelling regulations only apply to food that is sold in packages, such as tins or cardboard boxes, whereas many foods that are not pre-packaged, such as bread, meat, and fish, do not require a label. The following description of food labels applies specifically to North America, although many other countries have similar systems. Labels are of two types:

- Front-of-package labels inform the buyer of the brand name and the type of food, such as Kellogg's Cornflakes.
- Back-of-package labels provide details of the composition of the food, such as 255 mg sodium per 45 g serving. To help the consumer interpret the information, the amounts are also stated as a percentage of recommended daily intake (RDI). This part of the label also lists the ingredients in the food in order by weight (main ingredient first).

## 6.2 Problems with Food Labels

Around the world, food labels can be a source of confusion for consumers (Temple & Fraser, 2014). Here are the major problems:

- Front-of-package labels often give misleading names to soft drinks. In North America, only pure fruit juice can be called "juice." However, there are numerous imitation juice products that contain no more than 20% actual juice; many contain no juice at all. These pseudo-juice products are, in reality, sugar solutions with added flavours and colours. They are little different from other sugar-rich soft drinks, but they have misleading names such as "fruit beverage." Adding to the confusion, the brand name may also be suggestive of real fruit, naturally grown (e.g., *Sunny Delight*).
- The back-of-package label lists the ingredients in the food in order by amount but does not normally give the actual amount of each ingredient. Here is what this can mean in practice: A manufacturer sells a juice containing mainly apple juice, which is cheap, with some added berry juice, which costs much more. However, as many customers prefer berry juice, the front-of-package label will likely say, in large letters, "made with real berries" and feature prominent images of berries. Even if the customer realizes that the front-of-package label is deceptive and looks at the back-of-package label in an effort to determine precisely how much berry juice is present, the latter will be impossible.
- Another common problem with back-of-package labels is that they typically mix together food components the intake of which should be limited (such as sodium, sugar, and saturated fat) and food components that are often lacking in the diet (such as fibre and omega-3 fatty acids). This makes the label less easy to understand.
- Yet another problem is that labels for similar products often use different serving sizes, thereby making it difficult for consumers to compare them.

Imagine a typical shopper in a supermarket who is selecting a brand of breakfast cereals. The time spent evaluating each of the choices on offer is generally no more than a few seconds. For that reason it is the front-of-package labels that dominate decision-making, but, as we have seen, those labels can be quite misleading. Even if the shopper makes a determined effort to study the back-of-package labels in order to make a careful choice, he or she might easily end up being confused by the information. Indeed, research studies have revealed that the majority of people have problems understanding food labels (Cowburn & Stockley, 2005). This is especially the case with older adults and those with less education. Moreover, these studies were

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conducted in various Western countries. People in developing countries typically have less years of education than in Western counties, and therefore the labels are likely to be even more problematic. In addition, there may be language barriers. Accordingly, the food labels described above are likely to have limited value for large sections of the population in many developing countries.

## 6.3 Improved Designs for Food Labels

Clearly, the types of food labels used in many countries mean that consumers are not being given the information they require, in a user-friendly format, in order to make informed choices as to which food items are healthiest. In response to these problems several new designs have been developed (Temple & Fraser, 2014).

An alternative system that shows much promise has been developed in Britain and is based on the Traffic Lights Food Guide (Food Standards Agency, 2013). With this system, coloured circles are placed on the front of the pack and show at a glance if the food has a high (red), medium (orange), or low (green) content of fat, saturated fat, sugars, and salt. The label also indicates the actual quantity of these substances per serving. This system is simpler than the type of system described above. Research studies have been carried out in which consumers have been asked to compare Traffic Lights labels with other front-of-package label systems. In general, Traffic Lights labels are well liked and are very effective for helping people to assess how healthy a food is (Hersey et al., 2013).

One possible improvement to this system is to add an extra "traffic light" to indicate the global health value of a food (Temple, 2014). Such a system requires a standardized methodology for comparison of diverse foods. Several such systems have been proposed (Drewnowski & Fulgoni, 2008; Scarborough et al., 2007).

Other tests have been conducted using even simpler front-of-package labels that summarize the global health value of a food as a number of stars (or a similar symbol). Healthier products are given more stars. This format provides less information than Traffic Lights labels but it scores even better in terms of allowing people to correctly identify which foods are healthiest (Feunekes et al., 2008).

Traffic Lights labels and other simple systems may be especially valuable in developing countries because they do not require any ability at arithmetic from shoppers. Setting up an easy-to-use system for nutrition labelling in developing countries is obviously a challenging enterprise. The food labels used in each country should be carefully designed and based on local factors, such as: the major nutrition-related health challenges (undernutrition or overnutrition), the level of education (telling people the sodium content of food is not much use if most people are unable to interpret this information), and the types of foods sold (unwrapped food sold at outdoor markets or food in packages and tins sold in supermarkets).

# DISCUSSION QUESTIONS AND EXERCISES

1. The health department of your national government has decided to establish new regulations for food labels. Based on the situation in your country, write a letter describing the design of food labels that you consider to be most appropriate. Provide supporting arguments.
2. Your country already has a food guide. It has been suggested that FBDGs should also be developed and published. Discuss the merits of this proposal.
3. You are developing FBDGs for use in your country. Examine the FBDGs used in the UK (see section 2.3). Suggest one or two additional guidelines that are not included in those guidelines but that should be included in FBDGs for use in your country.
4. Various designs of food guides have been described in this chapter. Which one is most appropriate for use in your country? Explain your answer.

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# CHAPTER 15

# NUTRITION EDUCATION

*Jane Sherman and Ellen Muehlhoff*

## *Outline*

- Different types of nutrition education
- Identifying nutritional needs
- Models of nutrition education
- Planning nutrition education
- Strategies in nutrition education, including health promotion
- Evaluation of nutrition education

## *Objectives*

At the completion of this chapter you should be able to:

- Recognize the various forms of and names for nutrition education
- Recognize urgent nutrition needs, both globally and locally
- Express nutrition needs in terms of food practices
- Be aware of programme choices made in tackling nutrition issues and the roles of nutrition education
- Distinguish old and new models of nutrition education
- Appreciate the importance of researching players' knowledge, attitudes, practices, and perceptions
- Discriminate different ways of formulating objectives/outcomes
- Identify learning content and build it into a course map
- Recognize and be able to advise on appropriate nutrition promotion strategies in a range of settings
- Recognize the need for education evaluation
- Distinguish between different types and levels of evaluation.


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# 1. INTRODUCTION

It is increasingly recognized that nutrition is "absolute ground zero for any serious discussion of economic and human development" (World Bank, 2009) and that spending on nutrition is highly cost-effective. Yet nutrition is the "forgotten Millennium Development Goal," and is "often unrecognized, rarely acted upon and grossly underfunded" (World Bank). From 2004 to 2007, only about 1.7% of development and emergency food aid was dedicated specifically to improving nutrition (MSF, 2009), and of this only a very small proportion went to nutrition education. Yet understanding food and nutrition is essential to enabling a community to look after its health.

Nutrition education is not quite like other learning areas, and not many people know how to "do" it. There is an urgent need to educate more nutrition educators. While the subject for the community as a whole is examined in this chapter, the topic is also covered in Chapter 7 but with a specific focus on school-age children.

Putting learning into practice is the main message of this chapter. Relevant practice activities are provided at the end of the chapter. They are referred to at the appropriate points in the text with the symbol

# 2. WHAT IS NUTRITION EDUCATION?

We have all had some kind of "nutrition education." What kinds of nutrition learning have we experienced?

## 2.1 Personal Experience: The Hidden Curriculum

**Direct experience** We learn about food and food practices from birth, simply from personal experience. This is natural, unstructured, often unconscious learning.

**Social concepts** We also learn what our community thinks, believes, and does, from families, peers, colleagues, eating places, and shops. Daily conversations about food and eating are passed from group to group, and generation to generation.

**Commercial influences** We also gain a kind of "education" from what we see in media. More money may be spent on advertising a single product than many governments spend on their entire health promotion budgets.

These learned tastes, ideas, and practices are the "hidden curriculum" of nutrition education. Whether valid, incomplete, or thoroughly mistaken, they are powerful and must be taken into account. In nutrition education we never start with a blank slate.

## 2.2 Academic Nutrition Education

Unlike our "hidden curriculum" experience, professional nutrition education for doctors, nutritionists, and health workers has a scientific knowledge base dealing with nutrient functions, food groups, how the diet should be constituted, and what happens if it is inadequate. This education may include practical components that may or may not correspond to the knowledge and skills professionally required on the job (Rogers & Schlossman, 1997).

A simplified version of this nutrition education is often found in the training for other professionals (e.g., cooks, agricultural advisers) and in short talks for the public. It aims mainly to broaden knowledge and understanding rather than to deal with immediate nutritional needs.

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## 2.3 Functional Nutrition Education

Functional nutrition education, the main concern of this chapter, is needs-based and action-oriented: it deals with what people need to know and do in order to improve their diet and become healthier. We use it to tackle urgent issues and affect how people behave and think, to "change the script of daily life." Examples are public campaigns, counselling by health workers, national dietary guidelines, and school projects on healthy eating. Functional nutrition education may stand alone or be integrated into a direct nutrition intervention, such as food fortification or community gardening. Functional nutrition education appears in a number of contexts:

**Health promotion** This World Health Organization (WHO) concept is very influential, with a holistic vision of health and the aim of increasing people's control over their own health. For health promotion to achieve its intended impact it requires that the general population have access to information and attention to independent personal development.

**IEC** This is an acronym for information, education, communication – the choice of strategies for tackling all public interest issues.

**Social marketing** and **Communication for behaviour change** (**CBC**) These approaches emphasize the need to know your audience and how to reach them and aim at actual changes in practice.

**Nutrition education** This broad concept includes all the possibilities of participation, dialogue, and self-development in health promotion, training, information, and communication.

In this chapter we use *nutrition education* as the umbrella term.

## 2.4 The Role of the Community Nutritionist in Nutrition Education

Community nutritionists are involved with many forms of nutrition education. Examples are: conducting individual or group counselling; running short courses; advising institutions, associations, and businesses; training personnel; and assisting with national campaigns and promotions or setting up local ones. Apart from their own role as educators, community nutritionists need to recognize the need for education in all nutrition-related interventions and be able to advise as to the best approaches for long-term success.


# 3. WHAT ARE THE NUTRITION NEEDS?

Priorities for action have to be identified. A *nutrition needs analysis* therefore heads up most nutrition interventions and is a preliminary step to setting up a framework for nutrition education.


## 3.1 Nutrition Needs

Most countries are experiencing serious nutrition needs, such as undernutrition, lack of micronutrients, and overweight. The main focus now is on young children. The health and nutrition status of mothers before and during pregnancy, and while breast-feeding, are therefore critical.

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Nutrition needs are presented as

- *clinical* illnesses or symptoms (e.g., anaemia) or subclinical lacks (e.g., iron deficiency), OR as
- *dietary* lacks or imbalances (e.g., insufficient vegetables and fruit), OR as
- *food practices* (e.g., poor infant feeding, inactivity).

For educational purposes, the differences in the above perspectives matter because each perspective sets up different expectations about the action required in a given situation:

- A *clinical* approach often anticipates a medical solution (e.g., take a tablet).
- A *dietary* perspective suggests that the diet should change, but not who should change it. For example, an individual's diet could be changed through food fortification or school meals.
- Emphasis on *food practices* implies that consumers themselves need to change what they do, and calls for education.

For nutrition education, the focus on practices is most useful: it generates workable, understandable targets and activities, and allows education its full role in empowering people to protect their own health. This is why practices are the focus of most public nutrition messages in posters and food-based dietary guidelines (see Chapter 14).


### 3.2 Causes of Nutrition Problems and Educational Needs

To build an education programme we also need to explore causes of nutrition problems since these also reflect needs, and because many determinants of poor nutrition have an educational dimension. Ignorance, misinformation, and poor nutrition practices are constants. New patterns of food consumption, urbanization, commercialization, climate change, and rising food prices change the context and create new educational needs. Education may also be needed at an institutional or policy level to tackle unclear nutrition policies, uncoordinated nutrition programmes, or inadequate capacity (WHO, 2007).

### 3.3 Needs Analysis: Looking at Practices

A nutrition needs analysis usually involves a literature review that is supplemented by surveys. Often the available data do not explore nutrition practices in depth. For educational purposes, therefore, questions need to be asked not only about symptoms, diseases, and diet, but also about what is done, why it is done, and what the obstacles are to doing it differently.

### 3.4 Human Stories

Nutritionists who work with real people cannot forget that statistics represent thousands of individual cases of distress and deprivation. Educators always need to humanize their data with real-life examples; collecting stories should therefore be part of their nutrition needs analysis.

## 4. HOW ARE THE NUTRITION ISSUES TACKLED?

The international community has moved to put nutrition and nutrition education back at the centre of development concerns (World Bank, 2007). Professionals in the fields of nutrition and education may be

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called on to pioneer this change by influencing the choice of strategy in programmes, policies, or projects. They should therefore have some understanding of the range of possibilities and of the advantages and limitations of each.

## 4.1 Improving the Diet Directly

Most nutrition programmes aim to improve the diet directly, generally by increasing the food supply or improving the diet. The effectiveness of food fortification, food supplementation, and deworming, for example, have all been demonstrated, although these interventions may present logistical difficulties. Food-based approaches, which aim to improve local production of foods needed to enhance the diet, make intuitive sense, although there is not yet enough evaluation of their nutritional impact (Allan & Gillespie, 2001). It appears that increasing and improving food supplies does not necessarily enhance the nutritional status of the community (World Bank, 2007).


## 4.2 Nutrition Education as a Complementary Strategy

It is becoming increasingly clear that in direct nutrition interventions, education is often essential in order to raise awareness, promote compliance, or guide dietary choices and may be critical to a successful nutritional outcome and a sustained effect (Allen & Gillespie, 2001; World Bank, 2007, 2009; WFP, 2009). Yet many direct nutrition interventions either have little or no educational component. Nutritionists need to become "education sensitive" so they can advise on educational needs or help to integrate the nutrition and education components of a programme.


## 4.3 Nutrition Education as a Main Intervention

There is much evidence that nutrition education alone can have an impact on nutritional status (Roy et al., 2007; Webb & Block, 2004; Griffiths, 1994). Nutrition learning also has long-term effects: for example, parents with nutrition knowledge are more likely to have well-nourished children, regardless of how much they spend on diet, and the nutrition knowledge of mothers correlates well with their children's height for age (Webb & Block, 2004). There have been particular successes when nutrition education is accompanied by related hands-on activities (e.g., meal preparation, food gardening, feeding and weighing babies) or when it is a main element in a multi-component package (Knai et al., 2006).


However, the value of stand-alone nutrition education has been questioned. One contextual challenge is a lack of basic food security. It is clearly futile to learn to eat well if a healthy diet is unaffordable or inaccessible, which is a widespread problem globally (see Chapter 2). The sustainability of social marketing in nutrition has been challenged on the grounds that new behaviours are fragile and can quickly disappear, and that they rely on a complex mix of motivations, circumstances, and perceptions (WHO, 2007).

It seems that the question we need to ask is not *Does nutrition education work?* but *What kind of nutrition education works?* To identify the key elements of success we need to look at the models of nutrition education that are on offer.

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# 5. MODELS OF NUTRITION EDUCATION

## 5.1 Old Models of Nutrition Education: Information Delivery and KAB

The most rudimentary (and unfortunately the most popular) form of nutrition education is "information delivery," which is simply providing information (e.g., in lectures, leaflets, or food labels), without interaction, focus on needs, or practice. This approach mistakenly assumes that simply "putting the information out there" will affect people's behaviour.

A more focused model is known as KAB, which stands for *knowledge–attitude–behaviour* (Contento et al., 1995). This approach is more interactive and needs-oriented, but the assumption is still that "new knowledge leads to attitude change, which, in turn, leads to behaviour change" – that is, that knowledge is enough in itself to change eating habits.

The compelling evidence, however, is that knowledge and awareness alone do not lead to changes in practice (Contento et al., 1995), not even in optimal circumstances. The following are some reasons for this:

- It is hard to change a long-established habit.
- It is especially hard to change a habit that is shared and approved by one's group and society.
- People need to believe that a change really matters and can bring rewards in order to make that change.
- People often need someone to either lead them or to give encouragement/praise.
- People need to see what they need to do as well as when and how to do it.
- A change needs to be easy, convenient, and, if possible, enjoyable and profitable.
- Any strong temptations to do the opposite of what's needed to make a positive change must be avoided.
- People need to be ready to make a change. In other words, the change should fit with what they are already thinking.
- People need to try out new behaviours, and keep trying.
- People need to believe they can do make a change and maintain new habits.

## 5.2 The New Model of Nutrition Education

To change behaviour, we must actually address behaviour, not just knowledge and attitudes (Contento et al., 1995). The pendulum has therefore swung towards models of behaviour change, drawing on a range of educational theories. (For summaries, see Contento, 2015; Boyle & Holben, 2006; Stuart & Achterberg, 1997; and Rodrigo & Aranceta, 2001.)

### *5.2.1 How is behaviour learnt?*

Some relevant fields of learning theory are skills learning, behaviour change theory, social learning theory, and learner-centred approaches. Below is a brief overview of each.

*Skills learning.* The skills learning model has been proposed as a basis for health education (WHO, 2003; Hawes, 2003). New skills may be routines (e.g., handwashing), practical skills (e.g., new cooking methods), cognitive skills (e.g., analyzing diet, classifying foods), or life skills (e.g., involving others, planning). Such models build the actions involved in changing practices into a workable learning process.

Skills are acquired through various actions, such as the following:

- Observing existing practices, (one's own and others')
- Observing models of target performance, in demonstrations, peer behaviour, drama/stories, or role models
- Identifying the shortfall in existing practices
- Preparing for action, including looking for ways and means and identifying obstacles
- Repeated practice, feedback, and reinforcement; Advocates of experiential learning also recommend that after practice a form of "reflection on performance" should take place, such as a discussion or self-evaluation.
- Incremental learning (bit by bit), a general principle of skills learning

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- Maintaining new skills/habits; This is the acid test of successful skills learning and the final stage of most models of behaviour change (Rutter & Quine, 2002).
- Sharing learning and passing it on to others (e.g., peers, families, colleagues, the media); This reinforces learning and builds conviction while also disseminating information. This practice is endorsed by many educational movements (e.g., collaborative learning, peer teaching, mentoring) and experiments have been successfully conducted on it with respect to nutrition education.

**ACTIVITY 9**

*Social learning theory.* The skills learning process above is tried and tested, but it pays little attention to the actors themselves or to the social and physical contexts that shape their actions. The expanded skills model for nutrition and health learning (SNE et al., 1995; WHO, 2003) calls on social learning theory (Bandura, 1977) and is more firmly "situated" in context. It considers the following:

- The existing knowledge, understanding, and attitudes of learners
- Learners' interests, aspirations, fears, concerns, and role models
- Learners' motivation, readiness, intention to act, and belief in their personal success
- Potential actors in the learners' situation, such as family, peer group, employers, and vendors
- The effects of social interaction, social challenges, and social norms, such as peer pressure, advertising influence, and gender expectations
- Contextual constraints (e.g., poverty, lack of safe water) and other obstacles to establishing new practices

*Other theories of behaviour change.* A number of models focus closely on the stages of behavioural change and what influences people to change their practices (see Rutter and Quine, 2002). The following are some influential models:

- The stages of change model (Prochaska & Di Clemente, 1986); The natural process of adopting change moves from being unaware of the need (pre-contemplation) through contemplation and preparation for change to action and then maintenance of action.
- The Health Belief Model (Janz et al., 2002); Decisions to make changes in personal behaviour are influenced by perceptions: for example, ideas of risks to health, the expectation of favourable outcomes, ideas of one's own ability to sustain changes (self-efficacy).
- The theory of planned behaviour/reasoned action (Fishbein, 2000); Many factors combine to influence the individual *intention to act* and *ability to act* – for example, situation, attitude, perceptions of norms, self-efficacy beliefs, environmental influences, and existing skills.

Such models can act as checklists for exploring motivation and deciding how to target educational efforts. They have also been absorbed into integrated models for action, such as the skills learning model noted above.

*The learner-centred approach.* This approach evolved from direct experience of the limitations of teacher-centred approaches (e.g., Schön, 1987; Kolb, 1984). It has been widely endorsed for health education (e.g., Dixey et al., 1999) and is implicit in the WHO's concept of health promotion.

Broadly put, the learner-centred approach assumes that what the learner does, experiences, and thinks is what counts. As far as possible, it puts the learning process into the hands of learners and calls on a range of life skills, that is, the talents and practices needed to manage one's life. Examples of life skills are: confidence in one's own decisions, self-monitoring, and getting support. Some such skills may need to be developed as part of a learning programme.

Participatory approaches subscribe to the learner-centred approach (for example, see sections 6.4 and 9.3). Full participation as an "overriding and conscious concern" is particularly recommended for community nutrition education (Ismail et al., 2003).

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### *5.2.2. What is the role of knowledge and understanding in the new model?*

In a behaviour-oriented approach, knowledge and understanding are not the purpose; instead, they serve the purpose. At the same time, knowledge and understanding are some of the main catalysts of action. Equally importantly, they build towards the wider long-term social goal of nutrition literacy. Nutrition-literate people can

- apply nutrition principles to their own situation and make informed decisions about food and eating habits, such as choosing healthy foods, resisting social pressures, adapting to changes in food supply and prices, and evaluating advertising;
- influence others (e.g., siblings, peers, and own children), explain diet, and set an example;
- see the implications of their food choices and eating habits for the environment; and
- protect and change the environment (FAO, 2006).

These capacities demand a coherent foundation of knowledge and understanding and the experience of applying it in a variety of circumstances. This means that nutrition education programmes must aim not only at quick fixes with need-to-know information, but also at the long-term education of the community.

### *5.2.3 A model of nutrition behaviour change*

All of the elements of skills learning (the actions people take) and behaviour change factors (what influences them) described above can be used to build a model of what people experience, whether consciously or unconsciously, when changing their nutrition practices. Figure 15.1 provides a rough model of the nutrition education recommendations laid out in this chapter, with the actors at the centre of the action. Follow the central column down to see the main process. New learning is in the left-hand column and other influences on the process are in the right-hand column. Learners need to go through the process and develop the new understanding, skills, and attitudes, while the process, to be successful, must take into account and interact with all the influences on the learners.

A model like this can be used to plan or improve nutrition learning, or to check what is being emphasized (or neglected) in other learning plans and activities.

**ACTIVITY 10**

## 5.3 The Role of the Community Nutritionist in Information Delivery

Many nutrition education interventions are still limited to information delivery. If community nutritionists are aware of the basics of and obstacles to effective nutrition education, they can play an important role in the process by assessing and discussing ongoing interventions and making suggestions for improvements. The following are some important questions to ask:

- Does the intervention focus on specific nutrition needs?
- Does the intervention aim at changing practices as well as increasing knowledge and awareness?
- Does the intervention put the process of change into the hands of the actors?
- Does the intervention explore existing practices, attitudes, knowledge, and perceptions as well as the physical and social contexts in which people make decisions and take action?
- Does the intervention recognize the difficulties of changing practices and the time required to do so?

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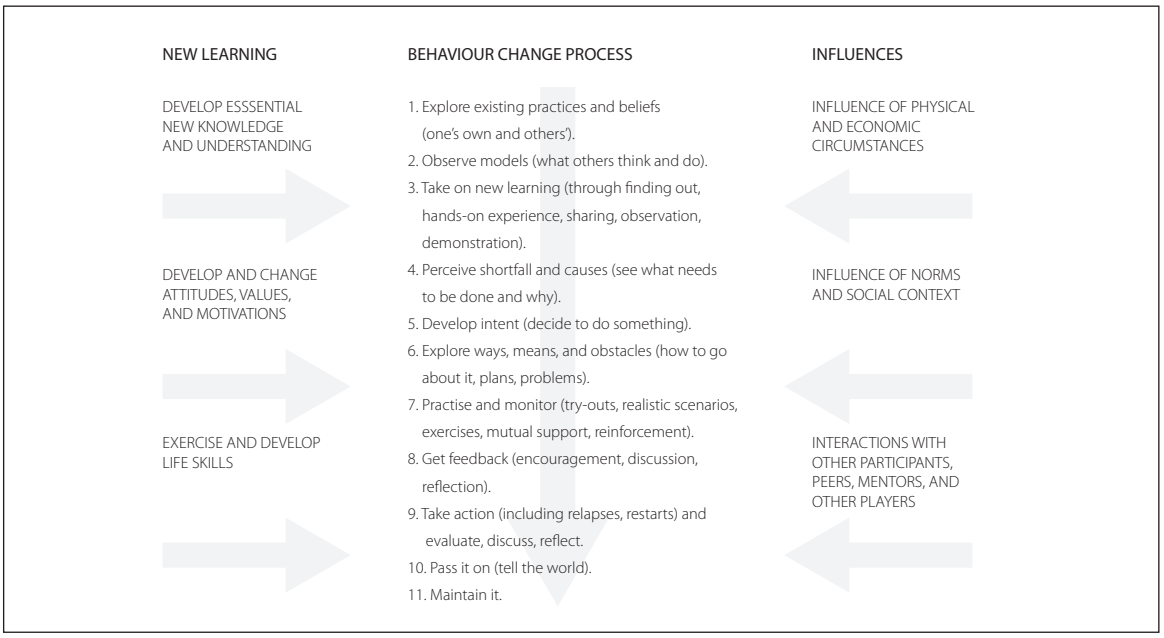


**Figure 15.1:** The process of behavioural learning in nutrition education

- Does the intervention follow the skills learning process by including practice, experimentation, sharing, and feedback?
- Does the intervention have a social dimension?
- Does the intervention reinforce learning by ensuring that it is passed on?
- Does the intervention aim at long-term nutrition literacy as well as immediate effects?
- Does the intervention operate in all the relevant dimensions of the learner's environment?

# 6. PLAYERS AND PRACTICES: KNOW YOUR COMMUNITY

A situation analysis usually begins with exploring nutrition needs (see Section 3). It should also look in depth at the main players through stakeholder analysis; knowledge, attitudes, perceptions, and practices (KAPP) enquiries; and learner profiles.

## 6.1 Who Needs to Learn?

The first question to ask when conducting a situation analysis is *Who are the learners?* Since nutrition education is often a critical part of educating the whole community, the answer is *An expanding circle*. There are four "waves" to this expanding circle:

- The primary actors are those who need to improve their practices.
- Family and social networks may also need to be addressed because they have influence and give (or withhold) support (WHO, 2001).
- The WHO (2001) also recommends addressing a third set of groups, chiefly the support network of families – community health workers, clinic staff, women's groups, church groups, community leaders. It is also important to address school contexts, the school staff, the parent-teacher association, cooks, and food vendors (FAO, 2006). The purpose of addressing these groups is to give consistent messages at all levels of the learners' environment.
- Planners and implementers too need education (FAO, 1995). Education officials, agricultural extension officers, health counsellors, materials writers, health promoters, teachers, or trainers may all need to know about nutrition and how nutrition practices are learnt.

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## 6.2 Carrying Out KAPP Enquiries

Understanding why people behave as they do is crucial to being able to influence their behaviour. This is one of the purposes of what is known as a KAPP enquiry – an assessment of **k**nowledge, **a**ttitudes, **p**erceptions, and **p**ractices. Attitudes include emotional reactions (e.g., liking vegetables, wanting to eat them), while perceptions relate to facts (e.g., thinking that water is safe if it looks clean).

In a KAPP enquiry, one observes practices and conditions, and talks to people through focus groups, interviews, and questionnaires. For example, an enquiry into the consumption of fruit and vegetables might

- observe the range of fruits and vegetables grown in food gardens and sold at local markets, and
- find out from people
  - what they know about the nutritional value of vegetables and fruit (knowledge),
  - how much they like the foods (attitudes),
  - how nutritionally valuable they think the foods are (perceptions), and
  - how often they eat the foods and why they don't eat them more often (practices).

KAPP findings help to set an educational agenda. For example, if we discover that vegetables are highly valued but not widely available, then the issues are how to provide more of them and how to get the best nutritional value for money or effort. But if we find that vegetables are seen as merely adding flavour, then education is needed to raise awareness of their value to health and show that good flavour can also mean good (and healthy) eating.

When conducting a KAPP survey, it is important to have a clear idea of both the purpose of the questions and what to do with the answers. Boyle and Holben (2006) and the FAO (2000) provide detailed guidance. Technical help with small surveys is available on the Surveymonkey website (www.SurveyMonkey.com). Sample questionnaires for the school setting are available from the FAO (2006).


## 6.3 Learner Profile

A learner profile gathers information that is closely concerned with motivation and learning modes and not directly with nutrition. It can be put together from a mini-survey, a focus group discussion, or just a brainstorming session with stakeholders. It may focus on leisure activities, worries, values, social groups, media preferences, and sources of information. Such information can, for example, be used to enhance the learning approach, link nutrition action to life goals, get the messages right, and appeal to the most influential role models. For example, children will be more interested in improving their diet if they realize that it will help them to achieve their goals, such as succeeding at school or sports.

## 6.4 Who Does the Situation Analysis?

For many situation analyses an expert team develops and administers questionnaires and collects, cleans, and analyzes the data. This approach is remote from the main actors, who may not be informed of the findings.

In the health promotion perspective, people should be involved in analyzing their own situation; this provides a basis for their own educational growth and decision-making. Participatory action research (PAR) proposes this closer involvement. A *participatory* situation analysis assumes that community members can perceive their needs and are able and willing to address them. This process has been endorsed by a standard handbook on programme evaluation by Royse and colleagues (2006) and is recommended by international agencies, such as the FAO, the World Bank, and the international development agencies of the USA, Sweden, and Denmark. For a procedural description see Havilland (2004).

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# 7. WHAT IS TO BE LEARNT?: OBJECTIVES AND CONTENT

After establishing needs and looking at practices as well as people and their problems, we can think about specific learning content. In other words. how can educational objectives best be formulated and built into a programme?

## 7.1 Establishing Action Objectives

The WHO's definition of *objectives* is "the behaviours to be influenced" (WHO, 2003); that is, the action results of learning. In this chapter, we refer to these as "action objectives."

### *7.1.1 Formulating the main action objectives*

It is useful to express the main objectives as things that the actors will do in real life, with a subject and a verb. Examples are: "Shoppers get more nutritional value for money," "Mothers give oral rehydration solution (ORS) to infants when they have diarrhoea," and "Teenagers choose healthier snacks."

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### *7.1.2 Aligned objectives*

Objectives formulated as learners' real-life actions tie in neatly with the learning activities and the evaluation, meaning objectives, activities, and evaluation will all be aligned (Biggs, 2003). To put it simply,

- the aim is for people to do X,
- the activities involve practising X and whatever it takes to achieve X, and
- in the end, people are able to do X.

### *7.1.3 Advantages and disadvantages of action objectives*

One advantage of using action objectives is that they in fact relate to people's real-life activities. Other advantages are that they tie in with nutritional guidelines, are understood by the public, and, quite literally, "practise what they preach." The results are usually measurable, so it is possible to develop precise indicators for monitoring and evaluation (for example, "50% more infants receive energy-dense weaning foods daily 2 years after the start of the programme").

One disadvantage of using action objectives is they may appear to try to manipulate behaviour. This may create unease in course developers and resistance from actors if they distrust the source of the message or resent being told what to do. Thus participation of the actors in the process of creating them is critical (see Sections 5 and 6 above).

## 7.2 What Learning Is Needed to Accomplish the Outcomes?

To achieve an action outcome, people may need various kinds of knowledge, understanding, attitudes, skills, or life skills. We can call these "subobjectives." They may emerge from observation, from a KAPP enquiry, or be identified by the actors. For example, to change to buying fortified flour, shoppers may need to

- understand the nutritional value of fortified flour,
- know whether their families need it,
- be convinced that it is worth the money,
- decide to buy it,
- be able to recognize it (know the name or what the packet looks like),
- know where to get it, and
- alert other family shoppers to the need for this kind of flour.

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Any or all of the example steps could be essential in moving from idea to action and therefore be learning targets. Equally, the absence of any of them could block the whole process. Thinking through all subobjectives in advance improves the chance of success.

**ACTIVITY 14**

## 7.3 Developing the Learning Programme

How do these elements build up into a learning programme? Conventionally, a learning programme is displayed as a classified list of items. However, a process format is better for planning purposes. Here is one way to map out a programme:

1. Decide what the main action objective is (e.g., Families should eat more fruits and vegetables.)
2. Brainstorm the subobjectives, that is, the new learning that needs to take place. For example:

    - Understand the role of fruits and vegetables in health.
    - Have direct experience of a range of fruits and vegetables.
    - Value fruits and vegetables through knowledge and experience.
    - Extend skills in preparing food.
    - Reduce obstacles to eating more fruits and vegetables.
    - Persuade self and family to act.

3. Incorporate these learning targets into the skills learning process (Section 5.2.3), working through all the stages: looking at one's practices, taking on new learning, building motivation, tackling obstacles, experimenting, passing on the experience.

From this it should become clear that there is a lot more to changing practices than just providing new information or advice.

## 7.4 Core Nutrition Knowledge

Single needs-based action objectives – such as "Mothers give infants high-energy foods" or "Shoppers buy fortified flour" – aim to move away from sterile unapplied knowledge towards specific improvements in practice. Equally important, they develop the habit of applying knowledge to practice, which is often lacking as a goal of public education.

However, experts are constantly warning against single-issue interventions in nutrition, since nutrition issues are almost never single, simple, or short-term (Ismail et al., 2003). There is a need to balance specific, urgent, behavioural targets against longer-term, more complex goals such as nutrition literacy (see Section 5 above) and the health-building understanding and attitudes that enable informed adults to tackle many-headed problems.

How can community nutritionists embed this wider goal in their programmes? First, they should have in mind a public curriculum covering major themes, such as food preservation and storage, balanced meals, food functions, and infant feeding. All action-oriented health promotion initiatives can then help to lay down a little of the broad understanding which will build an educated community. Single-issue campaigns can be supported with informative leaflets, community workers can underpin their counselling with factsheets (e.g., FAO, 2009), and sources of further information can be indicated.

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ACTIVITY 15

# 8. STRATEGIES IN NUTRITION EDUCATION

What are the best approaches to adopt in educational activities? We look first at general success strategies, then illustrate the strengths and limitations of different kinds of intervention.

## 8.1 General Strategies for Health Promotion

Reviews of nutrition education activities (e.g., FAO, 1997; WHO, 2001) have recommended a number of "meta-strategies." The summary in Box 15.1 can be used to design new programmes or to identify strong or weak points in existing programmes.

**Box 15.1:** Nutrition Education Strategies for Health Promotion

| | |
|---|---|
| **OVERALL** | |
| KAPP | Explore people's knowledge, attitudes, practices, and perceptions. |
| Players | Consult all core players (e.g., family, community groups, etc.). |
| Community | Promote participation and action in the community; Start where people are; Integrate with existing practices and build up incrementally. |
| Aim for behaviour | Work through the behaviour-learning process. |
| Participation | Put the process in the hands of the actors. |
| **IN THE ACTIVITIES** | |
| Action | Link theory and practice, with the emphasis on practice. |
| Relevance | Go for reality (or at least provide a feeling of reality): promote hands-on experience and practice. |
| Multi-strategy | Use several strategies (e.g., public messages, social networks, direct counselling). |
| Scenarios | Project situations and problems into dialogue, drama, and story. |
| Motivation | Generate status, pride, and social recognition. Link nutrition information with actors' other interests and motivations. |
| Modalities | Use several modalities (e.g., hearing, writing, talking, visuals). |
| Technologies | Use cheap available technologies (e.g., mobile phone photos, SMS). |
| **SUSTAINABILITY** | |
| Sustainable training | Work for sustainability of learning and of learning programmes. |
| Costs | Keep costs low. |
| Exit strategy | For any project, plan the exit strategy from the beginning. |
| Maintenance | Make maintenance planning part of the programme. |
| Passing it on | Create breeder effects (e.g., actors act as messengers or teachers). |

The issue of sustainability needs special attention. Food habits are hard to change because they are influenced by so many factors and constantly reinforced by them. Backsliding is therefore built into changing nutrition practices and this makes maintenance a must.

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*Sustainability of learning.* All learning needs to be reinforced. Some general reinforcing methods include multi-channel input (disseminating the information in several ways), repetition and recycling, passing on learning, and social endorsement. Some economical techniques which keep the information being disseminated are board or card games, personal and group records, regular group activities and radio programmes, labels on foods and dishes, and establishing domestic routines.

*Sustainability of educational provision.* Creating sustainable educational provision means being able to repeat the same learning experience many times, at low cost, and with no loss of quality. Too often the expertise and materials disappear along with the trainer. Recycling educational materials involves piloting and revising materials, training facilitators, making the learning available institutionally, and monitoring quality. Some options are independent learning materials, on-line access, and disseminating the information by having one group pass it to the next group (cascade training).

*Sustainability and participation.* Many sources (e.g., Ismail et al., 2003; Ndure et al., 1999) agree that for programme sustainability, participation is essential, to the extent that people take independent initiatives and establish control over decision-making. Participation in the learning process is certainly the most powerful learning device available.

## 8.2 Strategies in Action: Community Nutrition Education

### *8.2.1 Community nutrition education activities*

Regular community programmes are tailor-made for nutrition education: they have strong links with real life; staff who know the context and difficulties; access to the whole family; an interest in individual needs and difficulties; continuity; and personal interaction. They can relate to any target group and to all elements of the community; for example, schools, workplaces, health facilities, neighbourhood associations, NGOs, commercial organizations, and government agencies. Ideally, they plan their work in a cycle of needs assessment, analysis, action, and evaluation: they are therefore very well placed to handle the behaviour learning process.

Community nutrition education activities are very diverse. Here are a few examples:

- In Niger, a project used role-play, traditional theatre, and a village drama competition to promote foods rich in vitamin A (FAO, 1997).
- In Northern Ireland a cooking course aimed at disadvantaged groups. Course "graduates" became tutors in their turn (Health Promotion Agency, 2009).
- A study in Vietnam showed that nutrition education could improve calcium consumption by elderly people and reduce the risk of osteoporosis (Vu et al., 2008).
- In Ghana, the Credit with Education strategy combined microcredit with nutrition education with great success.

The choice of strategies depends on precedent, ideology, research interests, and natural appeal. The strategies can usually be strengthened by considering which elements of the learning process need reinforcement, for example: situation analysis, presentation of information, modelling, motivation, practice and implementation, feedback and support, participation, cost-effectiveness, evaluation, or maintenance (see Figure 15.1).

### *8.2.2 Complementary nutrition education*

Nutrition education has much potential when it supports direct interventions (see Section 4 above). An important task for community nutritionists is therefore to ensure that the staff of local interventions in horticulture, health and sanitation, food aid, school feeding, food safety, etc. recognize how critical education is to achieving an impact on practices. Once an education component has been established, a further challenge is to properly integrate the activities so that all players see how education and action should interact and support each other.

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### *8.2.3 Public health campaigns*

Social marketing strategies can add enhanced focus to public education campaigns (see Section 2). Their strengths are in needs analysis and stakeholder analysis, and in enhancing the quality of the message and the effectiveness of delivery. The acknowledged challenges are in implementation and sustainability. A particular problem is to balance "reach" against "impact." Some approaches reach more people while others have more impact; it is difficult to achieve both at the same time.

It has been suggested that public nutrition education should make more use of interactive communication channels and participatory approaches (Stuart & Achterberg, 1997), developing grassroots activities for clinics, health workers, schools, and other agencies; for example, displaying guidelines, demonstrating how to use them and asking clients to take them home, pin them up, and explain them to their families.

### *8.2.4 Workplace strategies*

Good food at work and related nutrition education can achieve excellent results in improving diet, increasing productivity and employee satisfaction, and reducing absenteeism (Wanjek, 2005; Steyn et al., 2009b). Workplaces therefore have much potential for improving nutrition, and are a proper target for community nutritionists' advocacy and advice. How should this be done?

1. The first step is to convince employers that providing subsidized food is worth their while.
2. The second step is to improve the quality of the food to meet workers' nutritional needs as well as appealing to their appetites; this usually involves a process of analysis, consultation, and experimentation, preferably involving employees' associations.
3. The third step is to raise awareness of the value of the improvement through educational activities (e.g., labels, displays, and demonstrations). (Wanjek, 2005)

## 8.3 Strategies and Activities in Schools

### *8.3.1 Looking at nutrition education in schools*

School nutrition education has great potential: schools have mass reach and can influence families and community, respond to both long-term and immediate needs, and complement community initiatives. They also deal in food, through school meals, snacks, vendors, and food gardens (FAO, 2005), and there is evidence that they can produce results (Steyn et al., 2009a). The United Nations has endorsed school nutrition education as a long-term measure for food security (UN, 2008), and there have been many school health movements, policies, and programmes, including FRESH and the movement for Health-Promoting Schools.

But there are also many challenges: lack of awareness, an overcrowded curriculum, untrained teachers, and classroom methodologies that favour information delivery (WHO, 2003; Hawes, 2003; UNESCO, 2000).

Community nutritionists need to establish strong links with schools and parents' associations, and work with them in promoting an approach to nutrition education that has a good chance of being successful. It should

- aim at particular dietary practices as well as at general nutrition knowledge;
- recognize that nutrition education should be promoted at home, in the community, and in the school environment, as well as in the classroom; and
- acknowledge that the learners are not only children, but also parents, teachers, school staff, and the community as a whole.

Some strategies that help are active involvement of school staff, parents and community; hands-on exposure; peer leaders; special training of teachers; multi-component interventions; and prolonged follow-up (Knai et al., 2006). If circumstances permit, schools can develop their own framework for nutrition education by working through the FAO Nutrition Education Curriculum Planning Guide (FAO, 2006).

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### *8.3.2 The school environment*

Schools should be encouraged to do the following:

- Develop a nutrition policy where healthy eating is embodied in school meals, snacks, vendors, hospitality, hygiene routines, sanitation, cooking/eating places, and the behaviour, attitudes, and training of school staff (see for example SNE et al., 2003).
- "Educationalize" all the nutrition aspects of the school environment, including direct health interventions, such as deworming (FAO, 2006).
- Give special attention to school food gardens, which can be especially effective in raising children's appreciation and consumption of fresh vegetables (Ozer, 2006; Parmer et al., 2009; FAO, 2005). This topic is discussed further in Section 4.3.3 of Chapter 7.

**ACTIVITY 16**

### *8.3.3 The family and the community*

Home is where eating practices are mainly learnt and reinforced. It makes sense, therefore, that home support increases the efficacy of school nutrition education (Rodrigo & Aranceta, 2001). It also educates families. The following are some effective strategies:

- Targeting parents as learners
- Using children as nutrition messengers (WHO, 1997; Stuart & Achterberg, 1997)
- Calling on children to teach other children (see Child-to-Child Trust home page)
- Discussing with parents how to support specific practices, and reviewing the effects at the end of the programme (FAO, 2006)
- Giving regular homework which involves families
- Ensuring that learning materials are taken home and shared.

Community members can play many roles in children's learning (Cederstrom, 2002). There are extensive possibilities for outreach (learners going into the community to observe and question) and of "inreach" (community members coming into the school to talk or demonstrate) (FAO, 2006).

## 9. EVALUATION AND CELEBRATION

Evaluating the effects of the education is important for the following reasons:

- To know if education works and if the time, money, and effort have been well spent
- To get feedback to improve the education
- To achieve satisfaction and change perceptions
- To build evaluation capacity, outlook, and habits

### 9.1 What Do We Measure?

All steps of an intervention can be evaluated. Specific questions are:

**Before the intervention**

*Preparation:* Is this likely to succeed? Have we selected priorities on the basis of a situation analysis? Have we looked at the obstacles and risks?

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**During the intervention**
*Process evaluation / formative evaluation:* Are we getting anywhere? Is the intervention being implemented as was intended? If not, why not? What has interfered?

**After the intervention**
*Summative evaluation / final assessment:* What did we achieve? Could we have done better? What are the long-term effects on health and nutrition status? (Oshaug, 1998; Rodrigo & Aranceta, 2001).
In functional education, the summative evaluation is often divided into four levels (Kirkpatrick, 1994):

- Consumer satisfaction – what participants thought about content, comfort, method, etc.
- Learning – what knowledge, attitudes, and skills were learnt
- Application – what behaviour changed as a result
- Impact – what the long-term effects were

While all four are important, the last is clearly the most significant but is not easy to achieve. Satisfaction may not reflect learning; learning may not lead to application; long-term impact may be blocked by many factors. The only way to be sure of the effects and to throw light on the process is to mark out and check *all* the milestones: for example that mothers understand about oral rehydration solution (ORS) and remember the information; that they actually give ORS when needed and make it correctly; that children recover more quickly; and, ultimately, that fewer infants die from diarrhoeal infections.

The following are frequent errors in evaluating nutrition education outcomes:

- Evaluating only by learner satisfaction
- Evaluating only by coverage or level of activity, such as the number of people/groups reached, subjects dealt with, or activities carried out
- Evaluating only by knowledge gains, which often do not translate into action
- Not evaluating for sustained impact (the critical outcome)
- Not evaluating by cost: many successful pilot interventions are never scaled up because the resources required cannot be obtained

**ACTIVITY 17**

## 9.2 How Are Evaluations Conducted?

Advice on evaluating nutrition education interventions is available in a number of manuals (e.g., FNS, 2005; Hersey & Daugherty, 1999). This issue is also discussed in Chapter 18. The basic process is the same as for any kind of project evaluation and consists of the following steps:

- Establishing the objectives
- Planning the form of the evaluation, what to measure, the scale and budget, the instruments, timing and staging, the analysis, the dissemination and use of the findings
- Establishing baseline data, based on the objectives and KAPP data
- Establishing benchmarks to monitor progress, quantitative or qualitative
- Formative evaluation during the intervention
- Measuring outcomes and impact, in comparison with baseline data
- Disseminating and using the findings

### *9.2.1 Evaluation instruments*

The following are types of evaluation instruments for use in nutrition education:

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- *Knowledge* can be measured in various ways, such as through oral or written questions and answers, practical exercises or actions (e.g., selecting foods), and comprehension exercises (e.g., reading food labels).
- *Changes in dietary behaviour* can be measured with food frequency questionnaires, food records, 24-hour dietary recalls, observations of food choices in canteens, looking at "plate waste," or by inspection of lunch boxes. (Methods for diet assessment are described in Chapter 22.)
- *Changes in related behaviour* may be a matter of record (e.g., school attendance, taking pills), observation (e.g., foods grown in gardens, handwashing), or by self-report (e.g., cooking practices).
- *Practical skills* can be assessed in demonstrations, simulations, questions about practices, or direct observation.
- *Direct assessment of subjects* such as anthropometric measurements, level of physical activity, frequency of sickness, and level of retinol in the blood.
- *Attitudes and preferences* may be measured with food preference questionnaires, Likert attitude scales, or focus group discussions. (Likert scales are used to assess people's opinions. Respondents are given statements and asked to say if they "Strongly agree," "Agree," "Neither agree or disagree," "Disagree," or "Strongly disagree." )

Evaluation instruments have various strengths and weaknesses. They must be appropriate to the respondents. For example, young children may be given pictures of faces smiling, frowning, and so on. These have to be tested for recognition, because pictures can be ambiguous and visual expression of attitudes differs from region to region. Oral interviews can be used for low-literacy adult groups. There are many pitfalls in formulating and asking questions, so all instruments should be thoroughly piloted. This is normally done by testing the instrument on a small group of subjects. The instrument can then be modified if needed.

### *9.2.2 The size of the task*

A formal evaluation that aims at statistical validity needs a strong research design, piloting of evaluation instruments, careful training of interviewers/enumerators, rigorous implementation, and immaculate data processing and analysis. The whole process must be closely overseen by the instigators, since experts in evaluation or data analysis may not be aware of particular educational or nutrition issues. This kind of evaluation is only worth doing if the purpose is clear, the process can be guaranteed, the results are worth the trouble, and the feedback is utilized.

## 9.3 Who Should Evaluate?

An expert evaluation carried out by outsiders does not generally aim to enable people to take control of their own lives. To own the process, the actors need to look at their own progress and appreciate their achievements: self-monitoring and self-evaluation are therefore built into the behaviour learning process (see Section 5). Such assessments can run in parallel with a more formal evaluation.

Participatory monitoring and evaluation (see e.g., Aubel 1999; Estrella & Gaventa, 1998) can work well for nutrition education. Most people understand the principles of monitoring and evaluation, for example as accomplished through monitoring crops, household income, or schoolwork. The real challenge is to develop an "evaluative outlook" through raised self-awareness, understanding and motivation, discussion about ways and means, schedules, mutual encouragement, and an element of display. This process may not produce reliable data for publication, but it is truly educational.

**ACTIVITY 18**

## 9.4 Celebration and Congratulations

Achievements should be celebrated and participants should congratulate themselves and each other. Everyone needs motivation. Celebration

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- raises awareness of the achievement;
- marks a point in the cycle for looking back and forward;
- is a chance to show off skills, knowledge, healthy activity, and achievement;
- spreads nutrition messages and advertises the programme; and
- reinforces learning through planning and organizing.

Delicious food, at the centre of the event, is in itself a cause for celebration. Celebrate the end of this chapter with something delicious and nutritious!

## ACTIVITIES

1. Explore the provision of nutrition education in your own country for one of the following professional groups: health counsellors, school teachers, nutritionists, trainee nurses, medical students, caterers, students of agriculture, or public health specialists. Answer the following questions with respect to the professional group you choose.
   - What proportion of their overall programme is given to nutrition?
   - What kind of nutrition education is provided?
   - What is the proportion of theory to practice?
2. Call to mind any nutrition intervention you are familiar with. Does it have an education component of any kind? If so, describe it.
3. Approaches to nutrition issues are more or less needs-based. Put the following community education topics on a scale of *need* and discuss your ranking: (a) the local history of baking, (b) washing hands when preparing food, (c) an experiment to demonstrate the presence of starch in potatoes, (d) evaluating one's own diet, (e) the micronutrient value of different kinds of meat, (f) preparing dishes rich in vitamin A, and (g) deciding what food to grow for a healthy diet.
4. Brainstorm the main nutrition needs in your country, consulting reliable reference sources if possible.
5. Identify as far as possible the published literature that would form the basis of a review of the nutrition needs of your country or community.
6. Find concrete evidence from your own experience or reading to illustrate the strengths or weaknesses of any particular nutrition intervention, including nutrition education.
7. If you know of a school feeding programme, find out what, if any, education is explicitly included, whether for children, parents, school cooks, teachers, school meal organizers, or the school as a whole.
8. If your country has a national nutrition agency, find out what educational activities are included in (a) its mission statement and (b) its regular programme activities.
9. Modelling behaviour may be positive (what to do) or negative (what not to do). It can be conducted through stories, drama, pictures, video, role-play, demonstration, personal anecdotes, real-life behaviour, or role models (people who inspire imitation). Suggest some ways to model eating and valuing vegetables in either a) a school lesson about school meals, b) group counselling for young mothers on complementary feeding, or c) a public campaign based on national dietary guidelines.
10. From your understanding of the nature of effective nutrition education, devise three questions to probe whether other nutrition professionals properly understand nutrition education.
11. Children on a large citrus farm have poor birth weight and growth. Workers and their families live on the farm. Some of the wages are paid in food. There is a general store and an infant school. Identify the main stakeholders in this situation.
12. *Problem 1:* Your aim is to promote consumption of iodine-fortified salt. A national policy exists, but a lot of cheap unfortified salt comes across the local border. Who are the main players? What information would you try to obtain before developing a strategy?

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13. *Problem 2:* Urban teenagers are buying junk food instead of a proper lunch. You wish to develop a plan to counter this problem. What KAPP information would you try to find out? Where would you look for this information? Who else would you approach?
14. Below is a community programme for mothers of young children. Reword the activities as action objectives for the mothers so that they will be easy to understand.

| **Health promoters will:** | **Mothers should:** |
|---|---|
| (a) promote exclusive breast-feeding for 6 months; | *breast-feed exclusively for 6 months; that is, mothers should not give their child any other food.* |
| (b) promote appropriate complementary feeding, starting at about 6 months, in addition to breast-feeding until 24 months; | |
| (c) promote appropriate nutrition management during and after illness; | |
| (d) foster psychosocial stimulation between caregivers and children; | |
| (e) ensure adequate vitamin A intake; and | |
| (f) promote regular use of iodized salt by all families. | |

15. The "fortified flour" subobjectives (section 7.2) have different aims: understanding, knowledge, attitude, skill, life skill, or action. Decide what each one aims at.
16. Some items in a public nutrition education curriculum should be: recognizing food that has begun to spoil, avoiding food poisoning, and knowing how to preserve food. The knowledge base for these actions includes a broad understanding of bacteria. What do the public need to know about bacteria?
17. A national school lunch programme has the following objectives: (1) manage a nutritious lunch for every student every day, (2) reduce malnutrition, and (3) provide free lunch for poor students. How could the programme promote nutrition *learning* as well as improving nutrition *status*?
18. The following are examples of insufficient evaluation measures:
    - In nutrition training for cooks, the final test is a 40-point knowledge questionnaire.
    - A mass-media nutrition campaign is assessed by public recognition of the logo, recall of the messages, and understanding of the concepts promoted.
    - A programme includes the objective of getting children to eat more fruit. Children are taught about the value of fruit. Afterwards they are asked what they remember, and teachers report whether children enjoyed the lessons.

Suggest how these could be extended to reflect the presumed action objectives.

18. A campaign is designed to encourage mothers to add pounded groundnuts or red palm oil to infant-weaning foods. Suggest a simple, memorable way mothers could monitor their daily practice and evaluate it after a month. Assume minimal resources and facilities, low literacy, and no previous monitoring experience.

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# PART 5

## KEY COMPONENTS OF COMMUNITY-BASED NUTRITION PROGRAMMES

# CHAPTER 16

# PLANNING OF NUTRITION PROGRAMMES

## An Outline

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### *Outline*

- Programme planning models
- Carrying out a needs assessment
- Formulation of a problem statement
- Defining programme goals and objectives
- Choosing an intervention
- Developing a management system
- Implementation of the programme
- Monitoring and evaluation

### *Objectives*

At the completion of this chapter you should be able to:

- Briefly describe models for planning community-based nutrition programmes (CNPs)
- List steps for planning a CNP
- Understand and perform a community needs assessment
- Formulate a problem statement
- Distinguish between programme goals and objectives
- Identify and select community health interventions
- Describe a programme management system
- Describe programme implementation
- Develop a monitoring and evaluation plan


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## 1. THE PROBLEM OF UNDERNUTRITION

Roughly one billion of the world's people are undernourished. The global problem of food insecurity – its origins and its scope – is discussed in Chapter 2. Although both the immediate and the underlying causes of this phenomenon vary from region to region, improved environmental and health practices that promote the consumption of a nutritionally adequate diet will clearly help to mitigate the problem.

As part of its efforts to improve the livelihood of the world's people, following its Millennium Summit in September 2000 the United Nations formulated a series of Millennium Development Goals (MDGs). These goals were subsequently adopted by all 189 member countries, with a target date of 2015. One of the goals is to reduce by 50% (from 1990 levels) the proportion of people who suffer from hunger, poverty, or disease (United Nations, 2006). Community-based nutrition programmes (CNPs) offer one means to achieving that goal.

In such programmes, the emphasis falls on direct contact between community-based health and nutrition workers (often volunteers) and local residents, especially mothers and children. Workers may visit residents in their homes, and participants in the programme also make regular visits to a centrally located health facility. As Mason et al. (2006), point out, "The existence, training, support, and supervision of the community worker – based in the community or operating from a nearby health facility – are indispensable features of these programs." If these programmes are to be successful, however, they must be carefully planned. A well-planned programme has clearly defined objectives, and it involves all the stakeholders in the community in which it will operate.

## 2. PROGRAMME PLANNING MODELS

The design of health and nutrition programmes is usually guided by one or more psychosocial models of health behaviour, the most common of which is the precede-proceed model. These models draw in turn on a number of more general theories of human motivation and behaviour (see Table 16.1).

**Table 16.1:** Models and theories used in nutrition programming

| Models | Theories |
|---|---|
| Health Belief Model (HBM)<br>Transtheoretical Model (TTM)<br>Precede-Proceed Model | Stimulus-Response Theory (SRT)<br>Social Cognitive Theory (SCT)<br>Theory of Reasoned Action (TRA)<br>Theory of Planned Behaviour (TPB)<br>Theory of Freeing (TF)<br>Problem-Behaviour Theory (PBT) |

*Source: McKenzie et al., 2005; Glanz et al., 2008.*

Depending upon the goals of a particular nutrition programme and the cultural context in which it will be applied, more than one of the models may prove helpful, in which case features from each can combined.

Conceptual frameworks for nutrition and health must take the following into consideration:

- Who is involved in the programme
- The nutritional needs of the community
- How those needs are met
- Who is most affected by nutrition problems
- Where affected people are located
- What decisions need to be made regarding the programme
- How the success or impact of the programme will be measured

Programmes are always preceded by an assessment of a community's health needs. The sources of data for a needs assessment may include the mass media and government publications.

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## 3. CARRYING OUT A NEEDS ASSESSMENT

Boyle and Holben (2006) outline six basic steps in programme planning, which are summarized in Table 16.2. These steps will provide the framework for the discussion in this chapter.

**Table 16.2:** The six steps for programme planning

| | |
|---|---|
| Step 1 | Review the results of the community needs assessment and formulate a problem statement. |
| Step 2 | Define the goals and objectives of the programme. |
| Step 3 | Develop specific interventions, including nutrition education. |
| Step 4 | Define the management system. |
| Step 5 | Implement the programme. |
| Step 6 | Evaluate the programme. |

*Source: Adapted from material in Boyle & Holben, 2006.*

Before a community-based nutrition programme can be planned, a needs assessment must take place. The needs assessment is an exploratory phase, carried out by the programme owners or stakeholders, in which specific health and nutrition problems are identified and the relationship between those problems and the resources available to address them is assessed (Edelstein, 2010). According to Nnakwe (2009), community needs, as perceived and expressed by the people who live in the community, can provide insight into the nature, severity, and causes of a problem, as well as into possible solutions. Once needs have been identified, they must also be prioritized, as it is rarely possible to give all of them immediate attention. The following are some key factors to consider:

- The frequency with which nutritional (or nutrition-related) problems occur in the community
- The history of a particular nutritional problem
- The pervasiveness of the problem
- The severity of the problem
- Perceptions among the community of the causes of the problem
- The root causes of the problem
- The availability of local support and resources for specific interventions, that is, measures designed to address a particular nutritional problem
- Political and financial support for the intervention.

To be effective, a needs assessment must adopt a collaborative approach. This means that the process must invite the active participation of all the identifiable stakeholders in the community, including chiefs, opinion leaders, religious leaders, community-based organizations (CBOs), and relevant government organizations. Ideally, these stakeholders will be involved in decision-making at all levels. Above all, those in the target group – that is, the people at whom the programme will be directed – should not be left out of the needs assessment. Although, in practice, the degree to which community members participate in decision-making can vary (see Table 16.3), active participation leads to an increased sense of self-esteem and a sense of ownership, and it also helps to ensure that the programme will be responsive to the community's needs. In addition, a participatory approach helps to avoid a duplication of efforts by bringing all those who are attempting to find solutions to the community's health and nutrition problems into contact with each other (McKenzie et al., 2005; Ismail et al., 2003).

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**Table 16.3:** Levels of community involvement in programme planning

| Level of participation | Feature |
|---|---|
| 1. Passive | Community members are merely informed of a planned intervention or provided with information about health and nutrition. |
| 2. Consultative | The views of community members are sought, but these people have no involvement in the decision-making processes. |
| 3. Incentive-based | Community members participate because they have been promised incentives by programme managers, but they lose interest when incentives are withdrawn. |
| 4. Functional | Community members perform certain tasks in order to meet the objectives of the nutrition programme but are not involved in its development. They may play very little role in the selection of activities. |
| 5. Interactive | The community members are involved in decision-making regarding key stages of the nutrition programme, such as the planning, implementation, and evaluation. |
| 6. Self-mobilizing | Community members pursue initiatives on their own, without the involvement of project staff, and seek external assistance to support the project technically and financially. However, decisions regarding the nutrition programme are still made by programme managers. |

*Source: Ismail et al., 2005.*

## 4. FORMULATION OF A PROBLEM STATEMENT

Once a needs assessment has been completed, the first step in developing and implementing a community nutrition programme is to formulate a clear statement of the overall situation and the problem to be addressed. Problem statements are generally the result of a brainstorming session among individuals who have knowledge of the problem to be addressed. This process identifies the causal factors at work in the situation, the magnitude of the problem, seasonal variations in its prevalence or severity, the race or ethnicity of the people affected as well as their sex and age groups, and the consequences of not addressing the problem. The involvement of a range of stakeholders allows for a variety of perspectives, which makes it possible to develop a clearer and more nuanced understanding of causal elements and their interrelationships.

## 5. DEFINING PROGRAMME GOALS AND OBJECTIVES

The second step in the planning process entails defining the programme's overall goals and immediate objectives. For the purposes of this step, goals are regarded as something broader than objectives. Goals articulate the fundamental aims of programme; objectives are the smaller steps that are taken to achieve those goals.

### 5.1 Programme Goals

Programme goals are set after the needs of the community have been identified and prioritized (Bendich & Deckelbaum, 2009). Goals are general in nature and are intended to provide basic direction for a programme (McKenzie et al., 2005). A programme goal identifies a target group within the community and specifies what the programme hopes to achieve in relation to that group, and by what means. For example, a programme that seeks to decrease childhood mortality in a developing country might have the following programme goal:

> To reduce under-5 mortality [*what the programme wants to achieve*] in fishing communities in the village of Abura [*target group*] through the establishment of women's support groups [*means of achieving the goal*].

When goals are initially set, those formulating them must be careful to take into account established policies and available resources (McKenzie et al., 2005; Levinson et al., 1999).

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## 5.2 Programme Objectives

Objectives consist of clear, concise statements that show how the programme goals will be achieved. Objectives are always "SMART": **S**pecific, **M**easurable, **A**chievable, **R**ealistic, and **T**ime-bound. They explicitly state specific actions, the results of which can be measured, and indicate how the degree of success will be assessed within a specified time frame (Boyle & Holben, 2006).

According to Owen and Frankle (1986) there are two basic ways in which SMART programme objectives can be phrased:

1. "To [action verb] / [desired result] / [target population] / [time frame]."
   For example:
   a. To increase school enrolment among girls less than 10 years old by 8% by the end of 2020
   b. To recover 80% of individuals buried alive by the earthquake within seven days
2. "By [date] / [desired result] will have been accomplished."
   For example:
   a. By the end of 2020, the school enrolment of girls aged less than 10 years will be increased by 10%.
   b. By the end of seven days, 80% of individuals buried alive by the earthquake will be recovered alive.

In addition, four distinct types of objectives can be identified: those that pertain to a specific *outcome,* to the programme *processes*, to a change in the surrounding *environment,* or to a growth in *learning* (Napoles & Gericke, 2008):

1. *Outcome*: An outcome-based objective focuses on a desired change in the health or nutritional status of a particular group.
   Example: "By the end of 2020, the prevalence of stunting in pre-school children in the village of Abura will be reduced by 2.5%."
2. *Programme processes*: An objective can also concern the daily activities and tasks to be carried out during the implementation of the programme.
   Example: "By the end of 2020, at least ten community-based clinics will have been established in Abura."
3. *Environment*: An objective can seek to assess changes in the physical or social environment.
   Example: "By the end of 2020, there will be an increase of 40% in the number of local clinics in the city of Xville."
4. *Learning*: An objective can aim to evaluate changes in knowledge, skills development, and behaviour of a particular group.
   Example: "By the end of the training programme on exclusive breast-feeding, 75% of community health volunteers will be able to communicate information about the need for exclusive breast-feeding to mothers correctly."

# 6. CHOOSING AN INTERVENTION

The third step in programme planning is the selection of an appropriate intervention. Five broad categories of community health interventions can be identified: health communication, health education, health policy, health engineering, and health-related community service (McKenzie et al., 2005). These interventions can be used in a variety of health-care contexts, including nutrition programming. The five interventions tend to complement one another, and programmes generally employ some combination of them. For example, in a campaign designed to encourage people to eat more fruit, the main intervention may take the form of health education, but one will need to include some health communication strategies in order to promote the campaign within the community.

## 6.1 Community Health Interventions: Five Basic Types

### *6.1.1 Health Communication Intervention*

A health community intervention aims to heighten people's awareness of a problem, improve their

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understanding of it, and encourage them to behave responsibly. An example of a successful health communication intervention is the malaria prevention and control programme in Ghana. In this programme, government health officials go into a community and use a public address system to inform the population about how to prevent mosquito bites and stop mosquitoes from breeding, as well as explaining what to do when someone falls ill with malaria. Such interventions have also been used in HIV/AIDS control and management in Ghana.

In Gambia, the health ministry runs a programme for the integrated management of childhood illnesses. The programme has successfully used drama to convey information about how to prevent childhood malnutrition and diseases.

Health communication interventions have also been used as a means to combat iodine deficiency disorders, which constitute a significant public health problem in Ghana. Information vans with loudspeakers move through communities broadcasting messages on the use of iodized salt, and the message is reinforced by the distribution of printed material. If vans are not available, billboards can be used instead, or they can simply complement the printed material. This intervention has been employed in both rural and urban communities to encourage the use of iodized salt. It has also been used to convey information about exclusive breast-feeding, complementary feeding, and the prevention and treatment of preventable childhood infections and infestations.

### *6.1.2 Health Education Intervention*

The health education intervention is a top-down approach to health communication and usually involves seminars and training workshops for those on the frontline of nutrition and health issues in the community. The intention is to transfer knowledge to community members so that they can improve their nutrition status and behaviour. Community health education can serve to inform the participants in a programme or the community at large about the availability of nutrition services as well as to provide appropriate nutrition messages.

### *6.1.3 Nutrition Policy Intervention*

A policy is a set of principles or rules formulated by an authoritative body that is intended to guide decision-making Nutrition policies are designed to improve nutritional status and/or to reduce malnutrition. For example, in order to counter the problem of iodine deficiency disorders, the government of Ghana mandated the iodization of salt, which led to a fall in the prevalence of the disorder. The school feeding programme in Ghana (and in many other countries), which provides schoolchildren with one hot meal per day, is another such policy intervention. It is intended not only to help alleviate malnutrition but also to encourage school attendance and improve performance, as good nutrition has been shown to increase a child's attention span in class and to improve cognition. The WHO code that governs the marketing of breast-milk substitutes is yet another example of a policy intervention.

### *6.1.4 Health Engineering Intervention*

The health engineering intervention is a type of intervention that involves the modification of existing methods of food processing and preparation. The goal is to improve the nutritional value of local foodstuffs, using methods that are simple enough to be adopted by those living in the community. Diverse technologies can be employed. One example of a health engineering intervention is the enrichment of gari – a kind of flour or meal made from cassava – with palm oil, which is rich in pro-vitamin A, so as to reduce vitamin A deficiency. Another example is the fortification of maize flour with cowpeas in order to improve protein quality. These low-cost interventions have helped to address the nutritional needs of many populations in developing countries.

### *6.1.5 Health-Related Community Service Intervention*

Finally, there are interventions undertaken on the part of private organizations in order to bring health services to a community. For example, Anglo-Gold Ashanti, an international gold mining company that operates in Ghana, supports the national fight against malaria, tuberculosis, and AIDS as a matter of corporate social

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responsibility. In most communities, churches also provide health-related services to community members. For example, a church might offer free screening for malnutrition or counselling about various chronic diseases, such as diabetes, high blood pressure, or hepatitis.

## 6.2 Ranking and Selection of Interventions

The relative value of specific interventions can be assessed by awarding points based on certain criteria, such as relevance and the availability of funds. This ranking enables stakeholders to decide which interventions should be given the highest priority, as well as how best to allocate existing resources. In the example shown in Table 16.4, education on maternal nutrition was the intervention selected since it received the most points (26).

**Table 16.4:** Decision matrix for the selection of an intervention

| Criteria | Intervention | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Measures to increase yam production** | **Provision of fertilizer** | **Availability of land for farming** | **Nutrition promotion for children under 5** | **Growth monitoring for children under 5** | **Advocacy for hygiene practices** | **Education on maternal nutrition** |
| *Relevance* | 10 | 1 | 3 | 6 | 4 | 2 | 6 |
| *Availability of funds* | 2 | 1 | 5 | 7 | 7 | 4 | 10 |
| *Sustainability* | 8 | 4 | 5 | 9 | 7 | 1 | 10 |
| **Subtotal*** | **20 (3)** | **6 (7)** | **13 (5)** | **22 (2)** | **18 (4)** | **7 (6)** | **26 (1)** |
| *Feasibility* | 5 | 2 | 2 | 8 | 7 | 10 | 6 |
| *Participation of stakeholders* | 10 | 6 | 2 | 9 | 8 | 3 | 7 |
| *Availability of technical input* | 4 | 1 | 2 | 10 | 8 | 7 | 9 |
| *Community acceptability* | 10 | 9 | 4 | 5 | 5 | 1 | 8 |
| TOTAL* | **49 (3)** | **24 (6)** | **23 (7)** | **54 (2)** | **46 (4)** | **28 (5)** | **56 (1)** |

** The ranking is shown in parentheses.*

*Note: The scoring for this matrix was carried out by students in the School of Medical Sciences at the University of Cape Coast as part of a community health intervention in Okwampa, Ghana.*

# 7. CREATING A MANAGEMENT SYSTEM

Creating a management system is the fourth step in programme planning. A well-planned management system takes into consideration the objectives of the programme, the activities that will be carried out under each objective, the resources available for each activity, and the indicators that will be used to monitor and evaluate the programme (Boyle & Holben, 2006).

As part of the development of a management system, responsibilities are assigned to particular people or groups, with clear timelines for the accomplishment of individual tasks (McKenzie et al., 2005). The programme's leadership is charged with the efficient and effective management of the available resources so as to achieve maximum benefit from them. Finally, a management system must also serve to gather relevant, accurate, and timely data that can be used to improve the programme and can also aid in staff supervision.

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## 8. IMPLEMENTATION OF THE PROGRAMME

Implementation is step 5 in programme planning. A programme can be launched as soon as all the logistics have been mapped out and a management system is in place. However, it is best to phase in a programme, rather than rolling it out on a large scale at the very outset. The phase-in process begins with a pilot stage, during which relatively few individuals are involved (see Figure 16.1). This stage provides the managers of the programme with an opportunity to test the basic programme tools. The subsequent phasing in of the programme helps to ensure that the most effective use will be made of limited resources, and it also allows scope for early evaluations of the programme. Feedback at this stage can suggest needed modifications, which are more easily carried out before the programme is fully launched.

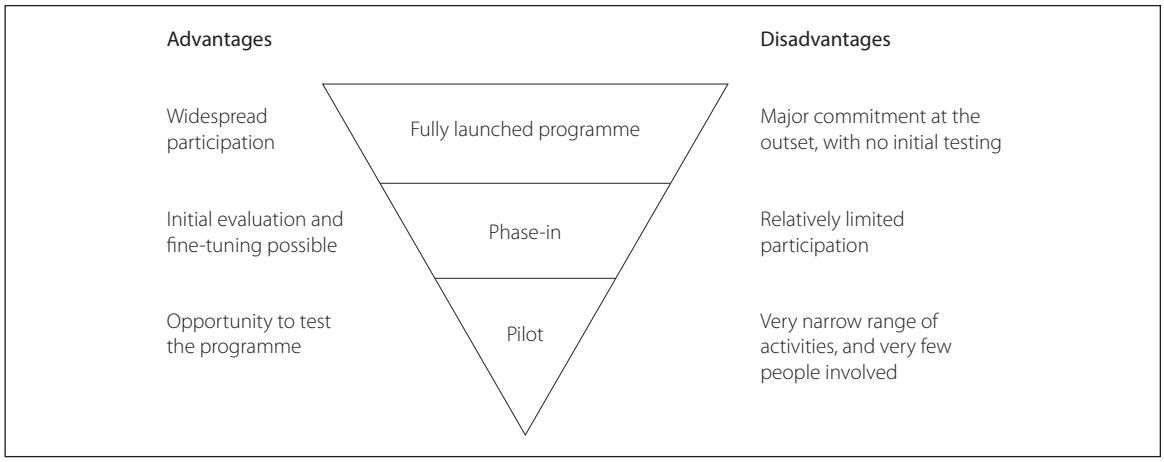


**Figure 16.1:** Phases of programme implementation.
*Source: McKenzie et al., 2005.*

As a programme is phased in, problems that arise, strategies that are tried out, and successes that are achieved can and should be continuously documented, so as to create an evolving record on which programme managers can draw. Phasing in of a programme also gives programme managers more effective control over the process of implementation. The number of participants in the programme can be gradually increased, in accordance with an implementation timetable, and if the programme is to be run at several locations, it can be started at a single site so that managers can learn from their experiences before moving on to additional sites. An excellent example of this strategy is the school feeding programme in Ghana. It was not launched simultaneously in all the selected schools. Rather, it started at a few schools in the larger towns and was then gradually expanded (McKenzie et al., 2005).

Even the most carefully planned and implemented nutrition programme will be of little value, however, if community members are unaware that it exists. Especially once a programme has been fully launched, it must also be promoted. As in almost any marketing campaign, nutrition programmes typically rely on a logo and a tag line that sums up the programme's central message – something short and catchy that will remind people about the programme. In addition, partnerships can be formed with government agencies and/or with non-governmental organizations in order to help to promote a programme, and faith-based organizations can be asked to inform or remind people about local nutrition programmes in the course of conducting their standard activities. In addition, community members themselves can be recruited to spread the word.

## 9. MONITORING AND EVALUATION

Although evaluation is listed as step 6 in programme planning, monitoring and evaluation procedures are selected at the outset of the programme, and evaluation should be an integral part of the entire programme

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process. Programme evaluation is discussed in detail in Chapter 18. Here, we provide only a brief summary of the process.

Evaluation rests on the answers to certain questions. Typical questions include:

- What are the programme activities, and how often are they carried out?
- Is the programme reaching those it is intended to help, and how many have benefitted?
- What is the level of satisfaction among participants in the programme?
- What resources are available, and how effectively are they being used?
- Is the programme staff able to handle problems and concerns?
- Is the project following the planned schedule?

Programme evaluations are generally framed in terms of inputs, processes, outputs, outcomes, and impacts. These key terms can be defined as follows:

**Inputs:** These are the goods and services available through programme activities. For example, the input could be a nutritional supplement.

**Processes**: Processes are all the activities carried out by everyone who is involved in the planning and execution of a programme.

**Outputs:** Outputs are a function of inputs: they reflect the consumption of the available goods and services. For example, the number of nutritional supplements distributed is an output, as is the number of mothers who attended education centres.

**Outcomes:** These are the immediate effects of the programme. For example, when the intake of a nutritional supplement produces an improvement in the status of the children participating in the programme, this is an outcome. The focus of an outcome is the ultimate goal or end result that the programme set out to achieve.

**Impacts:** These are determined when the programme has been completed. An impact evaluation measures the extent to which the programme's objectives have been met and can also include an assessment of the programme's overall value and sustainability.

It is important to bear in mind that certain assumptions or expectations are implicit in both the inputs and the outputs. For example, when the programme input is supplements containing iron, it is assumed that when the participants take the supplements, the nutrients will be absorbed. In the case of the corresponding output, the assumption is that when an iron-deficient person takes a supplement containing iron, that it causes the expected effect.

Valuable lessons can be learned from failures as well as from successes. Thoughtful, thorough, and objective evaluation is essential not only to the improvement of existing programmes but also to programme planning more generally. It provides the evidence on which future programmes can be built and positive outcomes achieved.

## DISCUSSION QUESTIONS AND EXERCISES

1. You are the nutritionist for a child-centred organization in Abura. Briefly describe the six key strategies you will adopt in the community for the successful implementation of an exclusive breast-feeding programme. What key elements were factored into the monitoring and evaluation plan?
2. Develop a problem statement from a nutrition situation in your community and formulate the goals and objectives of a programme designed to tackle the problem.

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# CHAPTER 17

# ACHIEVING SUCCESS IN COMMUNITY-BASED NUTRITION PROGRAMMES

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## *Outline*

- Definition of community-based nutrition programmes (CNPs)
- Efficacy, effectiveness, and impact of CNPs
- Success factors in CNPs
- Effective programme design
- CNP case studies

## *Objectives*

By the end of this chapter you should be able to:

- Describe community-based nutrition programmes
- Differentiate between community- and facility-based nutrition programmes
- Understand efficacy and effectiveness of CNPs
- Understand human rights in the context of CNPs
- Compare country experiences in CNPs
- Identify success factors in case studies of successful CNPs


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## 1. INTRODUCTION TO COMMUNITY-BASED NUTRITION PROGRAMMES

Community-based nutrition programmes (CNPs) are vitally important tools for improving the nutrition situation of the world's population, especially in developing countries. Such programmes may be have a broad goal, such as the reduction of malnutrition in children, or their aims may be specific, such as the promotion of exclusive breast-feeding for infants less than 6 months old.

Community health workers play a central role in these programmes. They may develop strategies for the attainment of programme objectives and may through their actions influence nutrition policy. A key factor in the success of CNPs is to ensure that the people living in a village have ample contact with trained community health workers. This requires a high ratio of community workers to households.

The majority of community health and nutrition programmes (CHNPs) focus on the prevention and treatment of communicable diseases and the alleviation of poverty, which is the main obstacle to good nutrition. CHNPs are especially important in areas where most people are poor as the combination of unhealthy food and other environmental factors put people at additional risk for developing chronic diseases.

Facility-based health programmes are conducted at a clinic or hospital. In contrast, CNPs generally take place in people's homes or at some central location in a village. But the two are part of the same enterprise: CNPs are frequently supported by personnel based in health facilities, who may on occasion visit people at home, while community-based health workers may refer people to health facilities. Improving nutrition, especially in poor communities, requires a combination of community- and facility-based activities. These activities may in turn be complemented by certain programmes initiated by the government. For example, food fortification may be accompanied by community- and facility-based initiatives to improve consumption of the fortified foods at the community level.

## 2. EFFICACY, EFFECTIVENESS, AND IMPACT OF COMMUNITY-BASED NUTRITION PROGRAMMES

Efficacy is "the extent to which a particular intervention, procedure, regimen, or service produces a beneficial result under controlled conditions" (Ekström et al., 2002). One example is the effect of slow potassium supplementation on hypokalaemia in severely malnourished children. Effectiveness, on the other hand, is defined as "the extent to which a specific intervention, procedure, regimen, or service, when deployed in the field, does what it is intended to do for a defined population" (Ekström et al., 2002). Thus, in contrast to efficacy, which is affected only by biology, effectiveness is influenced by both behavioural and biological factors.

Several studies have examined the efficacy and effectiveness of health and nutrition interventions in developing countries (Gwatkin et al., 1980). Prospective studies undertaken in a number of countries have shown that health interventions, with or without supplementary foods, cause children to thrive and survive better. This has been reported in Narangwal, India (Kielmann et al., 1978; Taylor et al., 1978), by the Institute for Nutrition for Central America and Panama (Delgado et al., 1982), in Jamaica (Waterlow, 1992), and in Gambia (Whitehead et al., 1976). These early studies were followed by a number of national or other large-scale programmes in several countries. Some of those were a direct follow-on, such as the World Bank Tamil Nadu Integrated Nutrition Program (TINP) (Balachander, 1993) that followed the Narangwal study (Kielmann et al., 1978) and was supported by the United States Agency for International Development (USAID). A number of overviews and analyses of these programmes have been conducted. For example, studies by Berg (1981, 1987), Shrimpton (1989), Jennings et al. (1991), Sanders (1999), Mason (2000), Allen & Gillespie (2001), and Gillespie et al. (1996) have demonstrated that interventions that are most effective in promoting child survival and growth are those which include both health and nutrition components. Those that include only a health component may be less effective (Measham & Chatterjee, 1999; Pelletier & Frongillo, 2003).

The success of a community programme is determined based on its impact on the community. Impact measurements are made by comparing results from baseline estimates with either a mid-term or that from the final assessment. This is possible if the groups are matched. Impact measurements are therefore based

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on available programme information. The most widely available indicators are mortality rates, prevalence of underweight in children, and indicators of immunization coverage rates.

# 3. SUCCESS FACTORS IN COMMUNITY-BASED NUTRITION PROGRAMMES

Success factors are those that help achieve the programme objectives. The concept of success factors has been of much practical value. Focusing on successful programmes helps identify success factors, some of which are programmatic (directly under the influence of the intervention itself), while others are contextual (Sanders, 1999). There are several factors that are related to success in CNPs including socio-political factors, physical factors, technical factors, community participation factors, and financial factors. These are examined below.

## 3.1 Socio-political Context

"Political will" and social attitudes have a major affect on nutrition programmes: both influence decisions to initiate or support particular programmes. Political will is considered to exist when governments respond positively to popular demand. This can lead to the initiation and sustainability of CNPs (Mason et al., 2006). Political support can also ensure large participation of women in the improvement of the nutritional status of their children.

## 3.2 Physical Factors and Technical Knowledge

These are broad components and fall into two groups. One group may be termed *programme hardware*; this includes buildings, equipment, transport, and other physical materials necessary for the programme implementation. The other group is *programme software*, which refers to the technical capacity of the programme personnel to design, initiate, manage, and evaluate the nutrition programme.

## 3.3 Community Participation

Gillespie et al. (1996) identified community involvement as a key feature of successful programmes. It includes full participation of community members in the assessment of community problems, analysis of the causes of the problems, and the taking of appropriate actions to deal with the problems identified. Projects that stress community participation are often those that seem to be more appropriate to community needs (Jennings et al., 1991).

An increase in community participation has been observed to influence the government's sensitivity and response to the demands of the community. Examples of such popular participation are China's mass public health campaigns in the 1950s and Nicaragua's mass immunization campaigns in the 1980s (Sanders, 1999). Gillespie et al. (1996) stated that successful CNPs tend to have had a combination of political will at the central level, middle-level district administrative support, and community-level organizational capacity.

## 3.4 Financial Support

Programmes to improve the nutrition status of a community should be accompanied by financial support; without it, the programmes are unlikely to be effectively implemented. Adequate supplies and human resources are essential to carry out activities of CNPs. Gillespie et al. (1996) found that $5 to $10 per head per year was a manageable amount in most nutrition programmes. The majority of successful programmes are externally funded. Some receive substantial amounts from the government, depending on the political will, which is also significantly shaped by government responsiveness to community demands.

# 4. EFFECTIVE PROGRAMME DESIGN

Sanders (1999) suggested that a prerequisite for any comprehensive programme is that a situational analysis

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be carried out in order to identify the prevalence and extent of the nutrition problem as well as its causes. (Note: a situational analysis is essentially the same as a needs assessment which was the term used in Chapter 16.) On this basis, the key programmatic factors can then be identified. This ensures effective programme design.

## 4.1 Developing a Conceptual Framework

A conceptual framework of the causes of the nutrition problems in a country needs to be used to guide action (see the discussion of models in section 2 of Chapter 16). A comprehensive situational analysis is likely to result in an integrated approach to solving a nutrition problem and assist in identifying sectors that need to be part of the intervention. Jonsson (1997) reported that success in implementing community-based growth monitoring and promotion in Tanzania's Iringa Nutrition Project (INP) was attributed to participation of each of the involved villages in conducting a quarterly nutrition assessment day.

## 4.2 Setting Objectives

Objectives may be based on outcome, process, or the programme itself. Processes and outcomes were discussed in section 5 of Chapter 16.

## 4.3 Programme Management

According to Sanders (1999) the key to successful implementation and management of a nutrition programme is having capable personnel. Successful programme management includes appropriate selection, training, support, and supervision of personnel during the implementation of the programme. Often workers are selected by community structures and are primarily responsible for the implementation of the programmes. This was the case with Tanzania's INP, Indonesia's UPGK (Mason et al., 2006), and Zimbabwe's CSFP (Sanders, 1993). In Tamil Nadu, selection criteria included residence in the village, as well as age and educational qualifications (Balachander, 1993). In all four of the above-mentioned programmes, selected participants were trained. Some programmes had more elaborate and longer training, including annual refresher training and orientation programmes.

In all of the above-mentioned programmes, two very important success factors were present that were related to coverage of the target populations. First, achieving high coverage of populations, which means reaching all or most of those who will benefit, is obviously crucial since much of the impact depends on individual contact. Second, reaching sufficient programme intensity, meaning resources per household, is also essential. This may be measured as households per village workers, supervision ratios, expenditure per head, and so on. It is likely that a minimum level of intensity is needed before any detectable impacts occur; resources need to be concentrated until intensity is reached such that improvement becomes significant.

Improved technology is helping programmes to become more efficient. Examples include the use of computers for calculating nutritional status and mobile phones to relay information on health and nutrition.

## 4.4 Programme Monitoring and Evaluation

All successful programmes have a built-in monitoring and evaluation system. A budget should be allocated for this component of the programme. Selected indicators should relate to the programme objectives so that the programme evaluation can determine if the programme is achieving its objectives. For example, in the Tamil Nadu and Iringa programmes (discussed in detail in section 5 below), monitoring activities were built in. For both programmes, management and information systems based on growth monitoring data were used to monitor project progress, and in the case of Iringa's INP, the data were used to inform and stimulate village-level discussion and dialogue with the government departments about progress. Another example is the Usaha Perbaikan Gizi Keluarga (UPKG) Family Business Nutrition Improvement in Indonesia (see section 5), for which a simple and standardized village-level monitoring system was developed that documented activities and progress on a monthly basis. A graphic display was utilized to encourage inter-village competition.

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### 4.5 Intersectoral Collaboration

Since multiple factors contribute to nutrition problems, several sectors need to be involved in dealing with the identified problems. Multisectoral collaboration works best when it builds on existing structures in sectors that are already implementing programmes at the community level. For example, community-level committees may work together with different sectors to solve multiple community problems. Intersectoral collaboration should ideally also include linkages to organizations and other programmes and projects which have nutrition or nutrition-related objectives. These linkages may provide useful technical support and a sharing of resources. For example, in Thailand, the health services and the religious organization at the village level were important. Effective, respected, and socially inclusive organization at the community level is a key feature for success in launching, expanding, and sustaining community health and nutrition programmes (CHNPs). Most of the successful CHNPs drew and built on established community procedures.

### 4.6 Capacity Building

To ensure the provision of quality services, capacity building should be part of the programme implementation. Capacity building needs to take place at all levels. Although most programmes provide training for programme implementers, few programmes go beyond the training received at universities and colleges. However, countries need senior nutritionists to take responsibility for leading such programmes.

### 4.7 The Human Right to Participation

Finally, a community-based nutrition programme should adopt a rights-based approach. From this perspective, community participation is not merely a tactic designed to encourage people to accept programmes that are "brought" to them by various authorities or outside experts. Rather, community members have a right, as human beings, to be active participants in programmes that affect their lives. Since community participation is often the key to successful programmes, community members should be directly involved in their planning, processes, and evaluation (Hamm, 2001; Khoza, 2004). Participation of the people concerned requires the decentralization of programming from the national or provincial level to the local level. The United Kingdom Overseas Development Institute policy paper (ODI, 1999) states that a rights-based approach requires performance standards that are best negotiated locally.

## 5. CASE STUDIES

### 5.1 Tanzania: The Iringa Nutrition Programme

The Iringa Nutrition Programme was an integrated project implemented during the 1980s in the Iringa region of Tanzania. The objective of the project was to improve nutrition and health status, which included enhancing the socio-economic situation of women. One of the important factors behind the improvement in the nutrition situation (apart from general political and economic stability) was the involvement of the Tanzanian Food and Nutrition Centre (TFNC), which comprised an interdisciplinary team consisting of economists, statisticians, agriculturalists, food technologists, chemists, doctors, nurses, nutritionists, dietitians, and health promoters. The team was involved in nutrition surveys, mother and child health, school feeding, food production, and nutrition education. These duties were carried out by the appropriate personnel. The community was strongly involved. Advocacy, information, and communication were the primary tools used for community mobilization. Management and implementation of the programme was done in such a way as to enable the expansion and strengthening of national capacity to address issues bearing on nutritional improvement at central, intermediate, and local levels.

The Triple-A Cycle approach of Assessment, Analysis, and Action is a framework that enables the analysis of the causes of malnutrition and death in any community. It also indicates the interrelationship between the various contributory factors and clarifies the objectives of actions selected for implementation. In a given context, the framework changes and become more focussed as the assessment and further analysis take place. This approach provided programme flexibility for the Iringa Nutrition Programme, and was used to explicitly express an objective for programme management and implementation.

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Responsibilities of the TFNC with respect to the Iringa programme included co-ordination of the following activities:

- Surveys or fact-finding by the Nutrition Unit
- Mother and child health with emphasis on nutrition by the Ministry of Health
- School feeding by the Department of Education
- Food production by the Department of Agriculture
- Nutrition education by the Ministries of Health and Social Welfare

An analysis of this programme revealed the following characteristics (Kavishe & Mushi, 1993):

- It was community-based, with strong community participation and management through the government and party administrative structures.
- A strong component of social mobilization through advocacy, information, and communication was present. This created widespread community concern with regard to the problem of child deaths and malnutrition.
- Active participation was sustained through good programme management.
- Management was strengthened through personnel training at all levels and through the discussion of results from the information system in the health and nutrition committees. Training was mainly in-service and was augmented by frequent supervision.
- The programme used an integrated multisectoral and multidisciplinary approach. Actions on improvement of household food security, caring capacity, health services, education, and water were carried out simultaneously by relevant sectors and non-governmental organizations (NGOs).

**Experience**: The programme was implemented in three regions and involved a multidisciplinary team from the TNFC.

**Outcome**: Programme impact was indicated mainly by the community-based ongoing nutritional status monitoring systems, and also by the results of various studies done as part of the programme activities or for the purposes of evaluation. The results show that the programme was highly successful in reducing underweight (from a prevalence of 56% at the start down to 38%; 1984–88) and increasing immunization coverage from 35% to 93% (Kavishe & Mushi, 1993).

## 5.2 Tanzania: The Child Survival and Development Programme

Based on the Iringa experience, the Child Survival and Development Programme (CSDP) was carried out in different parts of Tanzania in the late 1980s and into the 1990s. It began with an orientation for the various groups involved in the programme, such as administrative and technical staff and data-processing clerks in the districts and regions. This orientation was followed by promotion of the programme activities in the villages and social mobilization. Election of a health committee, particularly male and female village health workers, was also part of the programme. The practical activities were inaugurated by the showing of a documentary film. All children were weighed and, when necessary, immunized. Subsequently, a health day was held once a month or once a quarter for child weighing, immunizations, and so on. Other activities included setting up feeding posts, informal day care for children of mothers working in the fields, vegetable gardens, and the introduction of improved technology, such as grain mills and more fuel-efficient stoves (Kavishe & Mushi, 1993).

**Experience**: 1985–95, World Bank support. Results similar to Iringa.

**Outcome**: Underweight reduction rates similar to Iringa.

## 5.3 Bangladesh: The Bangladesh Integrated Nutrition Programme

Under the Bangladesh Integrated Nutrition Programme (BINP), the government worked hand-in-hand with

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NGOs organizations and communities to tackle malnutrition, which was affecting about 90% of children. The programme, which started in 1995, aimed at reducing the high levels of anaemia in pregnant and lactating women. The programme also involved community-based initiatives, such as family planning, improvements to the water supply, and better sanitation. The programme had both a national and a community component:

The national component included (a) national-scale nutrition activities, such as vitamin A supplementation, salt iodization, food fortification, promotion of breast-feeding, and information, education, and communication [IEC] activities for behaviour change, and (b) national-level capacity development for training, monitoring, and evaluation, and operation research.

The community component involved efforts to reduce the prevalence of anaemia and child underweight seen in most communities since 1995.

**Experience**: Governmental and NGOs managed malnutrition through already existing community-based programmes.

**Outcome**: Severe malnutrition (based on mid-upper-arm circumference) fell from over 20% to around 3% in just two years (Ismail et al., 2003).

## 5.4 Bangladesh: The Bangladesh Rural Advancement Committee

The Bangladesh Rural Advancement Committee (BRAC) has been working with rural poor people since 1972. In 1979, the BRAC began to provide credit via its 81 branches through the Rural Development Programme (RDP) (BRAC, 2004). Some of the components in which the BRAC worked include the following:

- *Orientation.* The operation started with an orientation programme through BRAC's functional education curriculum.
- *Institution building.* The functional education classes normally led to the formation of separate village organizations for men and women.
- *Training.* Different types of training were organized for the members of newly formed groups. Some of the training activities were carried out at BRAC's own training centres, while others were held in the RDP's local offices. The programme also included a paralegal aid programme to provide legal awareness to group members.
- *Credit support.* For the above activities, group members became eligible to receive credit from the RDP after approximately six months.
- Technical and logistical support.

**Experience**: Community-based health services with village health workers; the programme has had wide coverage since the 1980s, with particular focus on diarrhoea.

**Outcome**: No programme-specific data are available.

## 5.5 India: The Tamil Nadu Integrated Nutrition Programme

The integrated nutrition programme in the southern Indian province of Tamil Nadu provided an integrated approach for delivering basic services for improved child care, early stimulation and learning, health and nutrition, and water and environmental sanitation. This was targeted at young children, expectant and nursing mothers, and women's groups. The personnel consisted of nearly 300,000 trained community-based Anganwadi (health/nutrition) workers and an equal number of helpers and supporting community women groups. The programme was organized by the Anganwadi Centre, the health system, and the community. The services included: health services (immunization and referral services for health check-ups); nutrition supplementary feeding; child growth monitoring and promotion; nutrition and health education (NHED); treatment of minor illnesses; and early childhood care and pre-school education for children aged 3 to 6 years. Other support services were also integrated, such as providing safe drinking water, ensuring environmental sanitation, creating women's empowerment programmes, supporting non-formal education, and increasing adult literacy (Mason et al., 1999).

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**Experience**: Implemented from 1980 to the mid-1990s. Village programme in Tamil Nadu with World Bank support, growth monitoring, supplementary feeding programmes, and so on.

**Outcomes**: From 1979 to 1990, -1.4 percentage points per year (ppts/year) in Tamil Nadu Integrated Nutrition Project (TINP) districts, and -0.7 ppts/year in non-TINP districts. This indicates an improvement of approximately -0.7 ppts/year in underweight status as a result of the programme (Reddy et al., 1992).

## 5.6 Thailand

In the 1970s, the alleviation of nutritional problems in Thailand was embedded in a service-driven approach. This not only consumed a disproportionate share of the government budget but also restricted participation by the people and depended heavily on centralized planning. The approach failed, resulting in a paradigm shift to community-driven programmes, which were seen as investments for the health of the Thai population; nutrition was framed as part of the National Economic and Social Development Plan. The village programmes were part of the "basic minimum needs" approach, which includes consideration of housing and environment, family planning, community participation, and spiritual and ethical development (Tontisirin & Gillespie, 1999). Figure 17.1 shows the relationships between services that provide supervision and contact, with the health-care workers, referred to as "facilitators," and health/nutrition workers from the community, referred to as "mobilizers." The programme successfully linked community-based programmes and service delivery for improving maternal and child nutrition.

Mobilizers and facilitators were actively involved. A cluster of 10 to 20 households essentially depended on one or two well-respected individuals for guidance or assistance where technical support was required. Community members selected the community health nutrition volunteers or mobilizers, who were then given appropriate training. An initial training for these mobilizers focused mainly on basic theoretical and practical aspects of nutrition and health, including the importance of antenatal and post-natal care, maternal and child-care practices, birth spacing, breast-feeding, immunization, complementary feeding, and growth monitoring. Enhancing communication skills and on-the-spot refresher training and monitoring of specific activities for mobilizers were also pivotal elements of the programme's success. The major task for mobilizers was to link service delivery with communities and foster local community nutrition initiatives.

Mobilizers were mostly women equipped with leadership qualities and capable of instilling confidence in community members and encouraging them to become actively involved in the programme. In Thailand the mobilizers were part-time volunteers, whereas in other countries similar workers are paid for their services. Facilitators were paid frontline primary health-care workers, employees of NGOs, or staff from universities who provided support for and supervised and trained mobilizers. Facilitators made regular visits to the communities. The relationship between facilitators and community mobilizers determines sustainability, that is, the extent to which outside support can become catalytic and empowering rather than creating a new dependency (Tontisirin & Gillespie, 1999).

The success of the mobilizer system was accredited largely to supervision provided at all levels, especially at the community level. Supervision emphasized the need for support rather than policing, and it included on-the-spot training, problem solving, motivation, legitimization, and sharing of technical and managerial information between facilitators and mobilizers (Tontisirin & Gillespie, 1999).

**Experience:** National programme during the late 1970s; 600,000 village health volunteers were trained (1% of the population). Change made to National Economic and Social Development Plan during 1980s and 1990s, involving programme using facilitators and mobilizers to work at community level.

**Outcome:** Rapid improvement in the nutritional situation from 1980 to 1990. For example, the prevalence of underweight in children was reduced from 36% to 13%. Infant mortality rates in 1970, 1980, and 1990 were 73, 55, and 27, respectively.

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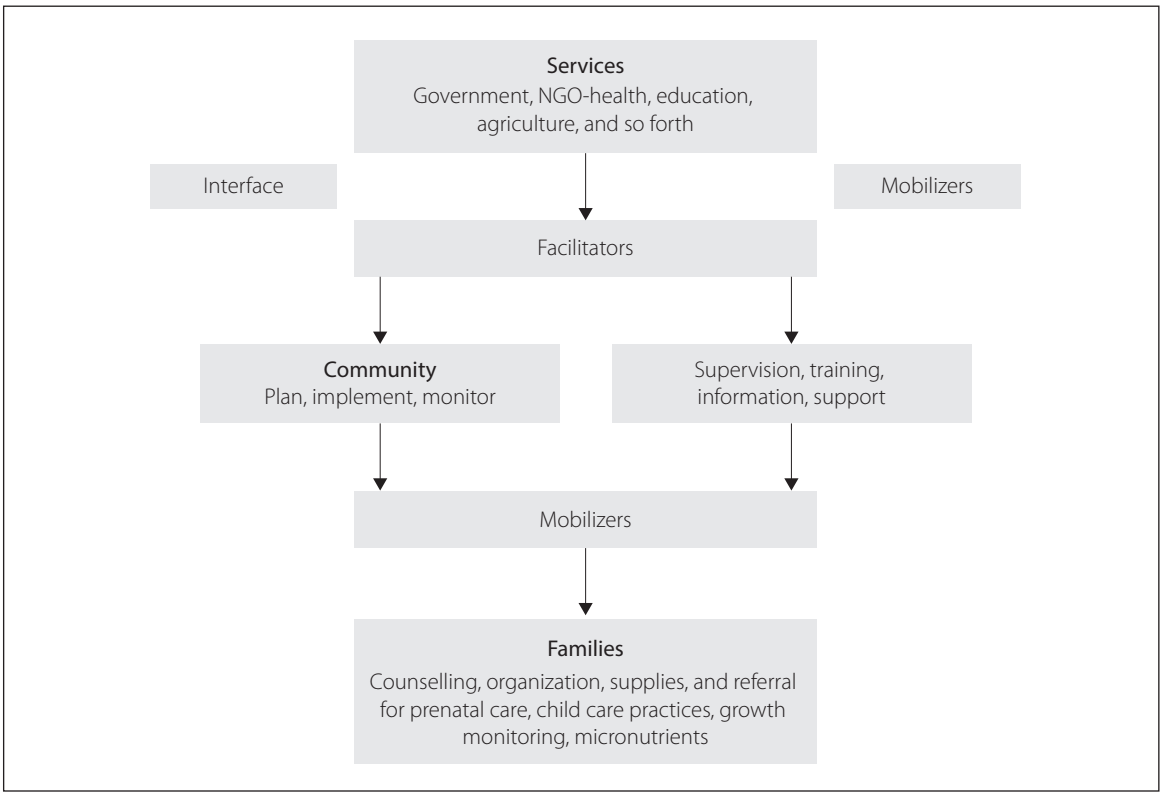


**Figure 17.1:** Overall structure for community-based programmes, based on Thailand's programme.
*Source: Tontisirin and Gillespie, 1999.*

## 6. SUMMARY OF KEY SUCCESS FACTORS

It is clear that nutritional programme success has been attained by a combination of contextual factors – notably active community involvement and sustained political support – and programmatic factors. In both Tanzania and Zimbabwe a conducive political environment, a well-developed culture of community participation, strong intersectoral collaboration, and good programme design and management ensured successful nutrition interventions.

The key programmatic factors included the appropriate selection and training of personnel from the implementation level to the management level. At the implementation level, and especially at community and household levels, a high ratio of workers to beneficiaries is required to ensure frequent contact. Support and supervision of implementers and continuous monitoring of programme processes is mandatory. The initial design of the programme is a key step, but is often neglected; neglecting this step makes it difficult to ensure that the programme is responsive to and correctly impacts the underlying causes of the identified nutrition problems – which inevitably require, in the longer term, intersectoral action. Finally, financial support is necessary to ensure programme sustainability.

## DISCUSSION QUESTIONS AND EXERCISES

1. Note the four main success factors in community-based nutrition programmes that have been identified in this chapter. Visit a community-based nutrition programme in the community where you do your practical work, then do the following.
   a. Identify success factors that have been incorporated into this programme.
   b. Summarize the sectors involved in the community-based programme you have identified.
   c. Describe the role of each sector.

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2. Imagine you are a newly employed nutrition worker who is expected to develop a community- and facility-based nutrition programme to eradicate undernutrition.
   a. Describe and illustrate each step you plan to take.
   b. Discuss the value of community participation and intersectoral involvement in community-based nutrition programmes.
3. Prepare for a role-play to sell a successful programme of your choice. Pretend you are in a market shouting for people to buy your programme because of its track record of success. Give recommendations to programme managers on how they could improve their growth monitoring and promotion activities in order to achieve the intended objectives.

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# CHAPTER 18

# THE EVALUATION OF COMMUNITY-BASED NUTRITION PROGRAMMES

*Oyediran Oyewole*

## *Outline*

- Basic approaches to programme evaluation
- Steps in the evaluation process
- The role of fieldworkers
- Possible challenges to effective evaluation
- Built-in evaluations
- Additional methods
- Evaluations as experiments
- Programme sustainability
- Ethical issues

## *Objectives*

At the completion of this chapter you should be able to:

- Define evaluation in the context of community-based nutrition programmes (CNPs)
- Explain the value of evaluation of CNPs
- Explain the types of evaluation, the procedures necessary, and the methods used for the evaluation of CNPs
- Identify the stakeholders to be involved in the evaluation of CNPs
- State the qualities of a good evaluator of CNPs
- Highlight the tools required for the evaluation of CNPs
- Examine the challenges associated with the evaluation of CNPs
- State ethical issues related to CNP evaluation
- Explain how the evaluation of a programme can be sustained

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# 1. EVALUATION: AN OVERVIEW

Although they may not call it an evaluation, people assess the value and impact of what they do whenever they ask questions, consult partners, make assessments based on feedback, and use those judgements to improve their work. When consultants, programme coordinators, principal investigators, or stakeholders conduct evaluation of a community-based nutrition programme (CNP), they seek to answer one or more of the following questions: What have we done? How well have we done it? How many people have we reached? How much have we done? How effective has the programme been? What could we do better or differently?

Numerous definitions of evaluation exist, but Green and Kreuter (1999) provide a usefully concise one: "The comparison of an object of interest against a standard of acceptability." In the case of nutrition programmes, the ultimate object of interest is the overall quality of the programme, which can be assessed by comparing the programme to others that have been deemed effective (i.e., that set the standard of acceptability). In order to be useful, however, evaluations must examine a series of more concrete components that together contribute to quality overall. The object of interest might thus be a particular intervention or method of delivery, a change in health behaviour or in the environment, or a specific measure of nutritional status (such as levels of vitamin A or infant growth rate). At the outset of the programme planning process, it is important to decide precisely how the programme will be evaluated – what the objects of interest will be and how the standards of acceptability will be defined.

A thoughtful and appropriate plan for evaluation is obviously critical to programme success. In particular, those who evaluate CNPs are always confronted with this key question: How can we state with confidence that the programme has the intended effects on the target population? This question is fundamental because the answer to it will determine whether the programme should be continued in its current form, whether certain elements need to be modified, or whether the entire programme should be cancelled and a new one designed. Part of the information needed to address this question can be obtained by evaluating project design and by analyzing all the necessary inputs that make the programme succeed. Moreover, these data can be used to screen out those projects that are unlikely to have any important effect on outcome and thus are not worth evaluating further. It is important to emphasize that decision-making is crucial to programme execution and successful programme outcome. If the decision process is technically deficient, it will affect the selection of inputs into the execution of the programme, which may lead to failure to achieve the desired goal.

We need to pose the following questions during the evaluation of a CNP:

What is evaluation of a CNP?

Why is it relevant?

What are the various types of evaluation?

How should the evaluation be conducted?

What are the necessary procedures?

Who are the stakeholders?

What are the qualities of a good evaluator?

What tools are required for evaluation?

What are the challenges associated with evaluation?

How can these challenges be overcome?

What are the ethical issues to be considered in the evaluation of a CNP?

How can the evaluation be sustained?

An important reason for incorporating evaluation activities into a nutrition programme is that the knowledge derived will help programme managers improve the quality of their intervention. At the most basic level, the monitoring of the service delivery system will help sharpen the implementation of the intervention. For example, careful monitoring of the stocks and flows of programme inputs may facilitate rationalization of the flow of supplies from warehouses to project sites, especially during the distribution of food and nutrition services in times of disaster management. This will help avoid losses due to spoilage, contamination, or

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deterioration that result when commodities and supplies are overstocked at the community level. The following are other examples of the benefits of evaluation:

1. Provide a basis for establishing food policies.
2. Determine the needs and priorities for acquisition, storage, transportation, preparation (including local enrichment), and distribution of food items, and provide nutrition education relevant to socio-cultural practices of the people.
3. Serve as a basis for planning community development programmes and strategies to meet the food needs of the concerned population.
4. Create nutrition consciousness among government, health, medical, and paraprofessional personnel, as well as lay groups.
5. Help people become aware of their peculiar nutritional needs so as to increase their involvement in solving nutritional problems.
6. Help determine a possible need for enrichment and fortification programmes.
7. Help support or explain morbidity, mortality, anthropometric, or biochemical findings.

All CNPs should be guided by a set of clear objectives, which are characterized as being specific, measureable, attainable, realistic, time-bound, and, in some instances, gender and ethnically sensitive. It is important that programme objectives are determined from the problems that the programme is intended to solve. A well-stated set of nutrition programme objectives has specific and measurable indicators; the checklist for determining effects, outcome, and/or impact will be formulated from this. It is therefore important to develop a strong evaluation tool that will provide information on what needs to be adjusted in order to have improved programme output. Unfortunately, planners of CNPs sometimes consider it unimportant to include the issue of evaluation in the design of the programme, usually because apart from change in knowledge that may be immediate, all other effects of the programme take a longer time to reflect changes. This may negatively affect the quality of the final report.

## 2. BASIC APPROACHES TO PROGRAMME EVALUATION

The following characteristics are fundamental to any well-conducted evaluation of a community-based nutrition programme, regardless of the specific approach adopted:

**Utility**: The evaluation should serve a useful purpose which needs to be made clear.

**Feasibility**: The feasibility of the evaluation should be considered, along with available local and external support and resources, as well as environmental factors.

**Propriety**: The evaluation should be socially acceptable and culturally sensitive, and it must be carried out in an ethical manner.

**Accuracy**: The evaluation method should provide technically sound and generate detailed information that is relevant to the programme objectives.

Although all evaluations should share these features, not all evaluations have the same scope. Three basic types can be identified, according to whether the evaluation focuses on effectiveness, impact, or outcome.

### 2.1 Process Evaluation (Effectiveness)

A process evaluation focuses on how the CNP is implemented and how the programme outcomes are achieved. Process evaluation is guided by these questions:

1. How good was the planning process?
2. What was the quality of the materials that were acquired for the programme implementation and evaluation?

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3. What was the level of competence of the personnel that were recruited for the programme implementation and evaluation?
4. How favourable was the environmental condition to the implementation and evaluation?
5. Is the programme being implemented as planned?
6. How is the programme achieving its objectives?
7. What activities were conducted?
8. What materials or services did participants receive?
9. What did people experience?
10. How is the coalition working?

In addition, process evaluation tracks the strengths and weaknesses of the programme and seeks to identify what parts of the programme are working and which are not.

### 2.2 Intermediate or Short-term Evaluation (Impact)

An intermediate or short-term evaluation answers questions about the short-term effects or benefits of an intervention programme, as opposed to long-term outcomes, such as weight gain or loss. It addresses the factors that are believed to precede, and that are linked to, longer-term outcomes. It focuses on questions such as: What effects did the programme have? Can the effects be clearly attributed to the programme? Were there changes in the knowledge, attitudes, beliefs, or behaviours of the programme participants as a result of the programme? Did the programme achieve its objectives?

### 2.3 Outcome Evaluation

An outcome evaluation looks at the wider effects of the programme, including social, economic, technical, and environmental effects. Outcome evaluation is long term and can address intended or unintended outcomes, be they positive or negative. Outcome studies evaluate whether the programme has made a real difference to the target group.

Outcome evaluation questions are generally related to the overall programme *goal*: For example. "What change in nutritional status occurred because of the programme? What is the current prevalence?" The evaluations often focus on what has changed; for example, reduction in child stunting, wasting, and undernutrition over a specific period of time. However, with many health programmes, the long-term goals are so distant that evaluating them may be beyond the range of the specific programme evaluation.

For an outcome evaluation, it is important to collect standard data to assess the CNP. These should include data related to the following:

- Morbidity and mortality rates at the beginning, during, and at the end of the programme may provide very useful information on the effectiveness and impact of the programme, especially when the influence of confounders is statistically accounted for during the period.
- Find the difference between the number of people registered at the beginning of the programme and the number remaining or at the end. This indicates the default rate.
- Change in weight of participants during the programme.
- Check for coverage. Ask, "How many of the target population were reached during the programme?"

An additional source of helpful information is the Program Development and Evaluation website of the University of Wisconsin–Extension (http://www.uwex.edu/ces/pdande/evaluation/index.html).

## 3. STEPS IN THE EVALUATION PROCESS

The framework shown in Figure 18.1 emphasizes six connected steps that together can be used as a starting point to tailor an evaluation of a particular public health nutrition effort, at a particular point in time. Because

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the steps are interdependent, they may be encountered in a non-linear sequence. However, an order exists for fulfilling each, because preceding steps provide the foundation for subsequent progress. Thus decisions regarding how to execute a step should not be finalized until previous steps have been thoroughly addressed.

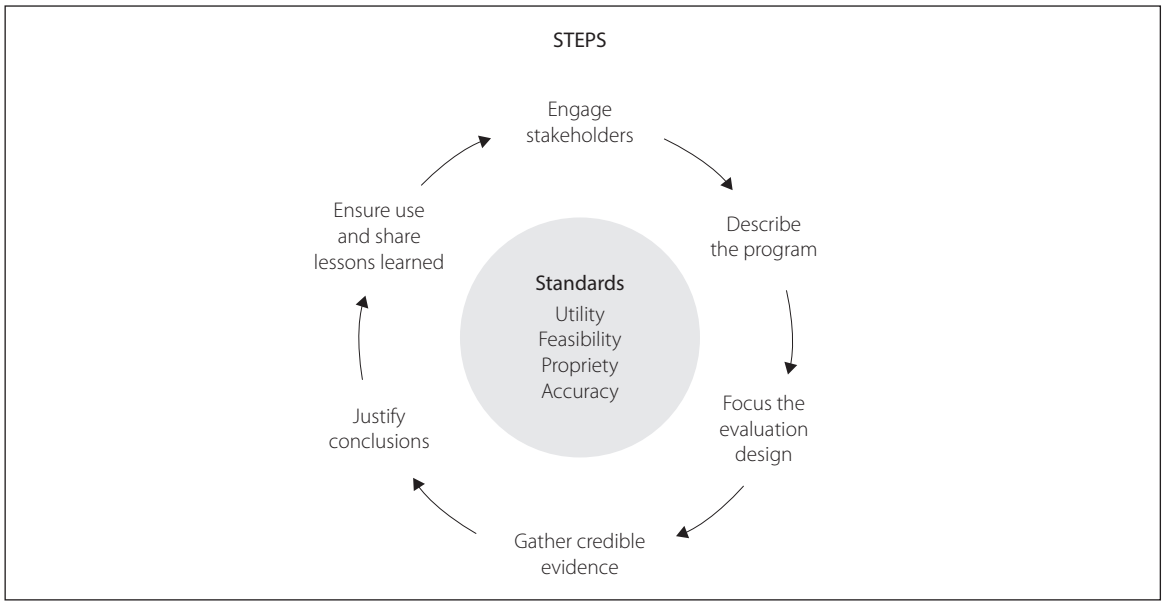


**Figure 18.1:** Evaluation framework.
*Source: Centers for Disease Control and Prevention (CDC, 1999).*

The six steps of a programme evaluation process are as follows:

1. **Engage stakeholders:** This is a process in itself, through which many voices are heard. As an initial step, it makes the benefits of the evaluation clear to all stakeholders. Completing this step helps ensure that the focus of the evaluation, and ultimately the results of the evaluation, support the needs of the stakeholders.
2. **Describe the programme:** A programme description sets the frame of reference for all future decisions about its evaluation. Programme description allows members of the evaluation group to compare the programme to similar efforts and makes it easier to figure out which parts of the programme brought about which effects. Keep in mind that different stakeholders may have different ideas about what the programme is supposed to achieve, and why. For example, in a programme to reduce undernutrition, some stakeholders may believe this means promoting food production and affordability (increased food supply can reduce prices), while others may believe it means focusing on basic hygiene practices to eliminate gastro-intestinal infections, including worm infestations. Evaluations done without agreement with respect to the programme definition aren't likely to be very useful. In many cases, the process of working with stakeholders to develop a clear and logical programme description will bring benefits long before data are available for measuring programme effectiveness.
3. **Focus the evaluation design:** To achieve a focused programme design, carry out advance planning aboutthe aim of the evaluation and what steps must be taken to meet the evaluation goals. Also consider developing a well-focused plan or strategy to improve the usefulness of the evaluation to intended audiences. Once the goal of the evaluation is determined, take the following steps to focus the evaluation design:
   a. Determine the information needs of the various stakeholders.
   b. Assess the best techniques to describe and measure the intervention programme activities.
   c. Assess what qualitative and quantitative data may be available.
   d. Determine the design method that best answers the key questions set by stakeholders.

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e. Prepare a written agreement that summarizes the evaluation procedures and specifies the roles and responsibilities of all involved.

4. **Gather credible evidence:** Through the process of gathering of credible evidence, information about the intervention is collected and synthesized for subsequent presentation. This step ensures that the benefits of evaluation – the uses of this information – are clear to all stakeholders and that the processes followed are those agreed upon by everyone.
5. **Justify conclusions:** Interpret the evaluation results and use the information to justify conclusions of the evaluation. The aim of this step is to ensure that evaluation results make sense to all stakeholders and reflect stakeholders' values about what is important. Justifying conclusions can help stakeholders consider what actions to take as a result of the evaluation.
6. **Ensure use and share lessons learned:** This step emphasizes the importance of translating results into action. Through the process of preparation, feedback, follow-up, and dissemination of the outcomes of the programme (as revealed by the evaluation), full information is provided to stakeholders. This ensures that the lessons learned from an evaluation are shared in such a way as to influence programme decisions, policy makers, and community-based initiatives (Baker et al., 2000).

After the evaluation has been completed, it is important that those who conducted it give feedback to staff and other stakeholders, preferably in the form of a face-to-face session. This allows for factual errors and misconceptions to be corrected, and for programme staff to provide further information on outcomes. It also provides an opportunity for lesson learning.

Similarly, a draft report should be circulated to those involved before the evaluation report is finalized. At some point, key stakeholders should have an opportunity to discuss and either accept or reject the findings and recommendations of the evaluation. Once the evaluation is complete, a follow-up process should be in place, in which the programme coordinator checks to see whether recommendations that were accepted have been implemented. The coordinator also needs to have a system for incorporating lessons from an institutional level into programme systems and procedures, and for disseminating lessons learnt more widely, where appropriate.

## 4. THE ROLE OF FIELDWORKERS

Evaluations customarily depend on fieldworkers, who gather the data on which evaluations are based. Fieldworkers must therefore be trained so that the data they collect will be accurate and the manner in which it was collected will be consistent. For this reason, programme managers often apply certain criteria when recruiting fieldworkers, in an effort to set a uniform standard. The following are commonly used selection criteria:

**Location:** A fieldworker who is a resident of the community and is known by members of the community is considered to be a key factor for sustainability. This promotes ownership, provides an opportunity to build indigenous capacity, and reduces the risk of attrition.

**Gender:** Some programmes mainly target women of childbearing age and therefore include a preference for female fieldworkers.

**Basic level of education:** Fieldworkers will be required to conduct a host of tasks, such as information sharing, record keeping, and sometimes community mobilization. Such tasks require certain skills and capacities that require a basic level of education.

**Overall competence:** Fieldworkers should have certain traits including honesty, communication skills, organizational skills, motivation, patience, and flexibility. These attributes must be given serious consideration with respect to finding personnel. Of course, it may not be realistic to expect all fieldworkers to possess all these traits especially where fieldworkers work voluntarily or are only paid subsistence allowance.

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# 5. POSSIBLE CHALLENGES TO EFFECTIVE EVALUATION

It is important to examine some of the challenges that may influence the evaluation of a CNP. The following are examples of such challenges:

**Goals that are too broad or are poorly defined:** Failing to define goals well at the planning stage creates a major challenge in the evaluation process. A goal that is not specific and measurable usually leads to poor evaluation.

**Differences in agendas and expectations:** During the planning process, if the agendas and expectations of different stakeholders are not focused on the same planning process and outcome, these differences will pose challenges to programme evaluation.

**Researcher not in control:** Since researchers are involved in the programme design, they are therefore of value to the evaluation process. Often, the researchers are not actively involved in the implementation of the programme. In such cases, the evaluation process will be negatively affected.

**Changing local situations:** Unforeseen circumstances can arise, such as changing environmental factors, socio-economic factors, or cultural disorientation. The occurrence of such situations can greatly challenge the evaluation process.

**Community context:** The evaluation process may also be challenged by situations arising from within the community. For instance, if the community does not support Western-style education, the members of the community may pose major challenges to documenting the evaluation process.

In addition to the challenges enumerated above, evaluators may face restrictive conditions. For example, they may be called on to evaluate the effects of a programme some years after the programme has begun. Often, they may find negligible baseline data and no control groups. In this situation, a common current practice is to collect data on programme participants, and possibly non-participants, then use statistical manipulations to investigate associations between programme delivery and outcome variables. These methods tend to be expensive and may be difficult to routinely apply in developing countries. Moreover, consideration of the questions that should be addressed before applying such methods reveals that they often turn out to be unnecessary, in that they may not provide much useful information.

Evaluation has often been viewed as a threat to programme continuity or as an expense that is hard to justify given the need to concentrate resources on service delivery. Rarely has evaluation been viewed as a tool to help learn how to achieve maximum impact of the intervention. As a result, the potential of evaluation as a means of improving project design and implementation has not yet been fully realized.

# 6. BUILT-IN EVALUATIONS: AN ALTERNATIVE APPROACH

## 6.1 The Concept and its Potential Advantages

An alternative method of evaluation is the inclusion of a system of on-going programme monitoring at designated stages during the course of the intervention. This may require the development of a checklist of simple indicators that form an integral part of the intervention. Evaluation then becomes an ongoing element of the planning and implementation of a project.

A built-in internal evaluation system conceptually merges the tasks of programme monitoring and evaluation. Data are generated throughout the chain of programme events, beginning with the cataloguing of inputs, the substantiation of the delivery of services, and, finally, measurement of nutritional outcome. This is done on a continuous basis at all project sites. Such information, to be gathered by project staff (rather than outside evaluation teams), is limited to selected key indicators of project operations and impact. The selection of data elements to be gathered and summary statistics to be computed should be based on a review of the minimal information needs of programme managers and a clear understanding of how each element and statistic will be employed in the decision-making process. A premium is placed on coverage at all project sites and on the collation and presentation of such data in simple and user-friendly formats that can be readily

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translated into action by managers. In summary, a built-in evaluation system is one that provides continuing feedback to programme planners, fieldworkers, and managers.

By building evaluation functions into an intervention, programme designers provide an incentive for fieldworkers to collect and record accurate data. All too often, programmes are initiated with a set of forms to be filled out in the field and, in some cases, transmitted to a central office. Unless they are educated, fieldworkers might not understand the necessity and purpose of the forms. Quite often, forms are not used, especially those with anthropometric data. Even when completed forms are sent to the central office, fieldworkers find that no response is forthcoming. Data collection appears to them to be a futile activity, and so they lose their motivation for accurately filling out forms. However, if a programme is initiated with a set of forms for collecting limited quantities of data and these are used actively for management at the local level, fieldworkers can quickly see a purpose in their efforts. When the data are aggregated at higher levels, with feedback given to the field-level functionaries, there is an even stronger motivation for collecting data properly.

An objection to built-in evaluation is that the costs are too high to justify the claimed benefit. This is a somewhat shortsighted view that emanates from a poor conceptual understanding of the activity. This argument would be valid if the result of using resources for data collection and analysis was that fewer resources were available for other programme activities. However, if real gains are derived from evaluation activities in terms of learning how to get more out of the resources applied to the delivery of services, the question becomes whether those gains merit the costs.

## 6.2 Characteristics of a Built-in Evaluation System

A built-in evaluation system has three components: the data, the analytic methodology, and the management support structure.

### *6.2.1. Data system*

The underpinnings of a built-in evaluation system are the data collection and recording procedures. Analytic results can be no better – no more accurate – than the data used in the computational algorithms. To be effective, a data system should include two types of indicators, namely process indicators and impact indicators. Process indicators are used to ascertain the provision of inputs, their costs, as well as the quality and consistency of the service delivery system. An example of a process indicator for a supplementary feeding programme would be the weight of the supplement distributed each month. Measures of impact are used to determine the degree to which a programme is achieving its goal. Taken together, these indicators enable one to relate project activities to impact. Traditionally, process-oriented data have been the subject of project monitoring systems but have been divorced from any attempt to explain the achievement of impact. An example of an impact (i.e., outcome) indicator for a supplementary feeding programme is the percentage of 2-year olds below 70% of a weight-for-age standard.

### *6.2.2. Analytic methodology*

Although certain analytic procedures may seem obviously useful, considerable skill is required to carry out and then properly interpret the statistical procedures used to summarize a batch of numbers. For example, it is intuitively appealing to estimate outcome by comparing the percentage of 2-year olds below 70% of the standard at two points in time. However, the experienced analyst will look at drop-outs in the intervening period (e.g., "Are the malnourished disappearing from the programme rolls faster than the well-nourished?") as well as new registrants during that period (e.g., "Were the new children entering the programme actually better off?").

An analyst must be trained to review the competing explanations for observed changes in outcome measurements – both process and impact – and to accept only those that withstand rejection. It is difficult to conceive of a data system that will systematically collect data on all possible alternative explanations in a real-life social setting. Thus, the burden of identifying the most plausible competing explanations falls on the local staff who live in the area and are aware of the changing conditions in their communities. Furthermore, a

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sense of timing must be introduced; that is, the analyst should learn to wait until trends become clear and not draw premature conclusions.

### *6.2.3. Management support structure*

To be effective, a built-in evaluation system should be supported at the local level with expertise drawn from higher levels of management. Ordinarily, an intervention is overseen by a hierarchical organizational structure. In other words, supervision of several local distribution centres is carried out by someone of a higher authority and/or greater responsibility (and often a higher educational background or more thorough training). The supervisory function provided at these higher levels is very important: first, to provide assistance to the manager of each distribution centre in the analysis of data, and second, to transfer knowledge derived at one centre to the managers of other centres.

In reviewing data collected at distribution centres, supervisors should identify centres with abnormally bad indicators or extraordinarily good ones. The former indicate that a centre needs extra help; the latter may hold the keys to success for all. However, it should be borne in mind that centres with abnormal indicators at either end of the spectrum are often those making serious errors in data collection and recording. By singling out centres performing at the extremes, supervisors can direct their efforts where they can best be used and, simultaneously, gain insight into what project components or community characteristics lend themselves to the attainment of programme objectives (Mason & Habicht, 1984).

## 7. ADDITIONAL METHODS

### 7.1 Qualitative Methods of Evaluation

Although the medical assessment of nutrition status primarily relies on quantitative data, qualitative methods used in social science research can offer an important tool for the evaluation of nutrition programmes.

Information gathered from interviews, first-hand observations, or written sources has proven to be of much value in the evaluation of CNPs. Such information may include detailed descriptions of situations, events, people, interactions, and observed behaviours, as well as people's own thoughts about their experiences, attitudes, and beliefs. Other data sources are excerpts or entire passages from correspondence, records, and case histories. In some cases, a scoring format can be developed for qualitative data to facilitate comparison. For example, in an intervention intended to improve nursing mothers' knowledge of breast-feeding, the success of the programme can be judged by assigning numerical scores to the degree of knowledge that mothers possessed at the end of the intervention (Oyewole & Amosu, 2008).

The use of both qualitative and quantitative methods can strengthen the validity of findings, if the results produced by different methods prove to be congruent and/or complement each other (Chapman & Boothroyd, 1988). Comparing the results of both qualitative and quantitative methods of assessment is often referred to as triangulation. The advantage of this approach is that the methods represent independent assessments of the same phenomenon (Green & McClintock, 1985).

Assessment of food intake practices, knowledge, and beliefs should constitute part of the evaluation of every nutrition programme. Indeed, such assessment should form the basis for initial as well as subsequent programme planning. Long-term changes in food practices require changes in knowledge, attitudes, and beliefs about food, as well as changes in food practices. Evaluation of nutrition programmes should therefore assess all of these factors.

The type of evaluation of household food consumption, knowledge, and beliefs depends upon the programme objectives. Programmes may be designed to introduce new food, to bring about one or more changes in existing production or consumption patterns, or do both. Therefore, evaluation usually requires the gathering of baseline information as the first step in initiating a programme, re-gathering of data during and upon completion of the programme, and continuous comparisons.

### 7.2 The Use of Logic Models in Evaluation

A logic model (LM) is a tool used by programme managers and coordinators to assess the effectiveness of an intervention programme. It consists of a narrative or graphical depiction of programme processes. A logic

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model illustrates a sequence of cause-and-effect relationships – in other words, it is a systems approach to communicating the path toward a desired result (Millar, 2001). Logic models link the problem (situation) to the intervention (inputs and outputs), and the impact (outcome). Further, the model helps to identify partnerships critical to enhancing the performance. A simplified version of a logic model is depicted in Table 18.2. An actual logic model would of course include a situation statement.

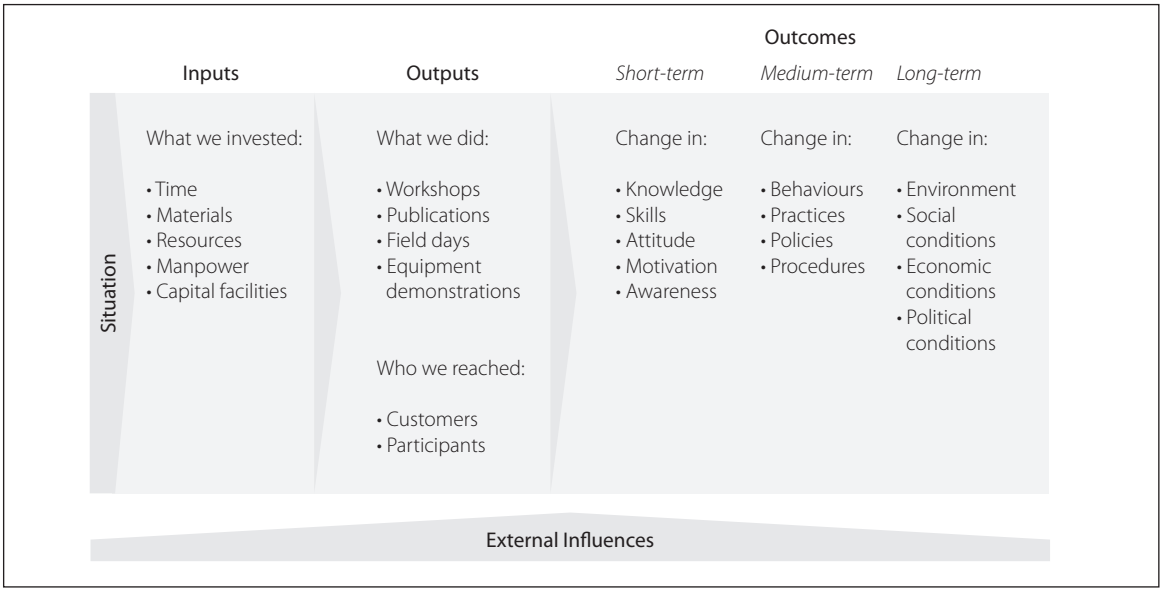


**Figure 18.2:** An evaluation plan in the form of a logic model.
*Source: Adapted from Taylor-Powell (1999).*

***Situation***. A situation statement is a description of a problem and its symptoms. The situation statement provides an opportunity to communicate the relevance of the project. It establishes a baseline for comparison at the close of a programme and provides a way to determine whether change has occurred.

***Inputs.*** Inputs include those things that we invest in a programme or that we utilize in carrying out a programme, such as knowledge, skills, or expertise of personnel. Describing the inputs needed for a programme provides an opportunity to communicate the quality of the programme.

***Outputs.*** Outputs are described as efforts expended, material resources used, and time spent providing the products, goods, and services to the programme beneficiaries. Outputs also include the people reached (e.g., informed consumers, knowledgeable decision makers). Describing outputs allows establishment of linkages between the problem (situation) and the impact of the programme (intended outcomes).

***External Influences.*** Many nutrition programmes are confronted with the issues of confounders, especially from the institutional, community, and public policies that may have either supporting or antagonistic effects on programmes. For example, at the institutional level, schools may influence healthy eating habits in a positive way by providing valuable education (Glanz & Rimer, 1995). The community also can influence eating habits either negatively (for example, through the proliferation of fast-food restaurants) or positively (for example, through the ready availability of produce via markets). Even public policies that provide support in the form of food banks that stock whatever has been donated or food stamps that allow people to acquire some items but not others could have an impact on healthy eating habits. Documenting the social, physical, political, and institutional environments that can influence outcomes helps to improve the programme planning process.

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# 8. INTERVENTIONS AS EXPERIMENTS: ADVANTAGES AND POTENTIAL DIFFICULTIES

Seasonal variations in weather, the ups and downs of the economy, or bad harvests could produce changes in nutritional impact indicators over time. Similarly, the amount of food lost due to spoilage or pilferage might vary over time and cause a change in the food supply. One task facing those conducting a programme evaluation is therefore to determine whether changes in observed indicators are the direct result of programme interventions or whether they might have other causes. For this purpose, the CNP can be conceived and designed as a form of scientific experiment.

## 8.1 The Importance of Controls

The use of controls enables a programme evaluator to decide whether observed changes in nutritional or health status can correctly be attributed to an intervention. In a laboratory setting, experimental conditions can be tightly controlled and maintained. However, communities are not laboratories. The external world is constantly changing, in ways that are beyond anyone's control. For this reason, it can be very difficult to establish and sustain reliable controls in order to ascertain the impact of an intervention. Specifically, evaluations have faltered because they have done one (or more) of the following:

- Failed to account fully for rapidly changing external factors, such as socio-economics, political considerations, and physical phenomena, which may have an even greater effect on nutritional status than the programme itself
- Wrongly assumed that interventions are applied consistently over time when, in fact, they undergo dynamic changes in the type and method of service delivery
- Ignored the natural changes that take place in the target group, such as ageing, addition, and/or attrition of participants, and spontaneous recovery of the malnourished, which, even in the absence of intervention, may result in significant population-based changes in nutritional status
- Overlooked the many problems inherent in measuring nutritional status
- Used a sample size that was too small

When circumstances preclude setting up a randomly assigned control group to be compared with a treatment group, it is possible to use statistical controls (e.g., multivariate techniques such as regression), reflexive controls (e.g., comparisons of the treatment group with itself at different points in time), or other analytical techniques to account for or minimize the effects of extraneous factors (e.g., adoption of mixed strategy using statistical controls to account for differences between the control group and the nutrition intervention group).

## 8.2 Statistical Analysis

The first consideration is whether a statistical association exists between the supposed cause (the intervention) and the outcome or effect, such as improved nutritional status. Seeking associations is useful only when one needs some level of certainty that the programme is causally related to the outcome. Showing an association requires comparison of measured outcome in at least two groups that receive different intensities of programme intervention. This may include: comparing two groups, such as control and treatment; showing correlations between different levels of programme delivery and outcome (a "dose-response relationship"); estimating regression coefficients between programme activities and outcome; and statistically controlling for confounders. Although statistical tests are performed after data collection, they must be planned in advance to ensure that the data collected are appropriate to the purpose.

## 8.3 Establishing Causality and the Problem of Confounding

It is a mistake to automatically conclude that changes observed after an intervention are a result of the intervention process. Even where impact data were available, some evaluations have failed to demonstrate nutritional or health impact, or they have produced inconclusive results. Even in the few cases where

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nutritional and health benefits have been shown, critics have hastened to point out the methodological flaws of those evaluations. This emphasizes the importance of appropriate statistical analysis to remove the effects of confounders (threats to internal validity of data) in any set of data collected. Major causes of confounding is indicated in Table 18.1. Removing the influence of confounders in data presentation gives more credibility to the results generated from a programme. However, because of weaknesses in data collection, measurement, research design, and interpretation of results, different approaches to analysis can reveal competing explanations for the observed outcomes or, in many cases, entirely different outcomes.

**Table 18.1:** Major causes of confounding (threats to internal validity)

| Causes of confounding | Example |
|---|---|
| **Selection procedure** | |
| When the assignment of subjects to treatment and comparison groups is not random, the groups may differ systematically in some characteristic(s) associated with the outcome variable. Selection bias is therefore likely to be present. Self-selection is a common source of this type of bias. | Mothers who choose to participate in a programme to reduce the incidence of low birth weight may tend to be more affluent, better educated, and more motivated than those who do not. These factors influence the outcome and compete with the programme as an explanation for an observed reduction in the incidence of low birth weight. |
| **Stages of human physiological maturation** | |
| People mature over time, and this process may cause changes in the outcome variable irrespective of programme effects. | The nutritional status of children aged 6–24 months is often poorer than that of older pre-schoolers. If the average age of participants in a nutrition programme increases from, say, 18 to 36 months, overall observed improvement may be due to maturation and might have occurred even without the programme. |
| **Records of historical events during the intervention period** | |
| When a programme is in effect, many other events may intervene and influence the outcome variable. When these historical events have different impacts on the treatment and comparison groups, they confound the programme effects. | A supplementary feeding programme is introduced in one of two areas that are otherwise equivalent when the programme begins. If food prices rise at different rates in the two areas, observed differences in nutritional status may not be caused solely by the feeding programme; the differential price rises may have influenced the outcome. |
| **Instrumentation** | |
| Error may arise from changes in the way measurements are made, in what is measured, or from measurement errors due, for example, to instrument decay. | The height for age of pre-school children is often compared across age groups. With infants from birth to 2 years old, it is usually length that is measured, but with children older than 2, height is measured. Groups with similar age are compared. |

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| **Regression artifact** | |
|---|---|
| If subjects are chosen on the basis of exhibiting an extreme value on some variable (e.g., wasting), there may be improvement over time without any intervention. This tendency is called regression toward the mean. The solution is either to observe the effect on the whole population or to make comparisons within the selected extreme group (e.g., malnourished people). | In a nutrition programme instituted for malnourished people, improvement may be shown in that some of the participants are no longer malnourished at the end of the programme. However, some improvement may not be due to the programme but to the fact that some subjects would have improved anyway. |
| **Subject dropouts** | |
| Some subjects may drop out of a programme during the course of its implementation. If these subjects have different characteristics than those who remain, any before/after effect shown may be confounded by inherent differences between people included in the populations. | A food-for-work programme may not lead to an improvement in the nutritional status of a community even if it has in fact been effective. This could happen if enough of the participants who improve leave the community in search of jobs elsewhere. In this case, the observed change underestimates the impact of the programme. |

*Source: Habicht et al., 1984.*

## 8.4 Additional Considerations

The impact of food programmes on the nutritional and health status of individuals is mediated by various characteristics of households. For example, sanitary practices in relation to food preparation and storage in the home affect morbidity. In most societies, households are a primary setting for the acquisition, preparation, distribution, and consumption of food. Therefore, household composition and organization should be regarded as an intervening or confounding condition affecting the impact of nutrition and health interventions.

The types of variables that are likely to be of greatest importance to the evaluation, and that should be included in a typical household interview, can be summarized under the following headings:

**Household composition:** The number of children and other dependants in the household in relation to the number of productive adults affects the quality of nutrition in the household.

**Household organization:** Such factors as household dynamics, gender role division, and types of family union have an influence on the evaluation process. Therefore, these aspects of family life should be considered.

**Material resources and conditions:** Poor weather conditions or a dearth of necessary materials to conduct the evaluation will have a negative effect on the evaluation process.

**Beliefs and attitudes related to food, nutrition, and health:** Poor knowledge regarding beliefs and attitudes of people in a community will not provide a holistic outcome of programme evaluation.

Care must be exercised not to assume equal food consumption among household members. If correlations are to be attempted with individual findings, individual food intake data must be obtained in addition to household consumption. Likewise, household data are not adequate for identification of vulnerable age groups, such as pre-schoolers and elderly persons.

In addition, the nutritional status of a child can be influenced by genetic endowment, maternal nutritional status, the availability of food to the family, seasonal variations in rainfall and catastrophic weather conditions, the accessibility of social services (especially health care), sanitation (e.g., sewerage, the availability of potable water), and nutrient wastage caused by such factors as infectious disease and parasitic infestations.

# 9. PROGRAMME SUSTAINABILITY

Sustainability is a recognized evaluation criterion with respect to development programmes. For instance, in order to ensure sustainability of the use of a micronutrient product by nursing mothers in a community with a high level of deficiency, the following should be considered:

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- Cost of the product
- Its continuous availability
- Level of promotion of the product
- Integration of the product into existing child-care programmes
- Periodic assessment and retraining of stakeholders and health staff
- Local production of the product
- Positive perception about the efficacy of the product

## 10. ETHICAL ISSUES IN PROGRAMME EVALUATION

Project evaluation should always be conducted in a manner consistent with ethical standards. Evaluation procedures must therefore protect the dignity of the target population and their rights. Protection of vulnerable groups, especially children, should be a top priority.

A guideline stipulating ethical issues in evaluation process focuses on the following:

**Beneficial:** The evaluation should benefit the target population and promote their interests.

**Not causing harm:** The evaluation process should in no way be prejudicial to whoever is involved in the programme.

**Justice:** The programme should consider equity and justice. All involved in the evaluation process should be treated fairly.

**Respect:** It is very important to work within the socio-cultural tenets of the target population. The rights of people should be respected in every way.

The evaluation design should include strategies to reduce the risk of any harm the programme might cause and promote the benefits. This is the main goal of ethical consideration in the evaluation of a CNP.

## 11. CONCLUSION

Programme evaluation is one of the surest means for distinguishing between effective and ineffective community-based nutrition programmes. It is a driving force for planning effective public health strategies, improving existing programmes, and demonstrating the results of the investment of resources. However, basic steps must be followed, and established procedures are vital in achieving the goals of programme evaluation. If an evaluation is not conducted in accordance with these principles, the result of such an exercise will be susceptible to negative criticism, which may lead to rejection from the funders of the programme.

Programme evaluation is essential for testing a new idea and for making comparisons. It is the driving force that permits a judgement of programme implementation and justifying a conclusion that the intervention is worthwhile. Although quite complex in nature as well as time and capital intensive, the long-term benefits in terms of reducing wastage of time and resources makes evaluation a cost-effective venture in the long run.

## DISCUSSION QUESTIONS AND EXERCISES

1. Why is it important to conduct process evaluation?
2. Who and what should be involved in a programme evaluation?
3. If evaluation results are negative, what should the next action be?
4. What are some environmental factors that may influence evaluation of a CNP?
5. How can the results of programme evaluation be authenticated?
6. What are the disadvantages associated with lack of programme evaluation?

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# PART 6

## POPULATION NUTRITION AND THE ROLE OF GOVERNMENT

# CHAPTER 19

# BARRIERS TO PROGRESS TOWARDS A HEALTHIER DIET

## The Need for Government Action

*Norman J. Temple*

### *Outline*

- Barriers to a healthy diet:
  - Energy density of food, nutritional value, and cost of dietary energy
  - Food costs and healthy diets
  - Salt content of food
  - Unhealthy oils
  - Food labels
  - Food advertising
  - Food eaten in schools
- Nutrition policy and government action
- Nutrition policies, disease prevention, and cost-effectiveness

### *Objectives*

At the completion of this chapter you should be able to:

- Explain the relationship between the energy density of food, the nutritional value of food, and the cost of dietary energy.
- Discuss the effect of the extra cost of healthy foods on the cost of a healthy diet.
- Discuss how the following factors act as barriers that impede progress towards healthier diets: the salt content of food, the use of *trans*-fatty acids and tropical oils in foods, food labels that are confusing, food advertising on TV that targets children, and the sale of unhealthy foods in schools.
- Discuss the merits of using nutrition policies implemented by governments as a way to improve the health value of the diet of the population.
- Discuss the cost-effectiveness of nutrition policies implemented by governments as a way to improve population health and prevent disease.
- Compare the cost-effectiveness of nutrition policies and that of health care (including drugs) as a means to improving population health.


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## *Abbreviations*

CDE cost of dietary energy
DALY disability-adjusted life years
ED energy density
QALY quality-adjusted life years

# 1. INTRODUCTION

This book contains a great deal of valuable information that will help community nutritionists in their work of providing education and advice to the general population. By these means, people's diets can be much improved. Explaining to people how they should eat in order to be healthy is quite easy, but actually persuading them to follow the advice is far more challenging. It is therefore important to recognize the limitations of what a community nutritionist can achieve when the tools available are mainly the spoken and written word.

In this chapter we examine how the food environment creates serious barriers to improving diets. This leads to a discussion of the importance of the implementation of nutrition policies by governments. As you will see, such an approach can both be effective and cost relatively little to implement.

# 2. BARRIERS TO A HEALTHY DIET

Several barriers stand between people and a healthy diet. Here, we examine several that community nutritionists should be aware of.

## 2.1 Energy Density of Food, Nutritional Value, and Cost of Dietary Energy

Studies conducted in developed countries have analyzed the relationship between the cost of different foods and their nutritional value (Drewnowski, 2004; Drewnowski et al., 2007). In these studies, researchers looked at food in terms of the following three key factors:

- Energy density (ED): the amount of energy per 100 grams of food
- Nutrient density: the content of micronutrients per 1000 kcal
- Cost of dietary energy (CDE): the price of food per 1000 kcal

In general, energy-dense foods (foods with a high ED) are relatively cheap sources of energy (foods with a low CDE). This includes foods such as refined cereals and foods with added sugar and fat. Unfortunately, such foods typically have a low nutrient density. The "opposite" of these foods are those with a low ED, including many foods with a high nutrient density, such as fish, lean meat, vegetables, and fruit. These generally have a high CDE.

It is important to remember that when our bodies send a signal that we are hungry, that we satisfy this hunger with energy, not micronutrients. Consider now a person who needs to buy food for a family but is poor. He or she will learn by trial and error which foods are the cheapest ones for providing the required amount of energy and therefore satisfying the appetite; far less priority will be given to the nutritional value of this food. Consequently, a low-cost diet is likely to have a high ED and a low nutrient density. Likewise, when people select a healthier diet, their food costs typically increase by about 20%.

The net result of this scenario is that low-income people are pressured to select foods and maintain a diet with a low content of several micronutrients, such as vitamin C and beta-carotene, but a high ED (Darmon & Drewnowski, 2008). Such a diet is doubly unhealthy: not only is it relatively poor in several essential micronutrients, but its high ED is also believed to be an important factor leading to spontaneous overeating and thence overweight (Rolls, 2009. These findings are especially relevant to developing countries where average incomes are much lower than in highly developed countries.

The editors of this book carried out studies in South Africa in order to better understand how food costs may pressure low-income people to consume an unhealthy diet. In one study we investigated the relationship between the CDE (cost per 1000 kcal) of foods and their ED (kcal per 100 grams) (Temple & Steyn, 2009).

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Table 19.1 summarizes the findings. We observed an extremely wide range in the CDE of foods: obtaining 100 kcal from lettuce, cucumber, and spinach costs approximately 50 to 100 times more than from oil, sugar, rice, maize meal, and margarine. The studies show that poor people simply cannot afford foods with a high CDE.

**Table 19.1:** Cost of dietary energy (CDE) and energy density (ED)

| CDE | ED | Foods |
|---|---|---|
| Low | low | maize meal, oats, lentils, rice, dry beans, spaghetti |
| | intermediate | bread |
| | high | sugar, biscuits, peanut butter, margarine, oil |
| Intermediate | low | milk, vegetables, orange juice, apples, bananas, tinned baked beans, tinned pilchards (sardines) |
| | intermediate | chicken, minced beef, eggs, jam |
| | high | cheese, sweets, chocolate |
| High | low | tuna, green leafy and raw vegetables (e.g., tomatoes, cucumber, lettuce) |

*Source: Temple & Steyn, 2009.*

Among foods with a low CDE, some have a high ED (such as biscuits, peanut butter, and oil) whereas others have a low ED (such as oats, lentils, and rice). We see the same pattern with foods of intermediate CDE: some have a high ED (such as sweets and chocolate) while others have a low ED (such as milk, vegetables, and apples). From this it follows that by carefully selecting which foods to eat, it is possible to consume a diet that has both a low cost and a relatively low ED. Moreover, many low-ED foods are also nutrient dense. However, selecting a diet that is both cheap and has a low ED requires that those who shop for food be aware of these issues and have a desire to eat a healthier diet. In reality, this is simply not realistic for the great majority of people. In practice, most people will select generous amounts of less healthy – but tasty – foods with a high ED, such as sweets, biscuits, jam, and chocolate, while having inadequate amounts of healthier foods such as oats, beans, carrots, and apples.

## 2.2 Food Costs and Healthy Diets

In our next study we looked at the cost of healthy foods and of a healthy diet in South Africa (Temple et al., 2011). We first compared the prices of six pairs of food items; each pair consisted of a commonly consumed food and a healthier version of that food. This comparison tells us the extra cost of improving the health value of the diet by making simple food substitutions. The food items were: bran flakes (in place of corn flakes), wholewheat bread (white bread), brown rice (white rice), fat-free milk (full cream milk), margarine or fat-reduced spread rich in polyunsaturated fats (brick margarine, high in saturated fat), and lean minced beef (high-fat minced beef). The healthier foods mostly cost 10% to 60% more on a per weight basis (cost per 100 grams). However, it is important to remember that healthier foods have a lower ED. As a result, when the foods prices were compared based on CDE (cost per 1000 kcal), the cost differences became expanded: the healthier foods were then between 30% and 110% more expensive.

Clearly, healthy foods cost considerably more than similar but less healthy food choices. What impact does this have on the total cost of a healthy diet? In order to determine this, we compared the cost of typical South African diets and healthier versions of these diets (Temple et al., 2011; Temple & Steyn, 2011). Our estimations reveal that the healthier diets cost about 70% more than typical diets. For a family of five people whose household income is exceeded by one third of the population, the increased food costs represent 30% of total household income. This figure could be reduced to about 10% to 15% by carefully designing the healthy diet so as to reduce the cost. For example, the diet could include more oats, lentils, dry beans, tinned

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pilchards, and tinned baked beans. However, that would require a level of motivation and dietary knowledge that most people do not have. These findings lead us to the conclusion that the healthier diet is likely to be unaffordable except for people in the top 20% or so of income levels.

Our calculations are based on food costs and incomes in South Africa, a middle-income country. The findings should only be extrapolated to other countries with much caution; factors such as local food prices, the foods selected, and income levels will have a major impact on the overall conclusions.

## 2.3 Salt Content of Food

Many foods contain excessive amounts of salt. In developed countries, around 75% to 80% of dietary salt comes from processed foods (Hooper et al., 2004), which results in an excessively high intake for most people, typically around 8 to 10 grams per day. This plays a major role in the causation of hypertension (He & MacGregor, 2013; Aburto et al., 2013) and is strongly linked to cardiovascular disease (CVD) (Aburto et al., 2013) as well as stomach cancer (WCRF/AICR, 2007).

## 2.4 Unhealthy Oils

Partially hydrogenated oils contain *trans*-fatty acids. Major foods sources include hard margarine, cakes, doughnuts, cookies, pastry, and deep-fried foods. As discussed in Chapter 12, *trans*-fatty acids significantly increase the risk of ischaemic heart disease (IHD).

Saturated fats are another kind of fat found in food that are undesirable because they are linked to IHD. Tropical oils, such as palm oil, are rich in saturated fat and are commonly used in many countries for cooking.

## 2.5 Food Labels

In Chapter 14 we discussed the problems seen with food labels used in many countries. In summary, the food composition is presented on labels in a way that is difficult for most people to comprehend.

## 2.6 Food Advertising

Many studies have been carried out in developed countries regarding food advertising that targets children. The great majority of this advertising is on TV, and 80% to 90% of it is for unhealthy food choices or for fast-food restaurants (Batada et al., 2008; Harrison & Marske, 2005). These advertisements rarely promote the consumption of fruit and vegetables. Mchiza et al. (2013) carried out a study of food advertising on both children's and adult's TV in South Africa. The pattern of advertising there was found to be similar to what is seen in Western countries.

Not surprisingly, such advertising leads to higher sales of the advertised foods (Coon & Tucker, 2002; Wiecha et al., 2006). We conclude that the effects of this may be damaging to children's health because studies reveal that children who see more food advertisements are more likely to become overweight (Chou et al., 2008).

## 2.7 Food Eaten in Schools

Most schools in North America have vending machines that allow pupils to buy foods or beverages that are energy dense but nutrient poor (i.e., "junk food") (Finkelstein et al., 2008). Temple and colleagues (2006) investigated this situation in schools in Cape Town, South Africa. They found that when adolescent pupils purchased food at school, it was mainly unhealthy items.

## 2.8 Barriers to a Healthy Diet: Comments

It is quite easy for nutritionists to give advice to the people living in their community, but it is far more challenging to persuade people to actually improve their diets. We have now reviewed various barriers that impede progress. Understanding the nature of these barriers helps nutritionists develop better action plans.

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Most of the evidence discussed above is based on research carried out in North America and parts of Europe. Some research conducted in South Africa has also been mentioned. However, every country tells its own story. It is therefore essential that community nutritionists carefully examine their local situation with respect to food prices, food advertisements, food eaten in local schools, and so forth. Based on this assessment of the local situation, the following questions need to be answered:

- What are the barriers that cause people to ignore much of the advice that community nutritionists give?
- How can community nutritionists improve their message in order to better overcome these barriers so that more people follow dietary advice?

# 3. NUTRITION POLICY AND GOVERNMENT ACTION

As a result of the barriers discussed above, there are limits on what even the most skilled and dedicated community nutritionist can accomplish. It follows, therefore, that in order to effect significant improvements in the diet consumed across a population, there must be action to overcome the various barriers. This can only be done by the implementation of nutrition policies by governments.

Policies, including government action, that are designed to improve public health have a long and highly successful history. For example, the terrible scourge of major infectious diseases, such as cholera and typhoid, was largely defeated in the industrialized countries in the nineteenth century by the provision of safe drinking water, sewage disposal, and proper hygiene. In recent decades there have been many more examples of this policy approach to the improvement of public health. One example is the banning of smoking in public places in many countries. Similarly, roads have been made safer by the criminalization of drunk driving and the mandatory use of seat belts. Such policy approaches can often achieve a major benefit at low cost.

As we shall see next, there is much evidence that nutrition policies can also deliver major health benefits at relatively low cost. The proposed interventions have been arranged in approximate order of cost-effectiveness, starting with the lowest cost. An explanation of cost-effectiveness is given later in this chapter. In Chapter 20, we describe the development and implementation of policies.

## 3.1 Reducing the Salt Content of Food

As noted above, the excessive level of salt in food is linked to hypertension and cardiovascular disease. The most effective solution to this problem is the implementation of government policy requiring that the salt content of processed foods be cut by at least half (Temple, 2011). Salt intake in most countries is typically around 8 to 10 grams per day; a reasonable goal is to reduce this to no more than 6 grams (roughly 2300 mg sodium) per day. A lower amount (1500 mg sodium) would be even better. Tests show that consumers have little problem accepting food with a much-reduced salt content (Li et al., 2009; Karanja et al., 2007). Such a policy would cost extremely little to implement and we can confidently predict that it would generate substantial health benefits (Bibbins-Domingo et al., 2010; Asaria et al., 2007).

Although, as we saw, in developed countries around 75% to 80% of dietary salt comes from processed foods, in many developing countries salt added during cooking and at the table is a major source. For that reason, an educational component of a salt-reduction strategy is needed in many countries.

## 3.2 Unhealthy Oils

A policy approach by governments is also the most effective means to reduce use of hydrogenated oils and thereby cut intake of *trans*-fatty acids. This would help reduce population risk of IHD. Denmark has implemented one such policy, while serious attempts have been made in some American cities to ban these fats from food sold in restaurants and bakeries. The cost of such a policy depends on the cost of alternative oils.

Where possible, tropical oils should be replaced by oils rich in unsaturated fats. For example, as a result of government policy, palm oil was replaced with soybean oil in Mauritius (Chapter 13). However, as discussed later, this policy is far less cost-effective than one focused on *trans*-fatty acids.

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## 3.3 Countering Excessive Intake of Alcohol

Alcohol is another important barrier to a healthy diet. It is estimated that alcohol is responsible for 3.8% of all deaths globally, about the same as the number caused by smoking (Rehm et al., 2009). However, the rates vary greatly between different regions. The most effective ways to counter this problem are to make alcohol more expensive and less available, and to ban alcohol advertising. These are highly cost-effective strategies for reducing alcohol-related harm (Anderson et al., 2009).

## 3.4 Improved Food Labels

Nutrition labels should be easy to understand. Unfortunately, as briefly mentioned earlier, food labels used in many countries are confusing. It is obviously a challenging enterprise to set up such a system in developing countries. The food labels used in each country need to be carefully designed based on local factors, such as the major nutrition-related health challenges (e.g., undernutrition or obesity), levels of education, and the types of foods sold (including packaging and whether food is sold in the street, a market, or a supermarket). A system that shows much promise has been developed in Britain and is based on traffic lights. It is described in Chapter 14. Traffic Lights labels, or some other simple system, may be especially valuable in developing countries because they are quite easy for people with a low educational or reading level to understand.

## 3.5 Nutrition Policy, Children, and Adolescents

Several important nutritional policies concern children and adolescents. An excellent place to start improving the diet is a ban on the advertising of unhealthy foods on children's TV. Such a policy has been put in place in several countries or jurisdictions (Caraher et al., 2006). Policies are also needed in the school food environment. Meals served in schools should be of high nutritional quality. Likewise, schools should be compelled to restrict the sale of unhealthy food. Allowing the sale of such food means that schools are – implicitly – conveying an educational message that is the opposite of the one stated in food guidelines. An important potential benefit of these policies is that improved dietary habits will, at least to some extent, carry over into adulthood.

There have been positive developments in recent years in the USA and other Western countries with respect to implementing policies that take the school nutrition environment in the right direction. In 2010, Abu Dhabi (part of the United Arab Emirates) declared a policy that bans unhealthy food from schools (El Shammaa, 2010).

## 3.6 Food Prices and Vouchers

Taxes and subsidies can be employed as tools to change food prices and thereby encourage healthier eating patterns. Such policy is based on price elasticity, a well-established principle in economics stating that consumption falls in response to a rise in price. This has been clearly shown for both smoking and alcohol (Anderson et al., 2009; Herttua et al., 2008; Meier & Licari, 1997). Adjusting food prices can therefore lead to a shift of eating patterns in a healthier direction (Andreyeva et al., 2010).

Studies carried out at worksites and in high schools in the USA demonstrated that halving the prices of healthier food choices (e.g., low-fat snacks sold in vending machines and choices of fruit and salad ingredients sold in cafeterias) led to a doubling or trebling of sales (French et al., 1997, 2001). Such evidence supports the argument that if governments use taxes and subsidies to manipulate food prices, desirable changes in eating patterns result (Powell et al., 2010). Several prominent nutritionists in the USA have argued in favour of a tax on sugar-sweetened beverages (Brownell et al., 2009). As price elasticity is generally stronger among the least affluent socio-economic groups, such a strategy is likely to be especially effective in developing countries.

The best way to design a programme is probably to make sure extra costs on some foods are cancelled out by savings on others (Nnoaham et al., 2009). This ensures that there is no overall effect on the cost of the diet as a whole, and that the cost to the government should be minimal.

An alternative strategy is giving vouchers to needy people, who exchange the vouchers for healthy foods (Finkelstein et al., 2004). For example, researchers in both the UK and USA reported an increased intake of fruit and vegetables when low-income women were given vouchers that could be exchanged for these foods (Burr et al., 2007; Herman et al., 2006). A closely related issue is that of the common unavailability of healthy food choices in local food shops (Temple et al., 2011). This is a particular challenge for rural populations, in which

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people often lack convenient access to a supermarket or large food store. Here again, effective action may require government intervention.

## 4. COMPARING THE COST-EFFECTIVENESS OF MEDICAL TREATMENT AND PREVENTATIVE NUTRITIONAL POLICIES

In order to assess the potential value of nutrition policies, a system is needed for estimating their cost-effectiveness. There are various ways to accomplish this. Such estimates are needed because they provide an objective basis for comparing different policies and thence choosing which ones should be implemented. Understanding issues of cost-effectiveness is also valuable if community nutritionists need to argue the case to government officials as to why particular nutrition policies should be implemented.

Many analyses have been made in the USA and other developed countries regarding the cost-effectiveness of medicine (Neumann, 2005). Benefits achieved as a result of medical interventions are often quantified based on how many quality-adjusted life years (QALY) are generated. The use of QALYs allows all types of interventions to be directly compared, both those that prevent deaths and those that improve the quality of life. The cost-effectiveness of diverse medical interventions can then be estimated based on cost per QALY. Often, as an alternative to QALY, benefits are expressed in terms of a similar measure, called disability-adjusted life years (DALYs).

The cost-effectiveness of medical interventions cover an extremely wide range. Some interventions are relatively inexpensive. Examples include aspirin therapy for the prevention of cardiovascular disease in persons at elevated risk, immunization of children, and screening for tobacco use followed by a brief intervention (Maciosek et al., 2006). However, those are the exception. The cost of most medical interventions is the range of $20,000 to $200,000 per QALY. Around one in eleven preventative interventions cost more than $250,000 per QALY (Cohen et al., 2008). These costs estimates are from the USA; they will be much lower in most other countries.

For example, consider medical treatments for hypertension and for the prevention of IHD. Drug treatment of hypertension for non-diabetics is estimated to cost approximately $53,000 per QALY (Kahn et al., 2008). Statins are a family of drugs widely prescribed for treating high blood cholesterol so as to prevent IHD. Their cost-effectiveness varies from about $20,000 per QALY for patients at high risk of IHD to tenfold more for patients at intermediate risk (Franco et al., 2005). (The cost-effectiveness of an intervention is much lower with high-risk patients as doctors need only treat a relatively small number of patients in order to prevent a new episode of IHD. But with patients at higher risk of IHD, several times more patients must be treated in order to prevent a new episode of IHD.) These cost estimates are based on brand-name drugs. Such drugs are usually still covered by a patent and are relatively expensive. When the patent has expired, any drug manufacturer is free to make and sell the drug. The drugs are then known as generic drugs and are relatively cheap.) Use of generic drugs greatly reduces the cost (Shrank et al., 2011). However, even with the use of generics, the cost of intervention with statins for the prevention of IHD is still typically in the range $8000 to $50,000 per QALY.

How do the costs of medical policy approaches compare with the cost of nutrition policy approaches? Australian investigators reported that reducing the salt content of food would cost approximately US$1180 per QALY (Neal, 2007). Implementation of a policy that leads to the removal of *trans*-fatty acids would also be highly cost-effective as the cost is modest and it should prevent at least 13,000 IHD deaths per year in the USA. Overall, if these numbers were translated into dollars per QALY, they would doubtless reveal a low cost, likely well under $2000 per QALY.

To summarize:

- For the medical treatment of hypertension and prevention of IHD, most medical interventions cost in the range $8000 to $50,000 per QALY (in the USA). If brand-name drugs are used, this cost is much higher.
- Researchers estimate that nutrition policy approaches can deliver the same health improvements for well under $2000 per QALY.

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In a nutshell, a strategy based on implementing preventative nutrition policies can be far more cost-effective than one based on medical diagnosis and treatment (Chokshi & Farley, 2012).

Health promotion interventions are another valuable example of the cost-effectiveness of nutritional policy approaches. Many studies have been carried out in the USA and other developed countries with the goals of reducing excess weight, lowering the blood cholesterol and blood pressure, and encouraging people to quit smoking and exercise more. Many such interventions have been done at worksites, and in these settings, a dollar spent on health promotion can generate several dollars of return for the employer, in the form of reduced days of sickness and correlating higher productivity (Aldana, 2001; Carnethon et al., 2009). Of course, much of this benefit comes from activities unrelated to nutrition. The evidence suggests that interventions that enhance health and prevent disease are cost-effective.

Earlier we discussed several other nutrition approaches, namely policies to counter excessive intake of alcohol, to create improved food labels, to ban the advertising of unhealthy foods on children's TV, to ensure that food eaten in schools is of high nutritional quality, to change food prices by means of taxes and subsidies, and to give vouchers that can be exchanged for healthy foods. Unfortunately, there is a serious lack of reliable estimates of the cost-effectiveness of these policies. However, it is logical to assume that they are all reasonably cost-effective, with one exception: the policy of giving vouchers may prove to be quite costly.

## 5. THE COST-EFFECTIVENESS OF NUTRITION INTERVENTIONS IN DEVELOPING COUNTRIES

While the details of costs and benefits may be very different in developing countries than in countries such as the USA, we can confidently predict that the same principle holds true: nutrition policies can be far more cost-effective than therapeutic medicine.

Developing countries commonly fail to deliver basic medical services to much of their population, because the cost of medical treatment is often too high and the available resources are inadequate. Studies in South Africa reveal that most people with hypertension or who require statins for treatment of high blood cholesterol fail to receive the required drugs (Maritz, 2006; Steyn, 2006). The situation is much worse on the rest of the continent. For this reason, not only may a strategy based on implementing nutrition policies not be the *better policy*, but it may also be the *only realistic policy.*

While information is limited, researchers such as Horton (2008) have reviewed and estimated the costs of various nutrition interventions in developing countries. Costs below are expressed in US dollars per target person per year. Horton (2008) found that fortification of food with micronutrients (iodine, iron, zinc, and vitamin A) is the least costly intervention: $0.05 to $0.24. Providing people with micronutrients in the form of supplements is somewhat more costly: about $0.20 to $1.70. The cost of educational interventions is: $0.20 to $2 for mass-media education programmes; $2 to $3 for breast-feeding promotion; and $5 to $10 for teaching such programmes as home gardening and growth monitoring. Community-based nutrition programmes cost from $2 to $10 or more depending on the level of intensity. By far the most costly programmes are those where people are given food or where it is subsidized: $36 to $170.

It is very useful to know not only the actual cost of different programmes, but also their cost-effectiveness. The cost-effectiveness of the above programmes is listed below roughly in order of most to least cost-effective:

- Breast-feeding promotion and vitamin A supplementation
- Iron and iodine fortification and zinc supplementation
- Community-based projects
- Feeding programmes and food subsidies

Several organizations, including the World Bank and the World Health Organization, carried out a major project known as the Disease Control Priorities in Developing Countries (DCP2) (Jamison et al., 2006). They estimated that reducing the salt content of manufactured foods, accompanied by an educational campaign, would cost between $1330 and $3060 per DALY. This estimate is surprisingly high. Gaziano et al. (2007) argued that salt reduction by way of public education costs no more than $200 per DALY and could even

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be cost-saving. A policy designed to replace *trans*-fatty acids has an estimated cost of a mere $25 to $73 per DALY. In stark contrast to this, a policy of replacing saturated fat with monounsaturated fat in manufactured products, accompanied by a community media campaign, is far more expensive, costing from $1860 to $4010 per DALY.

A cost analysis was carried out in Argentina, a country in which chronic diseases of lifestyle are now common (Rubinstein et al., 2009). In this setting, the prevention of cardiovascular disease is a priority. The most cost-effective intervention is one designed to reduce the salt content of bread, costing a mere US$40 per DALY. The next best strategy is mass education to reduce hypertension, hypercholesterolaemia, and obesity ($140 per DALY). Drug therapy aimed at the prevention of cardiovascular disease or the treatment of hypertension is many times more costly, at about $950–2030 per DALY for less costly therapies and $19,000 when statins are used. These findings again underline the superior cost-effectiveness of nutrition policies over therapeutic medicine.

It must be stressed that comparative cost-effectiveness varies greatly from country to country depending on local factors; there is no such thing as a "one size fits all" approach. Suppose, for example, that the cost of delivering supplements of vitamin A and iodine to a particular population is similar. But if the population has a high prevalence of vitamin A deficiency and this is causing many problems but problems with iodine are uncommon, then the vitamin A programme will be far more beneficial and therefore have a much superior cost-effectiveness.

Finally, it is important to bear in mind that poor nutrition causes a reduction in productivity at work, owing to impaired cognitive skills and decreased ability to engage in physical work. Therefore a nutrition programme may bring about not only health benefits, but also economic benefits from increased productivity at work.

## 6. LESSONS FROM DEVELOPED COUNTRIES

It is instructive to look at how developed countries have approached health care and nutrition policies: their results hold important lessons for developing countries.

A first class health-care system is typically viewed as an essential service. Costs are seen as something that should be constrained where possible. Nutrition policies, by contrast, are usually given far lower priority by most governments. One important factor responsible for this is pressure on governments by large, highly profitable industries. The pharmaceutical industry is one of the most profitable industries in the world, with profits dependent on the willingness of governments and populations to pay many billions of dollars for drugs for the treatment of disease. The food industry has exerted much pressure on governments in many countries. As a result, governments often adopt nutrition policies that serve the commercial interests of the food industry but are damaging to the health of the population (Nestle, 2007). This then leads to increased demand for medical treatment.

This whole approach is irrational as it causes much damage to both population health and national finances. Implementation of a evidence-based nutrition policies makes far more sense. Such policies can help prevent much disease and do so at much lower cost than is generally achievable with drugs. Directing finite resources to where they can be most effective makes obviously more sense. Developing countries can learn from and avoid making the same mistakes as developed countries.

## DISCUSSION QUESTIONS AND EXERCISES

1. What are the major food sources of salt for the population in your community? What is the approximate daily intake of salt per person? What would be the most effective way to cut salt intake? How much decrease in salt intake is a realistic target? Try to determine how much a salt intake reduction program would cost. Based on the answers you obtain, discuss what policies should be implemented.
2. Your local minister of health announces that she plans to make generic statins widely available. She plans to supply the drug to all patients who receive a prescription for it from their physician. Compare this policy with other policies relevant to heart disease. Write a letter to the minister explaining why you agree or disagree with her policy.

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3. Look at the food guidelines commonly used in your country. Do they recommend a higher intake of wholegrain cereals, fruit, fish, and lean meat? Investigate the prices of these foods in local shops. Estimate the extra cost incurred if people follow the food guidelines for these foods. Can people in your community afford the extra cost of following the food guidelines?
4. Which has the most impact on the health of the people in your community: machines selling cola beverages in schools, the use of *trans*-fatty acids in food, alcoholic beverages, or dietary deficiencies of micronutrients? Based on your answer, what nutrition polices should be implemented?

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# CHAPTER 20

# THE DEVELOPMENT OF GOVERNMENT POLICIES ON FOOD AND NUTRITION

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## *Outline*

- Content and purpose of food and nutrition policy
- Factors that influence policy development
- Policy-making models
- Stages in policy development
- Characteristics of good policy
- Policy approval and implementation
- Proposed outline of national policies
- Comparison of old and new food policies

## *Objectives*

At the completion of this chapter you should be able to:

- Understand the different definitions of *policy*
- Describe the content and purpose of policy
- Describe the characteristics of best policy
- Understand the hierarchy of policy development
- Describe the development and implementation of policies
- Describe the roles and responsibilities of different actors in policy development
- Apply different policy-making models to food and nutrition
- Describe the old and new paradigms of food and nutrition policy

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# 1. NUTRITION POLICY: PURPOSE AND CONTENT

Nutrition and nutrition-related activities in a community must be supported by the community and also by the government through its representatives that work in the community. When a course of action has been decided on by the government and its agents to address a situation, then a policy is said to be in place. A food and nutrition policy is the application of public guidelines in the area of food and nutrition leading to a more concerted collaborative action.

Nutrition policy is paramount in implementing the right to food, which is a fundamental human right, as stressed in Chapter 1. Nutrition policy also has an indirect bearing on developmental issues (Moodley & Jacobs, 2000). Food and nutrition policies should be based on scientific evidence and used as measures to deliver improved nutrition and health. In addition, food and nutrition policy guarantees the safety of food for all by issuing and enforcing rules and regulations along the food path. In particular, nutrition policies can serve the following purposes:

- Setting nutrition norms and standards
- Setting indicators for monitoring the success of nutrition programmes
- Protecting health professionals and consumers
- Guiding resource allocation

The content of a food and nutrition policy depends on evidence, context, process, and impact. The evidence that guides the policy should be based on surveys that collect information on nutritional status, food availability, and health outcomes. Political will and action is crucial – especially in developing countries – for the process of policy formulation, legislation, and levels of enforcement. The intended impact of the policy – for example, on agriculture and the food industry, on diet and health outcomes, and on the nutritional status of the target groups – should be clearly outlined in the policy statement. Overall, the content should have well-defined goals, with benchmarks that can be quantitatively measured.

Policy is implemented in order to guide strategies aimed at the achievement of goals of nutrition activities in a community. Policies differ in the degree of urgency with which their goals must be achieved. Some may require immediate action, while others can be implemented over time. In addition, in some cases policies that are geared towards nutrition also have other positive consequences. For example, policies that guide the implementation of school feeding programmes are primarily an attempt to directly improve the diets of school-aged children. But such policies also lead to an increase in school enrolment – a consequence linked to the right to education, with the goal of breaking the poverty cycle.

At the national level, policies are designed to meet broad objectives that pertain to the country as a whole and are most commonly expressed in the form of *laws* or *regulations*. In addition, government agencies may issue *guidelines*, that is, recommendations concerning how best to approach a specific issue. Guidelines generally support the goals of national policy, but they have greater flexibility, in that they can be interpreted and adapted to suit specific circumstances. Unlike laws and regulations, guidelines are not legally enforceable: the decision to adhere to guidelines is a matter of choice. For example, many developing countries have laws or regulations that require information about the nutritional content of packaged foods to appear on the label, so that consumers can make informed choices, or that require salt intended for home consumption to be iodized, so as to reduce the prevalence of iodine deficiency disorders. But countries may also encourage healthy dietary habits by publishing food guides, which provide advice to people about what to eat. Similarly, a country might issue guidelines that recommend exclusive breast-feeding for children under the age of 6 months, but mothers are not legally obligated to abide by this recommendation.

Policies are often accompanied by procedures, that is, instructions that lay out the methods by which the goals of the policy will be pursued. Ideally, procedures should be set up so that anyone attempting to abide by the policy will be able to follow them. If procedures are overly restrictive or inflexible, the usefulness of the policy will be limited. Thus, provided this is feasible, procedures offer various options – different ways to reach the same goal.

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## 2. FACTORS THAT INFLUENCE POLICY DEVELOPMENT

Several horizontal and vertical factors influence policy development. Some of these are shown in Figure 20.1.

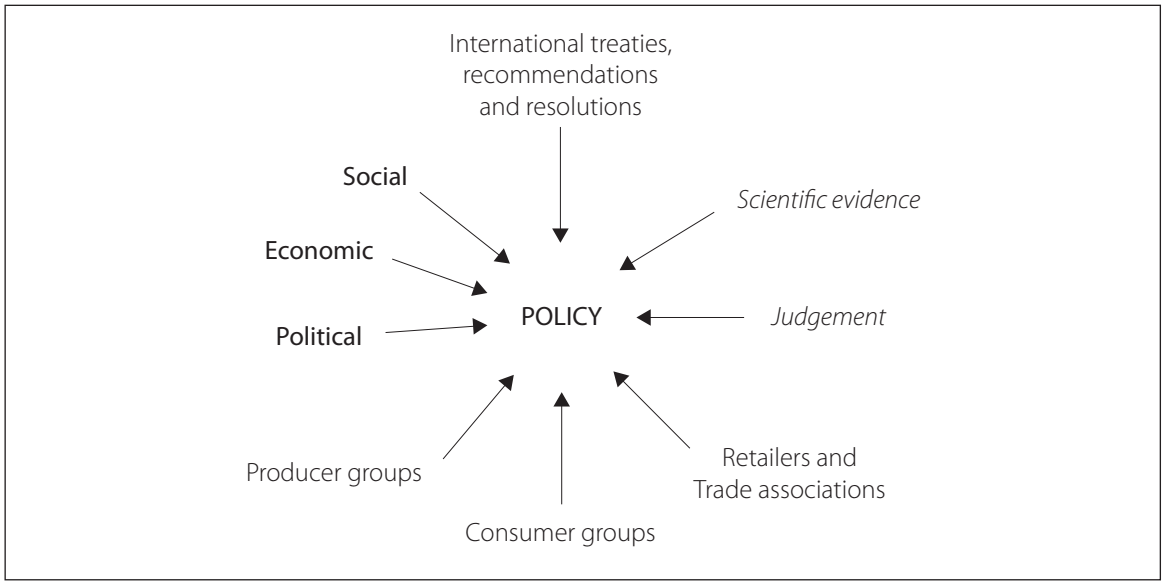


**Figure 20.1:** Factors influencing policy development.
*Source: Adapted from WHO, 2006; DOH, 2006.*

Here is an example to illustrate the process of developing policies. The government of a country that acts as policy-holder may have entered into an agreement with an international organization, such as the World Health Organization (WHO), to improve malnutrition among children under the age of 5. During policy development, the representatives of the international organization ensure that the new policy does not contravene any other agreement between the two entities.

The key actors involved in the development of policy vary depending upon the type of policy. The primary group is the policy-holder. Policy-holders are usually in the government but could be at any level from the grass roots all the way up to the national level. They provide resources, and they develop and monitor policy. In democratic countries, national policies are typically influenced by the election campaign promises of the political parties that gain power.

In addition, lobby groups or pressure groups contribute to the development of policy. Their main intention is to ensure that the interests of the public are met. They also follow and monitor how government policies are implemented. The following are examples of some lobbying/pressure groups:

- Non-governmental organizations (NGOs): voluntary sector, support the government in the execution of some policies as well as monitor the implementation of policies
- Opposition political parties
- Consumer groups
- Media: educates the population on the policy as well as monitoring its implementation (or, at least, that is what they should be doing)
- Scientists and institutions of higher learning, such as universities
- International bodies, such as the WHO: influence policy development and monitor its implementation (Moeng et al., 2008)
- Commercial companies: less conspicuous; in Western countries often employing lobbyists to argue in their support; their goal typically is to advance the commercial interests of their employers

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In addition, social groups may ensure that a policy brings social benefits to improve the food security of vulnerable population groups, as well as access to recreational facilities in the community.

Where consumer groups are represented, they ensure that appropriate information regarding the policy is provided to consumers and that a suitable system is in place to guarantee the interest of consumers. For example, in the development of policy on food safety, a consumer group may function to ensure that the nutritional characteristics of the food are preserved and that contaminants are eliminated. Consumer groups can act as watchdogs in monitoring whether the public and private sectors live up to their commitments, for instance, by means of voluntary codes and award schemes. Consumer groups then give feedback to consumers. In addition, groups representing food producers, such as farmers and food manufacturers, play a role in ensuring that food safety issues and good manufacturing practices, such as hazard analysis and critical control point (HACCP) systems, are addressed by a policy on food.

Research scientists are another important group of people who attempt to influence policy development. In so doing, however, nutrition researchers can face a number of hurdles, including the following (see Moodley & Jacobs, 2000):

*Time.* There may be much delay between research, policy development, and implementation. In particular, administrative and bureaucratic processes are often cumbersome, which delays the commencement of research – which in turn delays the translation of research findings into policy.

*Communication.* Interaction between scientific researchers and policy-makers is often fraught with difficulties.

*Tendering systems.* Governments typically seek to cut costs. As a result, policy development and/or implementation may be contracted to a commercial organization.

## 3. POLICY-MAKING MODELS

Howlett and Ramesh (2009) described different models or approaches for policy making: the rationalist model, the stakeholder approach, the participatory model, and the market-oriented approach.

### 3.1 The Rationalist Model

Most policy-makers use the rationalist model. It has six basic steps in policy formulation (Moeng et al., 2008):

1. Identification of objectives – agenda setting
2. Gathering of evidence – formulation of options
3. Making crucial decisions based on options available
4. Implementation of policy
5. Evaluation of the policy
6. Termination of the policy

Although the above steps suggest that policy making is systematic, in practice the steps may not occur in a logical order. This may happen because consensus cannot be formed on the policy objectives or the formulation of the preferred policy. Other possible problems exist. For example, the evidence to support the policy may be inconclusive or ambiguous. Also, political considerations may strongly influence decisions arrived at during the policy-making stage.

### 3.2 The Stakeholder Approach

This method often favours the powerful and important stakeholders in the group and depends on how well a stakeholder can bargain. Stakeholders negotiate with others, such as government agencies, and form alliances in order to serve their own interests.

For example, in the formulation of health-sector policy for reducing under-5 mortality, stakeholders may include the following:

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- Community-based organizations that are involved in child health
- Organizations involved in environmental cleanliness
- Non-governmental organizations with a focus on child health
- Ministries, departments, and agencies of the government
- Faith-based organizations in the community
- International organizations, such as UNICEF, whose activities are child-centred

### 3.3 The Participatory Model

This approach runs contrary to the stakeholder process in that it includes an active involvement of all stakeholders, which gives legitimacy to the policy-making process. By implication, therefore, the participatory process of policy formulation is interactive, drawn out, and open/transparent. In a participatory approach, multiple criteria are adopted to guide the policy being formulated. Criteria may include available expertise, use of evidence to support policy being formulated, sensitivity to community sentiments politically, and the role and power of various stakeholders involved in the process.

### 3.4. The Market-oriented Approach

In this model, which has become popular in the neoliberal era, decisions on policy are based on the needs of the clients. The client is therefore at the centre of policy development. A typical example is the development of policy by governments of developing countries to address inequalities in a wide range of issues such as unemployment, poverty, low standards of human and social development, the negative conditions affecting particular population sectors, and economic growth. The population of the country is at the heart of the policy development. The main expressions of this neoliberalism are the implementation of programmes for economic reform based on the liberalization of prices, deregulation of markets, elimination of subsidies and trade barriers, privatization of state operations, and opening up of competition at all levels (UNRISD, 1997). To alleviate poverty, therefore, the policy may include measures to meet some or all of the following targets (Adelman, 1986):

- Increase in the quality of assets of the communities that are targeted
- Increase the volume of market sales through generation of a meaningful range of employment opportunities in all sectors (formal and informal)
- Increase productivity through upgrading the quality of labour and expanding the range of support services available to the community
- Introduce a productivity-enhancing technical enabling environment.

## 4. STAGES IN POLICY DEVELOPMENT

Figure 20.2 is a schematic representation of the process whereby government policy is formulated and implemented. Although the figure suggests that the stages in the process occur in a linear order, this is to some extent an oversimplification. In practice, some of the stages may overlap because the policy is fine-tuned.

The process of developing a policy begins with statements of intention on the part of political leaders. During this initial stage, the issue requiring policy intervention is identified, as are the basic goals of the proposed policy, and leaders make an effort to convince the majority of citizens that the issue is indeed a matter of public concern. The process may be triggered by a crisis, such as the H1N1 flu pandemic, that, among other things, produced policies requiring schools to provide facilities for hand washing. The process can also be prompted by political factors. For example, in the case of nutrition policy, leaders may be responding to pressure from international organizations, such as WHO, that seek to guarantee certain worldwide standards. Especially in the face of an upcoming election, political leaders may also be responding to internal pressures from groups of citizens, in a desire to accumulate political capital.

Once it is generally accepted that a problem exists, the problem is then put on the policy agenda. A number of factors play a role in the formulation and development of policy.

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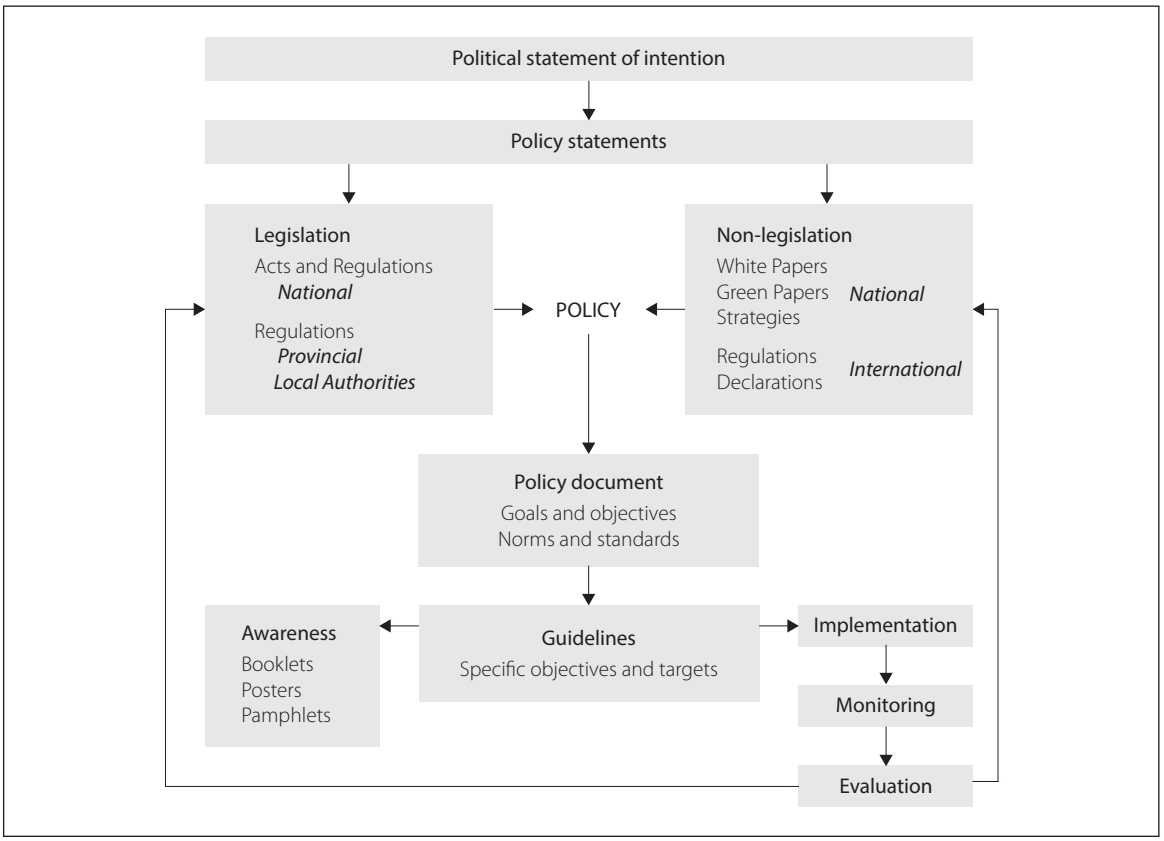


**Figure 20.2:** Policy formulation and implementation.
*Source: Adapted from DOH, 2006.*

**Advocacy.** With regard to the role of advocacy, Gibney et al. (2004) stress that those responsible for developing policy must be careful to distinguish between facts – that is, hard evidence that supports the need for policy – and other, more subjective factors. Those who advocate the adoption of a particular policy are sometimes influenced by personal convictions or judgements grounded primarily in opinion and emotion. This leads to the common problem of badly formulated policies. For example, a situation in which an obvious problem exists may attract a considerable amount of advocacy, often quite vigorous and vocal. However, unless the evidence that bears on the situation is critically examined and analyzed, the resulting policy may not represent an effective or appropriate means to address the problem.

**Evaluation of evidence.** In an effort to make the process of policy formulation more objective, Margetts et al. (2001) propose a policy cycle that is driven by the evaluation of evidence (see Figure 20.3). The cycle starts with a review of the available literature. The review takes into consideration the overall design of specific studies, including sampling procedure and sample size, and the degree of consistency (and hence the reliability) of the findings. On the basis of this initial review, goals are set and objectives defined, and a programme of action is developed and implemented. The results are then evaluated, and this review of the evidence accumulated during the course of the programme feeds back into the policy cycle.

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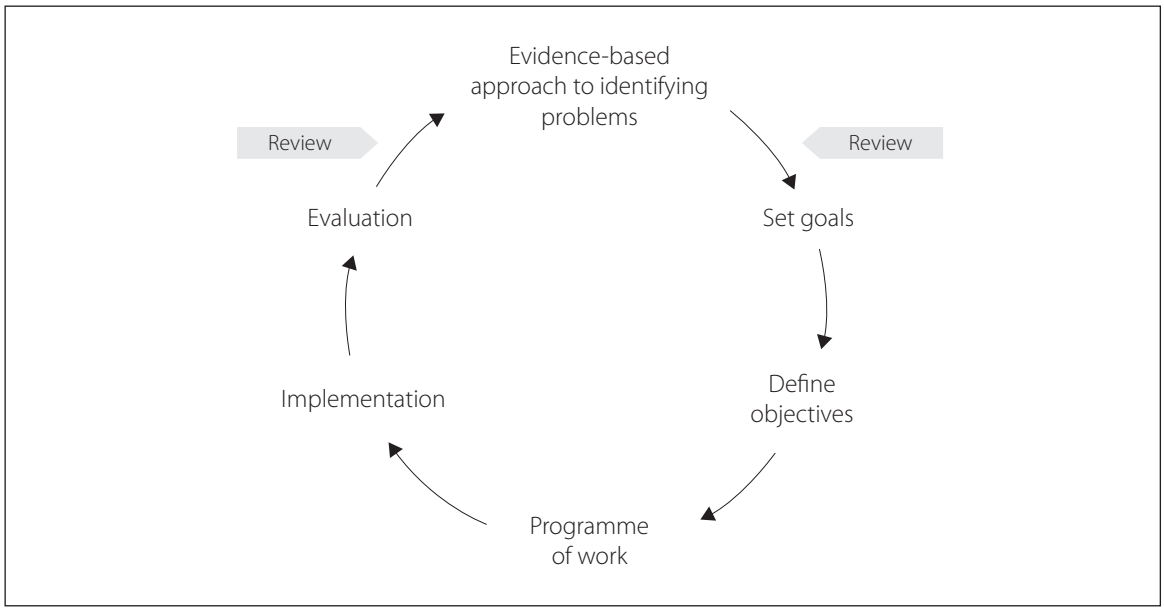


**Figure 20.3:** The policy cycle.
*Source: Margetts et al., 2001 (reproduced by permission).*

Here are a few examples of evidence-based approaches to nutrition policy development. These examples are drawn from South Africa and Ghana, but similar examples exist throughout the developing world.

- Policy 1: Fortification of staple foods. The National Food Consumption Survey (NFCS) was conducted in 1999 in South Africa among children aged 1 to 9 years. The findings revealed that most children appear to consume diets low in energy and poor in protein quality and micronutrient density. In addition, one out of two children had an intake of less than half the recommended level for vitamins A, C, and $B_6$, riboflavin, niacin, folate, calcium, iron, and zinc. The most affected children were from poor households in rural areas (Steyn & Labadarios, 2000). The study also identified the most widely consumed foods by income groups. More than 90% of households obtained maize meal, bread, sugar, milk, and margarine through purchasing, donations, or as part of their pay (Labadarios et al., 2000). Based on these findings, various recommendations were made for the fortification of some staple foods with minerals and vitamins (Steyn & Labadarios, 2000).
- Policy 2: Micronutrient supplementation. Research findings indicated that most school pupils in Ghana are deficient in vitamin A. These children were therefore given vitamin A supplements in accordance with the recommendations of a study carried out by the WHO/UNICEF/IVACG Task Force (1997). They were also given medications to control worm infestation in the gastro-intestinal tract.
- Policy 3: Mandatory salt iodization. As already mentioned, in many countries, salt intended for household consumption must be iodized. In Ghana, this policy evolved as a result of research that identified a high prevalence of iodine deficiency disorders in the country.
- Policy 4: School feeding programme. Surveys conducted nationwide in Ghana revealed that the nutritional status of children was not improving and that some children do not eat before going to school. As a result, the government decided to provide children with one hot meal per day at school. This programme is heavily supported by the Netherlands government.

Stakeholder involvement during the initial stages of policy development, the problem to be addressed and the desired outcome are identified. This stage does not necessarily involve all the stakeholders in the area of concern. Rather, a committee or working group may be appointed to draft the policy. Depending on their expertise, specific actors play different roles in this phase. For example, some of these players may

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be analysts, while others assume responsibility for actually drafting the policy. This is not to imply that the people whom the policy is intended to benefit play no role during the drafting stage; in fact, in some cases they contribute substantially to the initial analysis and formulation of the policy. In addition, as part of the cycle of policy development, a range of stakeholders are asked for their opinion of the draft of the policy before it is implemented. Their views are circulated for final comments before the document is submitted for approval.

## 5. CHARACTERISTICS OF GOOD POLICIES

It is the hope of all policy-makers that the policy they formulate will be highly successful. To help achieve this, the policy should meet the following criteria:

**Technical appropriateness.** Rather than attempting to re-invent the wheel, a policy should be guided by robust research and be grounded in what is accepted internationally as good practice and that will work within the local context. Solutions proposed in the policy must have content that is feasible and evidence-based. Therefore, people with the appropriate know-how must be involved from the initial drafting stage.

**Clarity of language.** A policy should be written in language that is easy to understand, without any ambiguity of purpose, so that it can be understood by those who are not experts in the field. Professional writers in the local language can be employed to write the document.

**Legal soundness.** The content and purported actions of a government policy should be consistent with the national laws and the constitution. The processes for development of the policy should also conform to legal requirements. If the policy is legally sound in its structuring and developmental processes, it can then be enforced.

**Financial viability.** The policy development process and its implementation may require much financial input. At the conception of a policy's development, therefore, the amount of money that will be needed to generate and sustain the policy as well as the source of the necessary funds should be considered. Policy implementation is likely to stall when funds run out.

**Acceptability to key stakeholders.** Key stakeholders should be part of the entire process. This generates commitment and transparency, thereby making the process acceptable to all parties. Stakeholder involvement gives the support needed during the implementation phase; in some countries it is a constitutional requirement.

## 6. POLICY APPROVAL AND IMPLEMENTATION

The specific approval process varies depending on the scope of the policy. For example, nutrition policies that will be implemented at a district level need the endorsement of the relevant senior personnel, such as the local director of food and nutrition. The policy may also need to be approved by the directors of specific government departments or agencies and/or by the senior management of non-governmental organizations that have a stake in the policy.

Because policy documents are usually legal documents, after the views of stakeholders and the beneficiaries have been incorporated, the document is subjected to legal scrutiny to ensure that it is consistent with the laws of the state. Table 20.1 shows the procedure followed by the Department of Health in South Africa (DOH) when giving legal backing to a policy document prior to its formal publication.

**Table 20.1:** Procedure for legal review of proposed policies

| Procedure for publication | | |
|---|---|---|
| **Stages** | | **Activities** |
| Step 1 | Submission of drafted policy document | Legal department evaluates the draft of the policy to ensure that it is consistent with departmental policies, and also to determine its legal implications once implemented. |

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| | | |
|---|---|---|
| Step 2 | Legal clarification and revision of document | A legal report on the draft policy is submitted. The report touches on any aspect of the report that needs clarification. |
| Step 3 | Document returned for revision to those responsible for the initial draft | Suggested amendments are incorporated. |
| Step 4 | Resubmission of document to legal department | Revised document is evaluated. If accepted, the document may be translated into local languages. |
| Step 5 | Publication of document for public comment | Public comments are forwarded to the relevant unit for perusal. Document is submitted to the responsible minister, requesting approval of public comments. After this stage, the document is published. |
| Step 6 | Finalization of policy document | Document is adopted and signed by minister when public comments do not change regulation significantly. |

*Source: DOH, 2006.*

Policies then pass through several subsequent stages of implementation. Table 20.2 lists the key stages identified by the World Health Organization in the implementation of health-related policies.

**Table 20.2:** Transforming nutrition policy into action

1. The policy, together with its associated programme of action, is formally adopted by the government.
2. An intersectoral coordinating committee is established. The committee
   - is embedded in the government structure,
   - is allocated an operating budget,
   - has members that are drawn from all concerned sectors and interests,
   - needs to make priorities, and
   - is subjected to periodic review.
3. Specific government bodies (such a ministry or department) are tasked with implementation of the policy.
4. Activities are ranked and prioritized.
5. These activities are monitored and evaluated.
6. Information about the country's food, nutrition, and health situation is now available.

*Source: WHO, 2001.*

While the details of policy implementation vary from country to country, the overall framework is generally quite similar.

## 7. COMPARISON OF THE PARADIGM OF OLD AND NEW FOOD POLICIES

The issues that food and nutrition policies seek to address are not static: they shift over time. Thus, the policy focus of today differs from the focus of policies that guided nutrition a decade ago. As described in Chapter 4, most developing countries are now in the throes of a nutrition transition, brought about by increased urbanization and a shift in the direction of Western food habits and food supply chains. As a result, policies are no longer formulated solely to offset undernutrition, but also to address problems of overnutrition, including chronic diseases associated with obesity. Table 20.3 contrasts the features of old versus new food policies in a number of key areas.

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**Table 20.3:** Old and new food policies

| Feature or area of concern | Old food policy | New food policy |
|---|---|---|
| Population | Mostly rural | Mostly urban |
| Rural jobs | Mostly agricultural | Mostly non-agricultural |
| Employment in the food sector | Mostly in food production and primary marketing | Mostly in food manufacturing and retail |
| Actors in food marketing | Grain traders | Food companies |
| Supply chains | Small number of food miles | Large number of food miles |
| Typical methods of food preparation | Mostly food cooked at home | High proportion of pre-prepared meals; food eaten out |
| Typical food | Basic staples; unbranded | Processed food; branded products |
| Packaging | Little | Much |
| Source of food purchased | Open markets, local stalls, or shops | Supermarkets |
| Food safety issues | Pesticide poisoning of field workers; toxins associated with poor storage | Pesticide residues in food; adulteration; biosafety issues in processed foods |
| Nutrition problems | Undernutrition | Chronic diet-related diseases |
| Nutrient issues | Micronutrients | Fat, sugar |
| People who are food insecure | Peasants | Urban and rural poor |
| Main sources of national food shocks | Poor rainfall and other production shocks | International prices and other trade problems |
| Main sources of household food shocks | Poor rainfall and other production shocks | Income shocks causing food poverty |
| Remedies for household food shortages | Safety nets; food-based relief | Social protection; income transfers |
| Forums for the development of food policy | Ministries of agriculture and health | Ministries of trade and industry; food activist groups and NGOs |
| Focus of food policy | Agricultural technology; local reform | Competition in the value chain; industrial structure in the retail sector; waste management; health education |
| Key international institutions | FAO, WFP, UNICEF, CGIAR, WHO | FAO, ILO, WHO, WTO, UNIDO |

*Source: Maxwell & Slater, 2003.*

Previously, food policies in developing countries were primarily concerned with improving food security and reducing poverty, especially in rural areas. At the national level, policies were aimed at ensuring that market prices of foods were low and stable. Governments also focused on improving the economy and increasing wages, in an effort to break the cycle of poverty. With regard to households, the older policies were geared towards improving access to foods, especially foods that would help to reduce micronutrient deficiencies. The new food policy focuses on the "double burden" of hunger and obesity. Policies are therefore designed to reduce the incidence of chronic diseases of lifestyle by, amongst other things, encouraging healthy food habits.

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In the past, many countries were excluded from global decision-making activities. New food policies seek to rectify this situation, on the principle that all countries should participate in global decision-making processes, especially the country or countries directly affected by such decisions. As part of this goal, new food policies are aimed at encouraging democratic modes of governance and prudent management of a country's economy. By this means, a country gains the confidence of the international community, which may in turn lead to inflow of foreign investment. Meanwhile, at the household level, policies are implemented that enable poor people to acquire formal education at little or no cost. Similarly, poor farmers are provided with skills training, with the goal of improving agricultural productivity and allowing the farmers to compete in the global market (Timmer, 2008). As these countries continue on their present trajectory of development, food policy will need to be responsive to changing needs.

## DISCUSSION QUESTIONS AND EXERCISES

1. Define the following:
   - a policy statement
   - a legislated policy
   - a regulation
   - a guideline
   - a procedure
2. Describe the processes in your country that concern policy development and implementation on either (a) exclusive breast-feeding, or (b) some other aspect of child growth and development.
3. "Eradicate extreme poverty and hunger": this is Millennium Development Goal 1 of the United Nations. Identify a policy gap in your country with regard to this goal and formulate a policy on it for presentation.
4. Identify any nutritional problem regarding children under age 5 in your community. Draft a letter to the sector minister clearly stating the evidence supporting your position and why it is important to have a policy direction.

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# PART 7

## ASSESSING NUTRITION STATUS

# CHAPTER 21

# NUTRITION SURVEILLANCE

*Jacob Setorglo and Matilda Steiner-Asiedu*

## *Outline*

- Concept and purpose of nutrition surveillance
- Functions and indicators of nutrition surveillance systems
- Surveillance for medium- to long-term planning
- Surveillance for programme monitoring and evaluation
- Surveillance for problem identification and advocacy
- Setting up a surveillance system
- Implementation of a surveillance system
- Assessment of nutrition-related health problems using surveillance
- Selection and establishment of a nutrition surveillance system
- Design of the surveillance system
- Limitations of nutrition surveillance data
- Community nutrition surveillance system in a developing country: the case of Indonesia

## *Objectives*

By the end of this chapter you should be able to:

- Understand the concept of nutrition surveillance
- Explain the purpose of nutrition surveillance
- Describe the functions and identify indicators of community nutrition surveillance
- Describe surveillance for medium- to long-term planning
- Describe surveillance for programme monitoring and evaluation
- Describe surveillance for problem identification and advocacy
- Apply knowledge gained in the selection and establishment of a nutrition surveillance system
- Identify the limitations of nutrition surveillance data
- Describe the components of a surveillance system in a developing country


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# 1. INTRODUCTION

The Centers for Disease Control (CDC, 2001) defined public health surveillance as "the ongoing, systematic collection, analysis, interpretation, and dissemination of data regarding a health-related event for use in public health action to reduce morbidity and mortality and to improve health.... Data disseminated by a public health surveillance system can be used for immediate public health action, program planning and evaluation, and formulating research hypotheses." As *ongoing* suggests, a surveillance system is a cyclical process, one in which the data gathered and analyzed form the basis for subsequent planning, as illustrated in Figure 21.1.

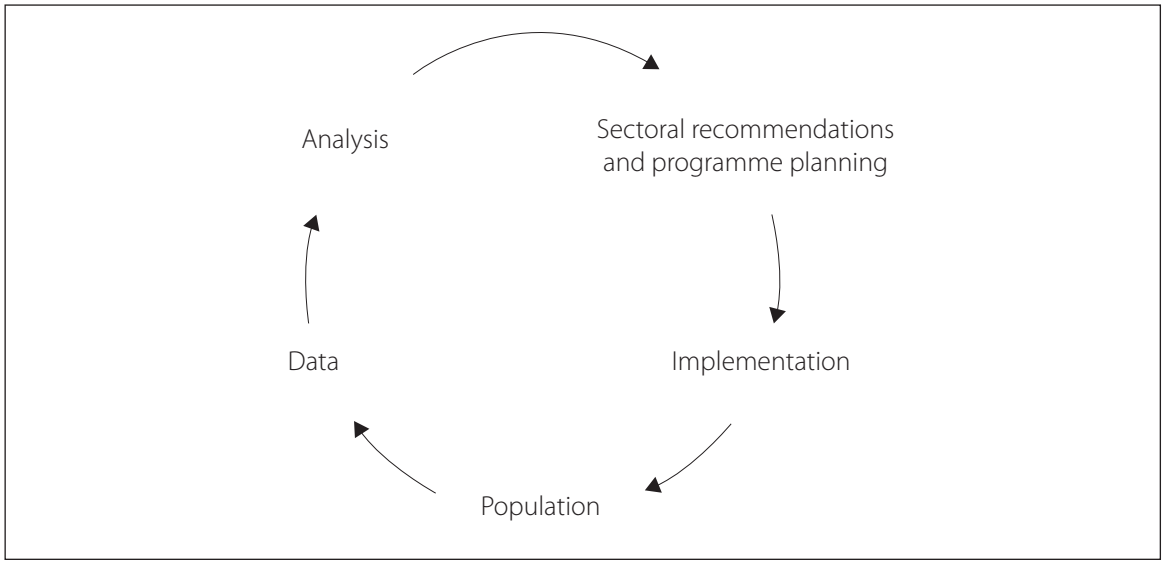


**Figure 21.1:** Information cycle in a surveillance system. Adapted from ACC/SCN, 1986; 1990.

As the CDC (2001) notes, "public health surveillance systems have been developed to address a range of public health needs." Among these are the need for adequate nutrition and the need to address nutrition-related health problems in a timely manner.

At the World Conference on Nutrition in Rome in 1974, nutritional surveillance was proposed as a key strategy as part of efforts to alleviate world hunger. This conference was held on the heels of a major famine in Ethiopia and massive flooding in Bangladesh, which likewise contributed to widespread famine. Two important agreements were reached at the end of the meeting. The first involved the creation of the World Food Programme (WFP) and a Global Information and Early Warning System for Food Security at the Food and Agriculture Organization (FAO) (Jost, 1996). Second, a resolution was passed inviting the FAO, the World Health Organization (WHO), and United Nations Children's Fund (UNICEF) to establish a worldwide nutritional surveillance system.

Nutrition surveillance was part of the 1990 UNICEF summit on children, where one of the goals was to eradicate hunger, food insecurity, and malnutrition within a decade. Surveillance data were to inform the improvement made in child health, roles of women in reproductive health, and the situation on food and nutrition security. Several key international meetings have taken place since 1990 and 2009 (see Chapter 1, section 2.1). More recently, the international community has agreed on what is known as the Millennium Development Goals (MDGs) (see Chapter 1, section 2.6). These goals are quantitative and therefore have measurable indicators. Surveillance data are required to monitor the performance of the strategies to be used and to inform planning.

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## 2. USES OF NUTRITION SURVEILLANCE

When nutritional surveillance was adopted as a concept, it was to serve as a source of information for the planning and monitoring of nutrition programmes, both at the regional and national levels (Mason et al., 1984). However, a paradigm shift has occurred in its core function to a set of new tasks which are: problem identification and advocacy (Tucker et al., 1989), monitoring the effects of structural adjustment policies on food and nutrition surveillance systems (Arnauld et al., 1990), and early warning systems (Brown, 2008).

Nutrition status data are commonly accepted as indicators of social, economic, and health conditions. Such data can be used to create objectives for the improvement of the nutrition of populations and to monitor the progress of social and economic development.

In a developing country with an agriculturally based economy, surveillance activities are geared towards gathering information for stakeholders in the agricultural sector (Jerome & Ricci, 1997). Information gathered from such surveillance may include the amount of food crops grown, quantity exported, and amount reaching households and families for consumption, as well as wastage along the path.

Nutritional surveillance data can also be used for several other purposes:

- To evaluate dietary guidelines
- To influence policy (Akhter & Haselow, 2010)
- To revise food selection guidelines
- To develop and evaluate fortification programmes
- To develop serving sizes for nutrition information panels on food labels
- To make decisions about specific food processing regulations
- To predict the impact of bioterrorism threats from food contamination (Chapman, 2005)

The data collected through nutrition surveillance systems should therefore satisfy certain criteria. Jerome and Ricci (1997) note that the resulting information should be:

- population-based,
- decision- and action-oriented,
- sensitive,
- accurate,
- relevant,
- timely,
- readily accessible, and
- communicated effectively.

Despite having the above common characteristics, nutrition surveillance systems vary widely and comprise a broad range of nutrition-related issues. The end users of the information may include communities, governments, non-governmental organizations (NGOs), and international organizations that have an interest in the nutritional problems being addressed. Nutrition surveillance systems can therefore be set up to collect data on a broad range of factors that affect nutritional status. These may include information on agriculture, dietary intakes, health practices, and socio-demographics of communities. The targets of the surveillance system can also be a specific group, such as pregnant and lactating women, children under 5 years of age, or elderly persons. The purpose of the surveillance system dictates its various features.

## 3. INDICATORS OF COMMUNITY NUTRITION SURVEILLANCE

### 3.1 Type of Indicators

A single surveillance system cannot perform all the functions listed above because the modes and types of data collection are different, and the purpose and the end users of the surveillance information vary. Indicators

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of surveillance systems are generally of three types, namely, leading, concurrent, and outcome. *Leading indicators* are used for measuring immediate vulnerability and resources. *Concurrent indicators* assess current food availability and its related socio-economic determinants, such as income and prices. Indicators of food availability may include farming practices, types of seed sown, and time taken to mature; associated socio-economic determinants may include the amount of money spent on fertilizer, farmers' knowledge of best practices, and the use of mechanized labour on farms. *Outcome indicators* are used to determine the past and continuing shortfalls in food availability. All three types of indicators may be useful for evaluation purposes. In 1990, UNICEF produced a conceptual framework for the causes of malnutrition among children (see Figure 21.2). Depending on the causes identified, indicators are selected for the purposes of (1) measuring objectives and (2) monitoring and evaluating the programme.

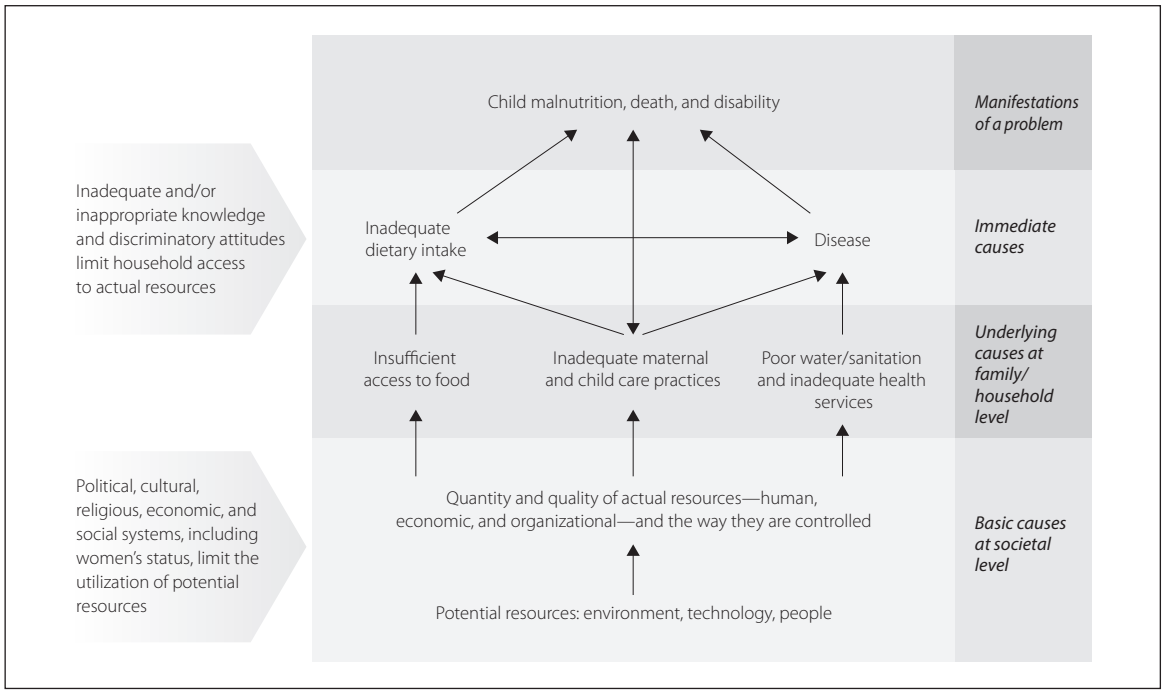


**Figure 21.2**: Conceptual framework of causes of childhood malnutrition.
*Source: UNICEF, 1998.*

## 3.2 Anthropometric Data

Anthropometric indicators are the easiest, cheapest, and fastest way of measuring and assessing nutritional status in developing countries. The dimensions usually taken are height, weight, and mid-upper-arm-circumference (MUAC). These measures can be made more meaningful by transforming them into indices that may then be compared with reference tables (e.g., NCHS/WHO) or standards (e.g., WHO, 2006). References are used to standardize a child's measurements by comparing them to the median or average measures for children of the same age and sex. More details on the methodology are given in Chapter 22.

## 3.3 Factors Leading to Malnutrition

Malnutrition is used to describe not only undernutrition, but also overnutrition. However, in most nutrition texts *malnutrition* refers to low intakes of energy and nutrients necessary for growth and development. Some of the conceptual factors related to malnutrition in a community include food security, food intake factors, access to food, caring practices, and household characteristics. Accordingly, surveillance systems collect data on these factors.

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### *3.3.1 Food security*

Food security factors include anything that affects the availability, accessibility, utilization, and stability of food within the community. The food security indicators used in nutrition surveillance may fall under the following broad headings:

- Ecological zone
- Farm size
- Use of extension services
- Food prices
- Population response to food shortages
- Use of wild fruits and vegetables

In some developing countries where agriculture is the mainstay of the economy and provides employment for the majority of the rural communities, extension services are provided to boost agriculture. Extension services are provided by agricultural experts employed by the government.

### *3.3.2 Food intake*

Food intake indicators used for nutrition surveillance measure the amount of staples eaten at the household level as well as the distribution of the food among household members. Measures of food intake may include the amount of rice or other staple foods, cooking oil, and eggs consumed per person. They may also assess the distribution of both micronutrients and macronutrients in the diets of women and children under age five. In Chapter 22, we describe the methodology for assessing people's food intake.

### *3.3.3 Access to food*

Economic factors that affect the quantity and quality of food intake underlie issues regarding access to food. For instance, it is assumed that when a household consumes produce from a small backyard farm, the produce will be used to supplement food bought in the market such that every member of the household will have enough food. The use of fortified products, such as iodized salt, may also generate information of interest for policy implementers on the success of the directive. Some indicators that may be used to profile accessibility to food may include:

- ownership of a farm,
- access to a home garden,
- food expenditure,
- food prices, and
- use of fortified foods, such as food containing iodized salt.

### *3.3.4 Caring practices*

Care practices by household members as well as government employees at health posts, clinics, and hospitals are also essential data. The coverage of nutrition and nutrition-related activities that guarantee the health of communities is often of interest to different users of surveillance data, such as government agencies and NGOs. Examples of data to be collected are

- breast-feeding practices,
- complementary feeding practices,
- environment sanitation and access to health services,
- sources of drinking water,
- type of latrine used by households,
- garbage disposal,

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- vitamin A capsule coverage among children aged 6 to 59 months and post-partum women,
- immunization coverage,
- iron tablets received by pregnant women, and
- family planning participation.

### *3.3.5 Household characteristics*

It is believed that household heads who are educated tend to earn more than uneducated individuals in the same position. A relatively large amount of the household head's earnings is used to buy food. Educated individuals are also expected to be likely to have a better knowledge of the relationship between nutritional issues and well-being, which should lead to good household food choices. Some basic factors to consider that have implications for nutritional status are

- household demographics,
- level of education,
- occupation, and
- participation in social programmes.

It is important to note that the groupings of the factors and indicators listed in this section are not based on any firm set of rules. Rather, these factors can be selected and grouped under headings that convey the most meaning to the data collectors and as directed by the objectives of the exercise. Classical manifestations of nutrient deficiencies exist, as described in Chapter 22; when the programme goals require it, these signs can also be recorded as part of the data for nutritional status assessment.

## 4. SURVEILLANCE FOR MEDIUM- TO LONG-TERM PLANNING

There is no set definition of *medium-term* or *long-term* in planning: how these designations are defined generally depends on the goals of the surveillance system. The information generated aids in future policy formulation as well as decision-making at the individual, household, community, and regional levels (Brinkman et al., 2010). For this process to be successful, policies must be in place to support decisions based on surveillance data.

### 4.1 Purpose of Medium-to-Long-Term Planning Surveillance

An important purpose of nutritional surveillance is to help develop better plans for the use of resources. This is crucial because the nutritional status of communities changes over time. In a typical farming season, for instance, failure of the rains can lead to deterioration in nutritional status. Surveillance information can help authorities to channel resources to address nutritional needs (FAO, 2007). Communication within the community is important to making this process effective. This can be done through traditional ways of dissemination of information, such as through chiefs, elders, opinion leaders, local radio stations, and the distribution of leaflets.

### 4.2 Population Sampled

For the purpose of advocacy, the population considered in medium-to-long-term planning should comprise the vulnerable, such as pregnant women, children, and elderly people. The samples selected must be homogeneous and compare well in the medium to long term. This is done so as to obtain a representative sample of the population and also to ensure that the data are comparable over time. The sampling frame also informs planning such that all requirements are provided for.

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### 4.3 Types of Data Collected

The type of data collected in nutrition surveillance are similar to those collected in health and nutrition surveys. Data types are anthropometry, biochemical, clinical, and dietary. The same data types are recorded for the population of interest on a number of occasions. As to whether to collect data on all of the parameters mentioned above will depend on the available resources (i.e., money, time, personnel) and the surveillance objective. These data are compared over time to identify variability in indicators, thus informing planning and, to some extent, policy. Anthropometric data are usually collected with respect to age, sex, weight, and height.

Deleterious nutritional status can be predicted by other possible factors, such as care practices and environmental health. The UNICEF conceptual framework of causes of malnutrition can serve as a useful guide (UNICEF, 1998). The socio-demographic, knowledge, attitude, and practice data of the community can also be considered and may be important in explaining trends in malnutrition.

### 4.4 Analysis and Application of Data

The analysis of surveillance data takes into account the prevalence over time of selected indicators, based on values that are above or below predetermined cut-offs. The population may be classified based on socio-demographic and other selected variables that are used for planning. The information generated serves to inform the managers of the surveillance system and stakeholders in the community, whilst also feeding into policy.

Nutrition surveillance findings have played an integral part of policy documents. For instance, findings of a high level of anaemia in Bangladesh led to the development of a national policy on prevention and reduction of the condition among children (Ahmed et al., 2006). Economic crises, such as changes in food prices as a result of failure of rains and increases in fuel prices, are common occurrences in the developing world and can have significant effects on the frequency of malnutrition. Nutrition surveillance data guide policies in order to reduce the effects of these factors on vulnerable people in the community. The application of nutrition surveillance data is therefore very important in achieving some of the targets of the MDGs. Performances per the indicators are monitored, and requisite amendments in policies and programmes are then made (UNDP, 2000). Additionally, surveillance data are used to guide national policies on the realization of the right to adequate food and nutrition.

## 5. PROGRAMME MONITORING AND EVALUATION

Stakeholders in community nutrition programmes are interested in the outcome and impact of nutritional interventions. Nutrition surveillance information should therefore include population-based indicators. The information gathered should be interpreted in its political and social context (Rodriguez, 1995; Shoekirman & Karyadi, 1995).

The following is a case scenario from Bangladesh. Data from a nutrition surveillance system were used to establish the associations of indicators related to the nutritional status of mothers and children (Semba et al., 2008), by observing and analyzing the trends over time. The findings were used to help design tools to monitor programme performance and evaluate the programme's impact on nutrition and other related indicators. The questionnaire used included tools to monitor coverage of infant and child feeding programmes such as vitamin A supplementation (VAS) among children and post-partum mothers, immunization, and utilization of health service facilities. The surveillance system generated data that were used to assess vitamin A coverage (HKI/IPHN, 2005) among different target groups, such as children aged 6–59 months. The different target groups received intervention through different means. Earlier findings from the surveillance systems were used to emphasize the need for universal vitamin A coverage among children to prevent night blindness (Bloem et al., 1995). The surveillance data were reported in open-access journals, such as the FACTS Report (Akhter et al., 2008). These reports contributed to the work of the International Vitamin A Consultative Group (Torlesse et al., 2003) and the Micronutrient Forum (Shafique et al., 2007).

Surveillance systems are essential to the successful implementation and performance of nutrition programmes. When such a system is successfully set in place and monitored, the impact of any programme

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is more likely to be felt (Swan et al., 2009). For example, in order to reduce malnutrition in Bangladesh, the government launched the National Nutrition Program (NNP), the country's largest nutritional intervention programme. The surveillance findings on malnutrition at the national level allowed for assessment of the impact of the programme against various trends over the same timeframe. Further in-depth analysis done using Nutrition Surveillance Project (NSP) data in NNP areas found that the programme's performance varied widely by area and implementing agency (HKI/IPHN, 2006), and that coverage of the intervention and targeting was inadequate. In most cases, evaluations assessing the NNP did not measure programme performance but only assessed the impact on malnutrition. A lesson learned was that when assessing the impact of programmes, an assessment of the quality of programme service delivery (such as targeting and coverage) should also be included in order to use the data to improve strategies.

## 6. PROBLEM IDENTIFICATION AND ADVOCACY

Surveillance data inform stakeholders about the nutrition situation of a given population (WHO, 2009). Advocates, such as pressure groups within the community, government organizations, or NGOs can then use the information to support demands for improved resources. When such demands are based on hard facts, such as surveillance data, advocate groups are more likely to receive a positive response from responsible agencies. Table 21.1 summarizes the characteristics of surveillance for long-term planning, timely warning, and programme management.

**Table 21.1:** Characteristics of nutrition surveillance systems

| | Long-term planning | Timely warning | Programme management |
|---|---|---|---|
| **Purpose** | To assess variations in nutritional status over time and thus aid in decision-making | To avoid nutritional problems by initiating a predetermined response | To ensure effective management |
| **Sample** | Targets that can be compared over time and are representative of the vulnerable population | Convenient sample of target population (e.g., children 0 to 59 months); sample does not need to be representative | Vulnerable individuals in the programme or target population; sample should be representative of the population |
| **Data to be collected** | Anthropometric data usually collected; in certain instances, a combination of anthropometric, biochemical, clinical, and dietary data may be collected, together with data on nutrition knowledge, attitudes, and practices | Example: Predictive data from weather forecasters used | Data that bear on the goals and the objectives of the programme and the nature of the intervention |
| **Sampling frame** | Takes into consideration planning needs; must allow for data to be compared over time | Depends on the target population; randomization may be useful | Target population selected in order to measure efficiency and effectiveness of the programme |
| **Analyses conducted** | Trends in prevalence | Trends in prevalence below chosen cut-off point | Requires quick data turnover |

*Source: Swart & Maunder, 2008.*

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# 7. ASSESSMENT OF NUTRITION-RELATED HEALTH PROBLEMS

The nature and degree of nutritional problems, as well as the people most affected by them, are used in specifying the surveillance information (e.g., agricultural, nutritional), the appropriate level for monitoring (community or regional), and the uses of the information generated for decision-making (Babu & Mthindi, 1994). It is important that the types and the levels of decisions are matched with the information needed at specific levels across the board and down to the community level.

Three aspects to the problem need to be described at this stage:

- *Evidence for the existence and type of malnutrition.* This information may be found in an analysis of food supply data (e.g., food balance sheets) and in records at community health-care centres and hospitals. A food balance sheet shows the total quantity of foodstuffs produced in a country plus the total quantity imported and adjusted to any change in stocks that may have occurred since the beginning of the reference period. After subtracting exports, feed to livestock, seed, industrial and other non-food use, and losses owing to wastage, the remaining quantity represents the food available for consumption. It shows quantities and contents of food supply, per capita availability, in terms of nutrient value.
- *Population groups most affected.* These populations need to be described in terms of geographical location, socio-economic status, types of production systems (e.g., manual versus mechanized), and resources available (e.g., crop types, water resources, land tenure). This type of information may be found in: national census reports; agricultural census and land use surveys; employment, income, and expenditure surveys; retail price reporting; local administration records; and research reports and publications.
- *Underlying causes*. A preliminary description should attempt to give an indication of probable immediate and underlying causes. It should also attempt to review trends over time with respect to the size and nature of the problem.

# 8. SELECTION AND ESTABLISHMENT OF A NUTRITION SURVEILLANCE SYSTEM

## 8.1. Setting Up a Surveillance System

The purpose of a surveillance system is to collect data that can be used to guide or develop a policy. The choice of indicators used depends on the established hypotheses regarding the cause of the nutritional problem to be tackled. These indicators can be measures of resources (e.g., farming systems or access to services), outcomes (e.g., nutritional status), or factors that link resources to outcomes (e.g., food production, food availability) (Mason et al., 1984). The indicators should be relevant, sensitive, specific, cost-effective, and appropriate for trends analysis (Ferro-Luzzi & Leclerc, 1991). Data should support community problem identification as well as the analysis and programmes essential for identifying appropriate and sustainable food and nutrition policies and interventions.

The process of setting up a functioning surveillance system involves assessment of the nutritional problem in the community in terms of causes, actions needed to improve the situation, and often a discussion with the priority users. The purpose of generating the surveillance information must be clearly defined, as must the channels for the dissemination of findings. The degree to which the nutrition problem can be managed by an intervention, given the most cost-effective allocation of resources, is a key factor in establishing priority areas for a good surveillance system. Institutions with adequate capacity may be strengthened and chosen to be part of the framework for facilitating organization and management of the system (Babu & Mthindi, 1994). The process of planning a community nutrition surveillance system is integrally linked to its intended functions. It should include the following (Swart & Maunder, 2008):

- Assessment of the type, magnitude, and context of the nutritional problems that may exist in the community
- Selection of the nutritional problem and putting in place the institutional framework
- Design of the appropriate surveillance system to include methods for data collection, its management, processing, analysis, and dissemination of the findings.

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After designing the surveillance system, which takes into account the purpose it is intended to serve, the next step is the implementation phase. This depends on five critical pillars:

- A demand for nutrition surveillance
- A good perception and understanding of the system
- The capacity to co-ordinate and implement the system
- The resources for information systems
- The availability of the required resources

Another school of thought has merged the five steps listed above into what is called a triple-A loop design (Jonsson, 1995). This refers to a cycle of the following events: **A**ssessment of a nutrition situation, **A**nalysis of data gathered, and **A**ction taken to address the situation. The triple-A loop process is based primarily on the prevalence of the nutrition problem, its cost to the community, and the feasibility of managing it (Ferro-Luzzi & Leclerc, 1991).

## 8.2. Design of the Surveillance System

The design of a surveillance system normally follows a structured approach. The steps in this process are described below.

### *8.2.1 Appraisal of existing data systems and identification of needs*

Available data sources are identified, and their suitability and adequacy for the surveillance is assessed. The existing information may be found inadequate with respect to the assessment of nutritional status or the coverage of some population groups, distinguished by geographic location or socio-economic situation, who may be exposed to particular seasonal or other recurrent risks. Where needed, an existing surveillance system can be further developed.

It may be valuable to have standardized definitions and coding that are used in data collection. It is important that a needs identification and appraisal of data systems are carried out in conjunction with agencies and institutions that will use the information as well as those that will generate it.

### *8.2.2 Institutionalization of the surveillance system*

Institutionalization of the surveillance system, with institutional financial support and commitment, is necessary for its success. This approach ensures commitment and makes institutions responsible for the management and presentation of data.

### *8.2.3 Considerations of cost and economic feasibility*

With regard to cost, a distinction should be made between the resources needed for initially setting up the system and the requirements for its continuous operation. Generally, the initial intensive phase is expensive and requires special funds, while maintenance needs are much more modest. The surveillance system may have to be modified if the associated cost exceeds the resources available.

### *8.2.4 Selection and use of outputs*

Outputs of nutritional surveillance systems depend on the objectives set at the planning stage. The precise nature of the outputs relevant to different institutions and uses should be determined through dialogue. Sample outputs can be generated from dummy tables for the perusal of users for their feedback. The institution responsible for nutritional surveillance should be sensitive to possibilities for disseminating newly available information. Possible behaviours of the population are taken into consideration when recommendations are suggested. When interim results are generated, they should be made accessible to users as early as possible; this may lead to early responsiveness to the community nutrition issues that will thereby be successfully

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promoted and reinforced. Such endeavours may require the use of professional expertise in communicating nutrition issues.

### 8.3 Limitations of Nutrition Surveillance Data

Accurate and precise data from nutritional surveillance is of major importance in helping to solve the nutrition problems of a community or country and thereby aiding in its development (CDC, 2001). However, the data are collected based on the beliefs and perceptions of community members with respect to knowledge, attitudes, and practice about nutritional issues, so the information collected may not be accurate. The nutrition surveillance data also may not be representative, timely, or sufficient for use in long-term planning purposes (Beyers et al., 1997). There is a wide range of inaccuracies in these data sets; in some cases it can range from 45% to 83% (UNICEF, 1984).

## 9. INDONESIA: AN EXAMPLE OF A COMMUNITY HEALTH AND NUTRITION SURVEILLANCE SYSTEM

The health and nutrition surveillance system, of Indonesia, also known as the Nutritional Surveillance Project (NSP), consisted of several components: design and sampling strategy; questionnaire development; field preparation and training; data collection and entry; data validation and editing; data processing and analysis; and information sharing for advocacy, modification, or development of programmes. The NSP was initially set up in Java in 1995 to monitor a province-wide programme for vitamin A deficiency control, including a social marketing campaign (de Pee et al., 1998a, 1998b).

### 9.1 Conceptual Model, Indicators, and Questionnaire

The choice of data collected by the NSP was based on the UNICEF conceptual framework discussed earlier in this chapter. Various indicators were used to gather information about the different causes of malnutrition. When the programme was expanded or other new ones started, specific indicators were used. For example, when a surveillance system was set up in central Java in 1995 for monitoring and evaluating the impact of a social marketing campaign that promoted the consumption of dark-green leafy vegetables and eggs, specific questions related to the project's implementation were added to surveys, such as whether people in the target population had seen the campaign's materials and remembered its messages (de Pee et al., 1998b).

### 9.2 Sampling

Sampling methodologies for the NSP were based on parameters selected by programme managers. In some cases, sampling was done to provide a good estimate of the prevalence of the main outcome indicators – wasting, night blindness among women during their last pregnancy, and maternal underweight. Probability proportional to size (PPS) sampling methodology was used at other times. For PPS, all villages in the zone were listed, with their population size. The total population of the zone was divided by 40 to derive the sampling interval. A different method was adopted in urban areas with existing slums, which were listed and selected using simple random sampling (SRS) techniques, with clusters then selected within each slum. Households within the selected clusters were used to generate the surveillance data. For each round of new data collection, a new sample of households was selected. Poverty was one of the criteria for selection in poor urban communities. Households with children less than 6 years old were randomly, but purposefully, recruited.

### 9.3 Quality Control

The NSP included clear definitions of duties, areas of operation, and lines of reporting. The data collected were cross-checked by a special quality control team that revisited the households interviewed within a few days after the first visit by enumerators. About 10% of the households that had already been interviewed and administered were selected to be part of the process evaluation. Furthermore, the quality of anthropometric

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data collected by enumerators was also checked to ensure that the findings were within acceptable limits for each measurement (WHO, 1995).

## 9.4 Data Entry, Cleaning, and Analysis

The NSP nutrition surveillance data were entered into a computerized database for analysis. The control of data entry occurred in different stages, such as data entry clerks comparing data entered with information on questionnaires, or supervisors doing the same with randomly selected questionnaires. A repeat entry system was also used, in which queries were made in all cases where the second entry differed from the first entry of the same data. After entering and checking the data, they were cleaned. Clear guidelines on how to clean anthropometry data were provided to the data entry clerks. Data analysis was only started when the codebook was complete and the administrators had ensured that any changes made to the data set had been documented.

## 9.5 Communication of the Results

The mode of communicating the results took the audience into account. For instance, at the local level, the audience included the population surveyed and the local government and organizations working with them; at the national level it included government bodies; and at an international level it included donor agencies and international organizations. The presentation of the findings was fashioned to match the specific interests of each different audience. For example, findings from the NSP about the impact of Indonesia's political and economic crisis on health and nutrition were communicated to the National Planning Board, while among the wider national and international audience, crisis bulletins that discussed special themes were distributed. For a wider audience, scientific articles were written and published in peer-reviewed journals. The data sets from the NSP were made available in the public domain through CD-ROMs.

## 9.6 Contribution to Policies by NSP

NSP data have contributed to policies and programmes such as

- vitamin A capsule distribution (Akhter et al., 2007; Dalmiya et al., 2007);
- vaccination programmes (Semba et al., 2007);
- food fortification (Melse-Boonstra et al., 2000; de Pee et al., 2004, 2007; Semba et al., 2008);
- assessing programme impact under real-life circumstances (de Pee et al., 1998b); and
- dual burden of overweight/obesity and malnutrition.

## 9.7 Comments on Indonesia's Nutritional Surveillance Project

The NSP achieved several successes. It enabled the successful monitoring of health and nutrition programmes in Indonesia. It enhanced the implementation of successful interventions that had positive impacts on nutrition and health. And it pointed to the most important factors that limit further reductions in malnutrition. The surveillance system enabled a close and simultaneous look at the different aetiologies of the causes of malnutrition. It also brought to the fore how policies, programmes, and macro-level changes of these different factors interplay to cause malnutrition. This understanding of the major pathways to malnutrition, under particular circumstances in most developing countries, is important for identifying appropriate strategies and target groups for reducing malnutrition and achieving the MDGs.

A successful surveillance system, such as that used in Indonesia, takes into account cultural and socio-demographic factors when indicators for the system are being developed, established, and selected. It is obvious, therefore, that a surveillance system that collects information on a range of key factors that affect nutrition and health is more likely to achieve the stated goals and objectives. Careful analysis of cross-sectional data is important for the optimal use of nutrition surveillance data.

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## DISCUSSION QUESTIONS AND EXERCISES

1. Using growth promotion and monitoring, describe the concept and purpose for establishing a nutrition surveillance system.
2. Using any of the Millennium Development Goals, describe the type of data to be used in a nutrition surveillance system, in terms of the following:
   - The type of data to be collected
   - Sampling procedure(s)
   - The type of analysis to be performed
   - The end users of the information generated
   - The intervention that can be put in place to address the problem
3. Using a nutrition intervention of your choice, describe how you would set up a surveillance system showing the indicators, data to be collected, data processing to be used, and the type of intervention that the data will illicit.
4. Using surveillance data in your country, write a review of the progress achieved so far on Millennium Development Goal 1.
5. Using your country as a case study, write about the benefits of the various surveillance systems that monitor nutrition of children under 5 years of age.
6. Describe a surveillance system that can monitor the effects of global warming on the food and nutrition situation in your country.

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# CHAPTER 22

# ASSESSING NUTRITIONAL STATUS

## Dietary Intake, Anthropometry, Clinical Signs and Symptoms, and Laboratory Tests

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### *Outline*

- Dietary assessment
- Anthropometric measurements
- Clinical evaluations
- Laboratory tests
- Nutritional status: Looking at the big picture

### *Objectives*

After completing this chapter, you should be able to:

- Identify, describe, and apply various procedures used in the determination of nutritional status, including dietary assessment methods, anthropometric measurements, and laboratory tests (blood and urine)
- Identify clinical signs and symptoms associated with macronutrient and micronutrient excesses or deficiencies
- Describe the advantages and disadvantages of each method used to assess nutritional status

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# 1. INTRODUCTION

People need to maintain optimal nutritional status in order to support their body's growth and development, to promote their health, and prevent disease. Because of the important relationship between nutrition and health, health professionals need to conduct nutritional assessments to determine an individual's nutritional status. In the past, intervention efforts have been directed at the important problem of malnutrition owing to inadequate food intake; the Food and Agriculture Organization (FAO) estimates that 800 million people living in low-income countries do not have enough to eat, so this form of malnutrition continues to be a major health concern.

Nutritional measurements are especially critical for at-risk individuals during periods of rapid growth and development, when nutritional requirements are high and inadequate nutrition can have irreversible health consequences. Additionally, in view of the public health threat posed by overweight and obesity in developed as well as developing countries, it is vital for health-care providers to also use available assessment tools to monitor for both undernutrition and overnutrition in patients. This chapter addresses the methods used to assess nutritional status in individuals and in populations overall. These methods fall into four main categories: dietary assessment, anthropometric measurements, clinical evaluations, and laboratory tests (Jensen et al., 2012). It is important to note that each method does not, by itself, provide a complete picture of a person's nutritional profile, so it is necessary to use them in combination. Once this has been done, appropriate interventions can be planned and implemented or referrals for further examinations made.

# 2. DIETARY ASSESSMENT

Dietary assessments can provide information on eating habits, food intake, and nutrient intake (Wrieden et al., 2003). A number of tools (e.g., instruments and questionnaires) have been developed to estimate intake of energy and nutrients. These tools range from simple checklists to detailed individual weight records to household surveys. Each tool is associated with specific strengths and weaknesses that should be considered when selecting a method. However, it is imperative that the tool selected be appropriate and tailored to the culture, ethnicity, age, and language of the target group. Furthermore, optimal strategies for dietary intake data collection should always be considered (see Table 22.1).

**Table 22.1:** Optimal strategies for specific target groups

| Target group | Optimal strategies |
|---|---|
| Ethnic populations | - Use interviewers of the same ethnic background as the participants.<br>- Use food lists and nutrient composition databases that reflect the foods consumed by the population. |
| Children | - For young children, include caretakers and caregivers along with the child during any data collection.<br>- For older children and adolescents, blend instruments with creative ways to ensure engagement and motivation. |
| Elderly persons | - Assess any special considerations (such as memory, special diets, dentition, or use of supplements) and adapt methods accordingly. |
| Respondents unable to self-report | - Use the best-informed surrogate: e.g., hospital records; dietitian or nurse for incapacitated patients.<br>- Analyze the effect of potential bias on the study results. |
| Illiterate persons or populations | - Ensure that the tool used is appropriate; in other words, ensure that tools are interviewer-administered and do not require self-administration. |

*Source: Adapted from Thompson & Subar, 2001.*

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Rutishauser and Black (2002) describe the procedure for dietary assessment in five steps, as follows:

1. Record all foods consumed by an individual over a defined period of time.
2. Quantify the portion size of each food item.
3. Determine the frequency with which each food is eaten, if appropriate.
4. Identify the foods eaten such that an appropriate item can be chosen from standard food tables or from choices presented in the software package for nutrient analysis.
5. Calculate the nutrient intake.

## 2.1 Methods Designed to Measure Food and/or Nutrient Intakes

### *2.1.1 Weighed food records*

The 7-day weighed food record is frequently regarded as the "gold standard" against which other methods are compared, because it uses many days of recording – which is more likely to capture the usual intake of an individual – and provides exact measures for portion sizes. Prior to consumption, subjects or investigators are required to weigh each item of food and drink. A detailed description of the food (individual ingredients, brand name, method of preparation, etc.) and its weight are recorded. Other than recording measurements on paper, methods include the use of a dictaphone, PDA (personal digital assistant; a type of electronic handheld device), computer, or self-recording scales (Thompson & Subar, 2001). Furthermore, a record of any leftovers is usually made in order to calculate the actual weight of food that has been consumed. Weighed records can be kept for 3, 4, 5, or 7 days. If they are kept for fewer than 7 days, the investigator should ensure that weights are recorded over consecutive days and include at least one weekend day, because eating habits usually differ between weekdays and weekends. This method may not be applicable in large-scale research surveys, and it may be more applicable in small studies (of 10 to 15 people) or in a clinical setting for individual clients. Using consecutive days is easier for subjects, but it can trigger a "leftover" effect whereby people eat the same foods for several days in a row (see Table 22.2).

**Table 22.2:** Strengths and weaknesses of weighed food records

| Strengths | Weaknesses |
|---|---|
| - Well established method<br>- Precision of portion sizes | - High respondent burden<br>- Potential for misreporting and/or underreporting<br>- Expense<br>- Food composition data are limited<br>- Can influence or change usual dietary intake |

### *2.1.2 Estimated food records*

Estimated food records are similar to weighed food records, the difference being the way in which individuals or investigators quantify food intake. Intake is estimated, rather than weighed, and then converted into amounts that can be used to calculate food and nutrient intake (see Table 22.3).

**Table 22.3:** Strengths and weaknesses of estimated food records

| Strengths | Weaknesses |
|---|---|
| - Well established method<br>- Lower respondent burden than weighed food records | - Respondent fatigue<br>- Potential for misreporting and/or underreporting including inaccurate estimation of portion sizes<br>- Expense<br>- Food composition data are limited |

**Example:** Estimated food records were used in the EPIC study (Voss et al., 1998).

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### *2.1.3 24-hour recall and multiple pass 24-hour recall*

A 24-hour recall is a retrospective method and is preferably administered by a dietitian or a trained interviewer. It requires the respondent to recall all the food and drink that he or she consumed in the previous 24 hours. Its accuracy is thus dependent on the respondent's memory and overall reliability, as well as on his or her ability to estimate and describe portion sizes. For this reason, respondents are prompted to remember what they consumed by linking it to certain times of the day (*in the morning, when you woke up*) or activities (*when you arrived at work*). Interviewers may assist respondents in estimating portion sizes by using household measures, such as cups or spoons, and/or food photographs or food models. The interviewer is responsible for recording all the information. At the end of the interview, the respondent is asked to verify the record, and any omissions or errors are corrected.

The Chronic Diseases of Lifestyle (CDL) Unit of the South African Medical Research Council offers tools that can be used to collect dietary intake data. These tools include the Dietary Assessment and Education Kit (DAEK; Steyn & Senekal, 2004). The kit consists of Food Flash Cards, a Food Photo Manual with generic and specific sketches of foods, 24-hour recall recording sheets, and instructions for the interviewer. The DAEK can also be used for nutrition education purposes.

A 24-hour recall is a valuable dietary assessment method, but it can only account for a single day's intake (see Table 22.4).

**Table 22.4:** Strengths and weaknesses of 24-hour recall

| Strengths | Weaknesses |
|---|---|
| - Low respondent burden<br>- Suitable for large-scale surveys<br>- Can be administered by telephone<br>- Can be used with illiterate populations<br>- The person's usual diet is not affected | - Estimation of portion sizes<br>- Memory-dependent<br>- Possible bias in reporting intake of "good" and "bad" foods<br>- Does not capture day-to-day variation |

A more accurate version of the 24-hour recall method is the multiple pass 24-hour recall. Here, several steps are followed during the interview to allow revisiting and checking of dietary information. The first step involves obtaining a quick list of foods consumed in the past 24 hours. Next, the interviewer prompts the respondent to identify food and drinks that may have been "forgotten," such as sweets, chocolates, and biscuits. Information is then recorded regarding when and where the various foods were consumed. In addition, more detailed information is obtained, such as detailed descriptions of foods, including preparation methods and individual ingredients. Finally, details regarding portion sizes are recorded. This method is more accurate than the previously described version of the 24-hour recall.

The multiple pass 24-hour recall method was used in the 1999–2000 National Health and Nutrition Examination Study (NHANES; Briefel & Johnson, 2004) in the USA and in the Low Income Diet and Nutrition Survey in the UK (LIDNS; Nelson et al., 2007).

If collected over a number of days, 24-hour recalls provide a potentially valuable picture of an individual's customary eating habits. For example, where control of excess weight is a concern, information on the intake of fat and sugar may enable a physician to counsel a patient more effectively.

### *2.1.4 Food frequency questionnaires*

Food frequency questionnaires (FFQs) provide information that establishes usual dietary intake. At its simplest, a FFQ consists of a list of foods and a selection of options relating to the frequency of consumption of each of the foods listed (e.g., times per day, daily, weekly, monthly). FFQs are designed to collect dietary information from large numbers of individuals (>100) and are normally self-administered, though an interviewer can carry them out, either through in-person or phone interviews (Haraldsdottir et al., 2001).

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The length of the food list can vary depending on the nutrients or foods of interest. If a range of different nutrients and energy values are required, the list of foods may contain upwards of 150 foods; however, if information about a specific type of food (e.g., fruits or vegetables) or nutrient (e.g., calcium) is required, the list may contain as few as 11 foods. The DAEK (Steyn & Senekal, 2004) includes a quantified FFQ that can be used in data collection. Many FFQs also attempt to collect information about portion size; these are referred to as quantitative food frequency questionnaires (QFFQs). Where portion size information is not obtained, standard food portion sizes (MAFF, 1993) are often used to calculate nutrient intakes. Next, the reported frequency of each food is multiplied by the amount of the nutrient in a specified serving of that food. This gives the estimated daily intake of nutrients and dietary constituents. If needed, an estimate can be made of the amount of particular foods or of food groups.

FFQs are used widely in case-control or cohort studies to assess the association between dietary intake and disease risk. They are generally used for ranking subjects according to food or nutrient intake rather than estimating absolute levels of intake (Thompson & Subar, 2001).

Many standard FFQs are available, and many continue to be adapted and developed for different populations and different purposes. Investigators need to carefully consider the appropriateness of the food list to ensure that it is specific to the culture, ethnic group, food brands, and preparation practices of the population being surveyed. Furthermore, questionnaires should be compatible with the database (e.g., South African Medical Research Council, 2001) that will be used for analysis (see Table 22.5).

**Table 22.5:** Strengths and weaknesses of food frequency questionnaires

| Strengths | Weaknesses |
|---|---|
| - Low respondent burden<br>- Suitable for large surveys<br>- Can be self-administered or posted Inexpensive<br>- Can be used to assess association between dietary intake and disease | - Potential for inaccurate estimation of portion sizes<br>- Potential of misreporting<br>- Requires validation<br>- Can take up to 60 minutes to complete<br>- Difficulty in obtaining accurate reports for foods eaten both as single items and in mixtures |

*Examples:*
Health Habits and History Questionnaire (HHHQ) (also known as Block questionnaire) (Nutrition Quest, 2009)
Harvard University Food Frequency Questionnaire (also known as Willett questionnaire) (Willett, 1998)
European Prospective Investigation into Cancer and Nutrition (EPIC; Bingham et al., 1997)
Abbreviated FFQs (Block et al., 1990)
The National Food Consumption Survey (NFCS, Labadarios et al., 2000)
Transition, Health, and Urbanization Study (THUSA; Venter et al., 2000; MacIntyre et al., 2001; Kruger et al., 2002)

### *2.1.5 Household food surveys*

A number of surveys are meant to collect information about dietary intake at the household level. This method has been used to monitor long-term dietary intake and provide information on food expenditure and food and nutrient intake trends over a period of time.

Some market research surveys relating to food purchase trends are also conducted at the household level. Recently, a feasibility study has highlighted the potential of utilizing large quantities of readily available data generated from supermarket checkouts in dietary surveys (Ransley et al., 2001). The association between fat and energy measured by this method and 4-day weighed records was found to be strong (see Table 22.6).

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**Table 22.6:** Strengths and weaknesses of household food surveys

| Strengths | Weaknesses |
|---|---|
| - Suitable for large surveys<br>- Ability to monitor diet trends at the population level | - Data not collected at the individual level<br>- Difficulty of assessing foods eaten away from home |

*Example: The National Food Consumption Survey (NFCS; Labadarios et al., 2000).*

## 2.2 Issues Relating to Dietary Assessment

### *2.2.1 Derivation of portion size*

In all dietary assessment methods, where food is not weighed, portion sizes must be estimated before nutrient intake can be calculated. There are a number of ways to do this. For example, fieldworkers can weigh particular food items, or photographic manuals and food models showing portion sizes of commonly eaten foods can be used (e.g., Nelson et al., 1997), as can data from manufacturers, portion sizes collected from previous weighed food records, and household measures.

### *2.2.2 Misreporting of dietary intake*

Misreporting of energy intake has been routinely observed in various surveys. This occurs when individuals report energy intakes that are inconsistent with biological viability (Huang et al., 2005; Ferro-Luzzi, 1990). The most common form of misreporting is underreporting. Goldberg et al. (1991) derived cut-off points to identify underreporting of energy intake, below which a person of a given sex, age, and body weight could not physiologically survive. The first step in checking for this is to estimate the ratio between energy intake and basal metabolic rate. This can be done using either Schofield equations (Schofield et al., 1985) or using doubly labelled water (Coward et al., 1986). Ratios of <1.37 and >1.67 are indicative of underreporting and overreporting, respectively (Goldberg et al., 1991).

Age and gender often determine the prevalence of misreporting. Various studies have shown that misreporting increases with age (Bandini et al., 1997; Bedard et al., 2003; Johansson et al., 2001). Misreporting in women is associated with psychosocial parameters, such as body image, weight concerns, social desirability, and dietary restraint (Ventura et al., 2006; Tooze et al., 2004; Horner et al., 2002). Furthermore, socio-economic status, procurement of food, food preparation, gender-defined roles, and family responsibility also affect the dietary intake reporting by women (Harrison et al., 2000).

Dietary energy intake misreporting not only affects the absolute energy intake reported, but also the reporting of some macronutrients. People who are concerned about being overweight and those who have been advised to change their diet often underreport foods considered unhealthy, such as those high in fat and added sugar (Harnack et al., 2004; Johansson et al., 2001). Macronutrient misreporting can therefore impact on our understanding of the relationship between diet and health (Venter et al., 2000; Briefel et al., 1997; Lafay et al., 2000). Also of note, alcohol intake is often underreported.

## 2.3 Diet Analysis

The final step of diet analysis is entering the diet record into a computer programme, which then analyzes the diet and provides extensive information on nutrients and energy. Several websites allow people to carry out this task at no cost. Some books are also available. See Section 10 for further details. The usual first step in this process is to give each food item a code. Carrying out this task on large numbers of diets is labour intensive. Fortunately, some computer software systems allow for direct coding.

When all the diet information has been recorded (e.g., via weighed food record and/or 24-hour recall), the entire diet can be entered into the programme. With a FFQ, the following calculation must be done in order to determine the total intake:

portion size (g) x frequency x nutrient content per gram = total intake

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# 3. ANTHROPOMETRIC MEASUREMENTS

Anthropometric measurements are used to estimate the body's physical dimensions such as weight, height, circumference, and body composition. Most of these techniques are easy to use, inexpensive, and non-invasive and are backed by a strong base of scientific data. An important consideration is that this is an objective measure of dietary intake.

## 3.1 Child Growth Standards

In 2006 the World Health Organization (WHO) published new child growth standards to be used in constructing indicators of nutritional status, such as stunting, wasting, and underweight (WHO, 2006). In cases of emergency nutrition, the new WHO standards are preferred over the previously recommended international growth reference developed by the National Center for Health Statistics, because of documented limitations of the latter (WHO, 2006). The WHO Child Growth Standards are available on the WHO website.

The WHO Child Growth Standards display a series of percentile curves and charts that demonstrate the distribution of selected body measurements of infants and children based on a large population study of children from diverse countries (Vesel et al., 2010). Standards are available for boys and girls from birth to 5 years, and from 5 to 19 years of age. Anthropometric measurements are taken for weight, length or height, head circumference, upper arm circumference, skinfold thickness, and BMI, all in relation to age, as well as for weight relative to height. These measurements are useful for estimating a child's growth and nutritional status. Clinicians use growth charts to track the growth of an infant or child over time, and to compare one child's growth to that of children in the general population.

A meaningful way of standardizing data when comparing a child's growth to others in a group is through use of statistical calculations, such as z-scores, percent of the median, and percentiles. A *z-score* is defined as the difference between the value for a specific individual and the median value of the reference population (for example, children of the same age or height) divided by the standard deviation of the reference population. The *percent of the median* is defined as the ratio of a measured or observed value in an individual to the median value of the reference data, expressed as a percentage. *Percentile* refers to the position of an individual on a given reference distribution. With respect to the specific characteristic under consideration (such as height), an individual's percentile ranking indicates the percentage of the reference population that the individual's own score either equals or exceeds.

The z-score is the statistic recommended for use in reports of results of nutritional assessments (Cogill, 2003). Z-scores allow the identification of a fixed point in the distributions of different indices and across different ages. The percent of the median does not allow the same comparison. Further, the proportion of the population identified by a particular percent of the median varies at different ages for the same characteristic.

Cut-offs, which are based on the statistical calculations discussed here, are useful in identifying those infants and children who are suffering from, or who are at a higher risk of, adverse outcomes. The cut-offs for z-scores of–3,–2, and–1 are the lowest 0.13th, 2.28th, and 15.8th percentiles, respectively, of a data set. These percentiles represent the percentage of children in the reference population who are below the cut-off point (Cogill, 2003). The most commonly used cut-offs are z-scores of +/–2 and +/–3, irrespective of the indicator used. For example, an infant or child is defined as stunted, wasted, or underweight if, respectively, his or her length-for-age, weight-for-length, or weight-for-age z-score is less than–2. If these z-score values are less than–3, the infant or child is considered to have severe stunting, severe wasting, or severe underweight (Vesel et al., 2010). In some cases, the cut-off for defining malnutrition used is–1 SD, or a z-score of–1; in the reference, or healthy population, 15.8% of people would be below that cut-off.

Cut-offs for measures of mid-upper-arm circumference (MUAC) are somewhat arbitrary owing to its lack of precision as a measure of malnutrition. A cut-off of 11.0 cm can be used for screening severely malnourished children. Those children <12.5 cm with or without oedema are classified as being severely or moderately malnourished, respectively.

Section 2.1 of Chapter 7 provides additional information on making anthropometric assessments of children.

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## 3.2 Body Weight and Fat Distribution Measurements

BMI is defined as weight in kilograms divided by the square of the height in metres ($kg/m^2$). A BMI assessment is a reliable indicator of total body fat. BMI has been directly linked to health risks and mortality in many populations. Based on BMI values, a range of weight assessments can be made, including underweight, normal weight, overweight, and obese. The WHO has developed BMI classifications aimed for international use. Weight classifications based on BMI are shown in Table 22.7. Most health organizations, such as the National Heart Lung and Blood Institute (of the USA), use BMI criteria to assess body weight in adults. It is recommended that practitioners use the BMI to assess healthy and unhealthy weight of their clients as a way to monitor general health and as a basis for designing intervention strategies. Table 22.8 shows the relationship between height, weight, and BMI. There are many websites available that allow a person to quickly determine BMI based on height and weight; simply do an online search for "calculate BMI."

Health-care providers should be aware that differences between ethnic groups may exist with respect to appropriate BMI cut-off points. For example, evidence suggests that for some Asian populations, a BMI of >23 is equivalent in terms of health risks to BMIs >25 and >27 in people of European and African decent, respectively (WHO Expert Consultation, 2004). Although the BMI is a useful tool in assessing body fat, some limitations should be noted; it tends to overestimate body fat in muscular individuals, such as athletes, and underestimate body fat in people with decreased muscle mass, such as elderly people and people who are severely undernourished (WHO, 2004).

**Table 22.7:** Weight classifications based on BMI

| BMI value | BMI classification |
|---|---|
| <18.5 | Underweight |
| 18.5–24.9 | Normal weight |
| 25.0–29.9 | Overweight |
| 30.0–39.9 | Obese |
| >40.0 | Severely obese |

*Source: U.S. Department of Health and Human Services et al., 2013.*

**Table 22.8:** Body mass index for adults

| Height in metres (in) | BMI | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| 1.47 (58) | 100 | 105 | 110 | 115 | 119 | 124 | 129 | 134 | 138 | 143 | 148 |
| 1.52 (60) | 107 | 112 | 118 | 123 | 128 | 133 | 138 | 143 | 148 | 153 | 158 |
| 1.55 (61) | 111 | 116 | 122 | 127 | 132 | 137 | 143 | 148 | 153 | 158 | 164 |
| 1.60 (63) | 118 | 124 | 130 | 135 | 141 | 146 | 152 | 158 | 163 | 169 | 175 |
| 1.65 (65) | 126 | 132 | 138 | 144 | 150 | 156 | 162 | 168 | 174 | 180 | 186 |
| 1.70 (67) | 134 | 140 | 146 | 153 | 159 | 166 | 172 | 178 | 185 | 191 | 198 |
| 1.75 (69) | 142 | 149 | 155 | 162 | 169 | 176 | 182 | 189 | 196 | 203 | 209 |
| 1.80 (71) | 150 | 157 | 165 | 172 | 179 | 186 | 193 | 200 | 208 | 215 | 222 |
| 1.85 (73) | 159 | 166 | 174 | 182 | 189 | 197 | 204 | 212 | 219 | 227 | 235 |
| 1.90 (75) | 168 | 176 | 184 | 192 | 200 | 208 | 216 | 224 | 232 | 240 | 248 |

*Note: Weight is given in pounds. To convert kilograms to pounds, multiply kg by 2.20.*

*Source: U.S. Department of Health and Human Services et al. (2013).*

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Not only is total body fat content important, its distribution can give important clues to disease risk. In particular, abdominal fat (i.e., fat around the waist) is particularly hazardous. Therefore, waist circumference (WC) is another technique recommended for use in clinical settings. WC provides an initial assessment of a client's abdominal fat content; above-normal values pose a high risk for chronic disease such as cardiovascular disease and type 2 diabetes (Cameron et al., 2013).

WC is measured at the narrowest part of the waist; however, for best results specified anatomical landmarks should be used to guide measurements. The International Diabetes Federation has established the following criteria for WC cut-offs above which health risks increase: Europid males ≥94 cm, Europid females ≥80 cm, Asian males ≥90 cm, and Asian females ≥80 cm. Other populations (people with ethnicities originating in sub-Saharan Africa, the Middle East, the Mediterranean, and South and Central America) should use the Europid classification until more specific data are available. It is not necessary to measure WC in obese individuals, whose measurements will far exceed the cut-off points and lack predictive value. For comparison, the American cut-off points use ≥102 and ≥88 cm for men and women, respectively (International Diabetes Federation, 2004).

Child obesity deserves particular attention. It is a major public health threat because children who are obese are more likely than other children to become obese adults. It was estimated that in 2010 43 million preschool children were overweight or obese and that 81% of them were living in developing countries (de Onis et al., 2010). It is therefore important to monitor the growth of children through growth charts as a way of assessing overnutrition.

## 3.3 Body Composition Analyses

Health professionals can measure the amounts of body fat and lean tissue in an individual. Dual X-ray absorptiometry (DXA) is currently the gold standard for assessing body composition (Champagne & Bray, 2010). Men with body fat >25% and women with body fat >33% are considered obese (Friedl, 2004). DXA is often used in research settings, but its use in clinical settings is unlikely in developing countries except in rare instances.

Another method for determining body composition is bioelectrical impedance, which is based on measuring electrical conductance through body tissues. Muscle is high in water and conducts electricity well, while adipose tissue is the reverse. The technique is easy to use, but variability can occur from one analyzer to another, and the technique's accuracy can be affected by hydration status.

Measurement of skinfold thickness is a cheap and simple method that can be very useful in the field. It is one of the most commonly used indirect methods for assessing body fat, and is based on the fact that a representative measure of subcutaneous adipose tissue layer provides a reasonable estimate of total body fat (Lukaski, 1987). The measurement of skinfold thickness is made by grasping the skin with the thumb and index finger, 7.5 cm apart, and the skinfold is then gently pulled away from the muscle below. Caliper jaws are placed perpendicular to the skinfold, over the lifted fold of skin. The thickness of the compressed skinfold is then recorded to the nearest full or fraction of a millimetre within 2 to 3 seconds after releasing the caliper extender (Williams, 1997). In individuals with moderately firm subcutaneous tissue, skinfold measurements are easy to perform, but in subjects with easily compressible or very firm tissue, obtaining valid measurements can be difficult (Lukaski, 1987).

Many equations are available for the prediction of body density and thus body fatness from skinfold thickness measurements (Eston et al., 2005). Durnin and Womersley (1974) developed a widely used formula that uses the logarithmic sum of four upper body sites (biceps, triceps, subscapular, and iliac crest), age, and gender. Another commonly used method estimates body density, and subsequently body fat, by utilizing logarithmic transformation of the sum of seven skinfolds (chest, axila, triceps, subscapular, abdomen, thigh, and suprailiac), age, and wrist and forearm circumference (Jackson & Pollock, 1978). Box 22.1 shows an equation, similar to the two mentioned above, that was developed by Peterson et al. (2003), which combines three upper-body skinfolds (triceps, subscapular, and suprailiac) with a lower-limb skinfold (mid-thigh). Findings from previous studies indicate that including lower-limb skinfolds with upper-body measurements improves the prediction of percent body fat (Eston et al., 2005).

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**Box 22.1:** Examples of Equations Used to Estimate Percent Body Fat

For men: $\%BF_{new}$ = 20.94878 + (age x 0.1166)–(height x 0.11666) + (sum4 x 0.42696)–(sum4$^2$ x 0.00159)
For women: $\%BF_{new}$ = 22.18945 + (age x 0.06368) + (BMI x 0.60404)–(height x 0.14520) + (sum4 x 0.30919)–(sum4$^2$ x 0.00099562)

*Height is in cm and* sum4 *is the sum of the triceps, subscapular, suprailiac, and mid-thigh skinfold thicknesses.*

*Source: Peterson et al., 2003*

Skinfold measurements are often combined with mid-upper-arm circumference (MUAC) and used as an indicator of protein-energy malnutrition. The estimated muscle arm circumference, $C_m$, provides the basis of the body's muscle mass and thus its main protein reserve. MUAC is determined by measuring to the nearest millimetre the circumference of the right arm, midway between the tip of the acromion and olecranon processes, with the arm relaxed. The triceps skinfold is then measured to the nearest millimetre at the same location in the posterior compartment of the arm. MUAC is derived using the equation: $C_m = C_a - \pi S$, where $C_a$ = MUAC and $S$ = triceps skinfold thickness. Because these two variables by themselves are not strong predictors of nutritional status, combining them to yield the following equations, in which $F$ = mid-arm fat and $M$ = mid-arm muscle, provides a more reliable estimation of arm fat and muscle (Lukaski, 1987):

$$F = SC_a/2 + \pi S^2/4$$

and

$$M = (C_a - \pi S)^2/4\pi$$

## 4. CLINICAL EVALUATIONS

A clinical assessment begins by taking vital signs and anthropometric measurements, namely weight, height, and BMI. These can provide important first clues of a client's nutritional status. Following a BMI determination, terms such as *normal weight*, *underweight*, *overweight*, and *obese* are used to describe the client. Adults and children who are consistently underweight are at high risk for marasmus and kwashiorkor. Marasmus is a form of protein and energy malnutrition that is characterized by severe tissue wasting and excessive loss of lean body mass and subcutaneous fat stores. Kwashiorkor is mainly a protein deficiency condition whose clinical signs include lethargy, apathy, irritability, retarded growth, changes in skin and hair pigmentation, and oedema of hands and feet. Study findings also suggest that many of the signs and symptoms of kwashiorkor are caused by micronutrient deficiencies, such as that of vitamin A, rather than poor protein intake (Golden, 2002).

The initial evaluation is followed by inspection of the skin, hair, nails, eyes, mouth, and other areas for signs of toxicity or nutrient deficiency. During this stage in the evaluation many micronutrient deficiencies can be uncovered. It has been suggested that 4.5 billion people worldwide are affected by deficiencies of iron, vitamin A, iodine, and zinc (Dickinson et al., 2009). A clinical examination of major body parts can reveal signs of micronutrient deficiencies, such as pale mucous membranes, Bitot's spots, goitre, and hair loss, that are associated with iron, vitamin A, iodine, and zinc deficiencies, respectively. Table 22.9 describes a list of specific signs associated with macronutrient and micronutrient deficiencies by body region. (A glossary of clinical terms is provided at the end of the chapter.) Lack of energy and inability to perform normal tasks are symptoms that may indicate iron-deficiency anaemia. Clinical evaluations are important in making a diagnosis in later stages of malnutrition, but they are not useful for detecting deficiencies in the early stages, when signs and symptoms are not readily apparent. A clinical evaluation should also include a measure of blood pressure as an indicator of heart disease risk.

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**Table 22.9:** Clinical signs and symptoms of nutritional significance based on physical examination

| Body system | Signs/symptoms |
|---|---|
| General | - Height, weight, body mass index, waist circumference, percent weight change (underweight, overweight, obese |
| Skin, hair, and mucous membranes | - Dermatitis (marasmus, deficiency of niacin, riboflavin, zinc, biotin, essential fatty acid, vitamin A)<br>- Pigmentation changes (marasmus, niacin deficiency)<br>- Pressure ulcers/delayed wound healing (kwashiorkor, diabetes)<br>- Pallor (deficiency of iron, copper, folic acid, vitamin $B_{12}$ or E) |
| Head | - Dispigmentation, easy pluckability (protein), alopecia (zinc, biotin deficiency)<br>- Delayed closure of fontanelle (paediatric undernutrition or growth retardation) |
| Eyes | - Night blindness, xerophthalmia, Bitot's spots, keratomalacia (vitamin A deficiency) |
| Mouth | - Angular stomatitis (riboflavin, iron deficiency)<br>- Bleeding gums (vitamins C, K, riboflavin deficiency)<br>- Cheilosis (riboflavin, niacin, vitamin $B_6$ deficiency)<br>- Dental caries (fluoride deficiency)<br>- Discolouration of teeth (fluoride toxicity) |
| Neck | - Hypogeusia (zinc, vitamin A deficiency)<br>- Goitre (iodine deficiency) |
| Thorax | - Thoracic rosary (vitamin D deficiency) |
| Abdomen | - Diarrhoea (niacin, folic acid, vitamin $B_{12}$ deficiency; marasmus)<br>- Ascites (kwashiorkor, alcoholism) |
| Genital/ urinary | - Delayed puberty (marasmus)<br>- Hypogonadism (zinc deficiency) |
| Extremities | - Bone ache, joint pain (vitamin C deficiency)<br>- Oedema (thiamine and protein deficiency)<br>- Muscle wasting and weakness (vitamin D deficiency, protein-energy undernutrition) |
| Nails | - Softening of bone (vitamin D, calcium, phosphorus deficiency)<br>- Spooning (iron deficiency) |
| Neurologic | - Dementia, delirium, disorientation (niacin, thiamine, vitamin $B_{12}$, vitamin E deficiency)<br>- Loss of reflexes, wrist drop, foot drop (thiamine deficiency)<br>- Tetany (vitamin D, calcium, magnesium deficiency) |

*Source: Reproduced from Hark et al., 2003. Reproduced with permission.*

## 5. LABORATORY TESTS

Laboratory tests can help confirm nutritional status findings uncovered during a dietary assessment and physical examination. To perform a laboratory test, a sample, such as blood or urine, must be collected and analyzed for various substances. Measurements of haemoglobin and ferritin levels in the blood provide reliable information regarding iron status, while serum retinol is useful in diagnosing vitamin A deficiency. Inadequate levels of these two nutrients represent the most common nutrient deficiencies in developing countries. If undernutrition is suspected, tests that measure protein status in the body are necessary. Serum albumin and prealbumin can be useful indicators of body protein status. However, because tests for these proteins are non-specific and non-sensitive, care should be exercised in interpreting results. Additionally, levels of these proteins may decrease in response to injury, disease, or inflammation, which means that individuals with low serum albumin and prealbumin levels may or may not be malnourished (Gordon, 2002).

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A laboratory examination should also include tests for components of the metabolic syndrome, an indicator of risk for heart disease and diabetes. Tests include blood levels of glucose, insulin, and lipids (especially triglycerides and HDL-cholesterol). Table 22.10 lists biochemical tests and their associated nutrients.

**Table 22.10:** Biochemical tests used as indicators of nutrient status

| Nutrient | Biochemical test |
|---|---|
| Protein | - Serum albumin (reflects nutritional status over the last 3 months)<br>- Serum transferrin (reflects protein status over the previous several weeks)<br>- Serum prealbumin (reflects protein and calorie intake over the past week) |
| Lipids and other indicators of heart disease risk | - Cholesterol (LDL-cholesterol and HDL-cholesterol)<br>- Triglycerides |
| Carbohydrates and other indicators of diabetes | - Serum glucose<br>- Haemoglobin (Hgb) $A1_C$<br>- Insulin levels<br>- C-reactive protein<br>- Serum and urinary ketone bodies |
| Electrolytes | - Sodium, potassium, chloride, calcium, phosphorus, magnesium, blood urea nitrogen (BUN), creatinine, urine urea nitrogen, uric acid<br>- Serum retinol |
| Vitamin A<br>Iron | - Complete blood count (CPC), serum iron and ferritin, total iron-binding capacity, transferrin saturation, mean corpuscular volume (MCV) |

*Source: Reproduced from Hark et al., 2003. Reproduced with permission.*

## 6. LOOKING AT THE BIG PICTURE

In this chapter we have looked at many indicators of both undernutrition and overnutrition. Both conditions are widespread in developing countries. However, prevalence varies widely from country to country. Indeed, even at the community level it is not uncommon to see people who have signs of undernutrition while their neighbours are overweight. A community nutritionist should therefore be familiar with the major nutrition problems within his or her community and choose appropriate tests on that basis.

We shall now look more closely at the problem of overnutrition. This is of enormous concern as the prevalence of chronic diseases of lifestyle (CDL) has been rising rapidly in developing countries in recent years. The pattern of CDL appears first and most prominently in an urbanized environment. The most obvious sign of it is escalating rates of obesity. Various indicators for nutrient status can be used to identify the health problems that appear whenever overnutrition and obesity have become common. Major problems are as follows:

- High blood pressure (or hypertension) is common among overweight and obese middle-aged people. The condition is also associated with a high salt intake. High blood pressure is a major risk factor for heart disease and stroke.
- Insulin resistance and glucose intolerance are strong predictors of elevated risk of type 2 diabetes. This disease is strongly associated with obesity, and risk rises sharply with age. Table 22.10 lists biochemical tests for risk factors linked to diabetes.
- There are several major risk factors for heart disease: high blood pressure, smoking, lack of physical activity, and abnormal blood lipids (high levels of LDL-cholesterol and triglycerides, and low levels of HDL-cholesterol). The presence of type 2 diabetes is another major risk factor.

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The condition known as metabolic syndrome refers to a cluster of measurements, notably high blood pressure, abdominal obesity, insulin resistance, glucose intolerance, high blood triglycerides, and low blood HDL-cholesterol (Alberti et al., 2009). The presence of the metabolic syndrome signifies an increased risk for heart disease, stroke, and diabetes (International Diabetes Federation, 2004).

## DISCUSSION QUESTIONS AND EXERCISES

1. Discuss the advantages and disadvantages of the various dietary assessment methods.
2. Discuss the steps that you would follow to conduct a thorough nutritional assessment of a community.
3. Compare and contrast the various anthropometric methods used to evaluate nutritional status.
4. Select five body systems, and for each one, discuss the clinical signs or symptoms that may be evidence of poor nutritional status.
5. Choose and discuss seven biochemical tests that reflect levels of nutrients in the body.
6. Carry out a 24-hour food recall on three classmates. Compare the intake of different food groups with the food guide used in your country. Next, carry out a computer analysis of each diet (use the various sources referred to in the "Additional Resources" section at the end of this chapter). Compare your findings with the values given in Appendix III at the end of the book. Identify possible problem areas with each of the diets. Use the results of this exercise to help plan ways to improve the diets.
7. Write a report on the nutritional status of children in your community using any recent surveillance data. Classification of nutritional status using anthropometry should be based on the World Health Organization growth standards.

## GLOSSARY OF CLINICAL TERMS

(Source: Fremgen & Frught, 2009)

**alopecia:** the loss of hair from the head or body, sometimes to the extent of baldness

**angular stomatitis:** an inflammatory lesion at the labial commissure, or corner of the mouth, often occurring bilaterally

**ascites:** accumulation of fluid in the peritoneal cavity

**Bitot's spots:** buildup of keratin debris located superficially in the conjunctiva, which are oval, triangular, or irregular in shape

**cheilosis:** angular stomatitis

**dermatitis:** inflammation of the skin

**dispigmentation:** lightening of the skin, or loss of pigment

**hypogeusia:** diminished ability to taste things (to taste sweet, sour, bitter, or salty substances)

**hypogonadism:** decreased functional activity of the gonads

**keratomalacia:** an eye disorder that leads to a dry cornea

**oedema:** an abnormal accumulation of fluid beneath the skin or in one or more cavities of the body

**pallor:** a reduced amount of oxyhaemoglobin in skin or mucous membrane; a pale colour that can be caused by illness, emotional shock or stress, stimulant use, lack of exposure to sunlight, anaemia, or genetics

**spooning:** flexion and dorsal arching of the wrists and hyperextension of the fingers when the hands are extended sideways, palms down

**tetany:** the involuntary contraction of muscles, caused by diseases and other conditions that increase the action potential frequency

**thoracic rosary:** enlarged ends of the ribs, resembling beads, that can be palpable and visible at the costochondral junction

**xerophthalmia:** a medical condition in which the eye fails to produce tears

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## ADDITIONAL RESOURCES

Information on making anthropometric measurements is available at the website of FANTA (Food and Nutrition Technical Assistance II Project): http://www.fantaproject.org/publications/anthropom.shtml.

Further details on the National Health and Nutrition Examination Study (NHANES) can be found on the following website: http://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm

Information on food composition, dietary guidelines, and weight and obesity can be found on the website of the U.S. Department of Agriculture (USDA): http://fnic.nal.usda.gov/

Various food composition tables are available. The first four can be accessed online at no cost:

http://www.nal.usda.gov/fnic/foodcomp/search/. This is the USDA National Nutrient Database (also available via the previous website).

http://www.nutritiondata.com. Operated by NutritionData. This source contains the same data as the USDA database but presented in a different format.

http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/nutrient_value-valeurs_nutritives-eng.php. This Canadian website provides detailed information on the nutrition content of large numbers of foods.

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The following books are available for purchase:

Food Standard Agency, Public Health England. 2014. *McCance and Widdowson's the Composition of Foods: Summary Edition*, 7th ed. London, Royal Society of Chemistry. List price: £54 (UK).

Wolmarans P, Danster N, Dalton A, Rossouw K & Schönfeldt H. 2010. *Condensed Food Composition Tables for South Africa.* List price: R 400 (approximately US$31). Available from: Food Composition Database Officer, Nutritional Intervention Research Unit, Medical Research Council, PO Box 19070, Tygerberg 7505, South Africa, http://safoods.mrc.ac.za. E-mail: natasha.danster@mrc.ac.za.

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# PART 8

## FOOD SERVICES AND FOOD SAFETY

# CHAPTER 23

# PROVIDING MEALS IN INSTITUTIONAL SETTINGS

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## *Outline*

- How to plan a menu
- Food service processes
- Food production processes
- Hygiene and food safety
- Management principles in food services

## *Objectives*

At the completion of this chapter you should be able to:

- Identify which community facilities typically require food services
- Understand what factors to consider when drawing up a menu
- Develop a menu for any community facility
- Describe the principle of cycle menus
- Explain the different food service processes
- Understand and implement the different food production processes
- Apply the basic hygiene principles of a food service unit
- Explain the basic principles of management


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# 1. INTRODUCTION

As author Sheila Graham is reputed to have said, "Food is the most primitive form of comfort." As her comment suggests, in order to be regarded as a success, a meal needs to be both psychologically and physiologically satisfying.

In institutions of various types the provisioning of meals is often a main event. Not only do meals provide nourishment and comfort, but they also offer an occasion for social interaction. Providing meals that satisfy these various needs poses a continuous challenge to food services staff, especially since meals must be delivered several times daily, 365 days a year. In this chapter we discuss the management of food provisioning at community-based facilities, also referred to as food service units.

Nutritional management can be defined as planning, organizing, leading, and controlling the use of resources to achieve specific objectives with respect to the diet (Hudson, 2005). In the case of health facilities, at the community level these objectives include the provision of meals and snacks that are affordable and culturally appropriate and that meet the nutritional requirements of a diverse array of clients. The focus of this chapter is to provide appropriate knowledge and tools required to manage community-based feeding in an effective and efficient way to the benefit of all stakeholders.

## 1.1 The Basic Goals of Food Management at the Community Level

Countries may follow a policy that is included in their constitution, stating that citizens have the right to have access to sufficient food as a basic human right. In the case of community health facilities, this responsibility falls on the facility providing the service. This makes good sense because nutrition forms an integral part of treatment and recuperation.

It is usually the national department of health that sets the minimum standards for food service units in a country, with the goal of providing the best possible food service to hospitals and other health institutions and facilities within the limitations of financial resources (DOH, 2001b). The management process in health facilities is often influenced by the following stakeholders:

- Community members making use of facilities, e.g., patients, learners, or residents, who expect meals that are nutritional and that respond to their emotional and social needs
- Staff working in a food service unit (preparation, cleaning, and management) or assisting in service delivery (ordering, storage, and procurement), who expect acceptable and safe working conditions, fair treatment, adequate skills development, and reasonable remuneration
- Staff using a food facility, who, like clients, also expect to receive good-quality meals
- Political structures and institutional/facilities management, which determine the policy on food provisions and budget allocations, not only for food, but also for physical facilities, equipment, and staffing
- Members of the public, who expect the availability of a reasonably good service in exchange for taxes paid
- Suppliers to the facility, who expect fair procurement procedures, a service according to specifications set, and payment of accounts within a reasonable timeframe

Management at the institutional/facility level thus has a responsibility that extends beyond simply providing meals. Management must not only ensure that a food service operation runs smoothly and is cost-effective, but also that the meals served promote good health and satisfy the expectations of those who consume them.

## 1.2 Facilities that Deliver Food Services

Any facility in which members of the community reside or work for longer than 8 to 12 hours at a time faces the challenge of providing meals. Numerous public facilities settings exist in which food services are required. Most commonly, meals must be arranged for the following situations:

- Children aged 6 years and younger at day care facilities or early childhood development centres
- Students attending schools, colleges, or universities, especially those who reside in dormitories
- Older adults living in retirement villages or old-age homes

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- Industrial workers at mines or factories
- Patients and staff at hospitals and after-care facilities
- Inmates and staff at correctional facilities

The nutritional requirements and psychosocial needs of these groups vary, and, as far as possible, food service delivery should be adapted accordingly.

# 2. THE MENU

The menu is the focal point of the functioning and production planning of any food service, and it directs all other food service actions. A menu can be defined as a detailed list of foods to be served at a meal or, in broader sense, a total list of food items offered by a food service unit (Shugart & Molt, 1993; Spears, 1995).

The objective of menu planning is to integrate different food items in a specific plan to satisfy the needs and requirements of clients to be served. The menu determines the ingredients to be purchased, the equipment needed for preparation, the work to be done, the skills of staff needed, the work schedule, and supervision required. It is also the basis for costing of food that will be served (Brown, 2014; Hudson, 2005; Spears, 1995).

## 2.1 Factors to Consider When Planning a Menu

As the menu forms the backbone in planning and managing a food service, spending time and effort in adequate menu planning is valuable. The following factors should receive attention.

### *2.1.1 The client*

The most important factor to consider is the customer or client (Cronjé, 1993; Spears, 1995). The person planning the menu should consider the characteristics of the group to be served, their age, gender, nutritional needs, health status, and food habits, as well as their individual, religious, and cultural preferences. This becomes especially important if the food service offers a limited choice of foods. Menus should be planned to meet the needs of the majority of patrons, with enough flexibility to satisfy everyone (Brown, 2014; Shugart & Molt, 1993).

### *2.1.2 Nutritional adequacy*

The aim of providing food is to ensure optimal health by meeting the nutritional needs of the client. It is therefore necessary to firstly determine these specific nutritional needs. Ideally, a dietitian or nutritionist should convert nutritional needs into quantities of specific foods that will be included in the menu. Specific guidelines and tools are available to guide menu planning and ensure nutritional adequacy. These include the following:

- Food-based dietary guidelines, developed for each country, to address specific health issues. Chapters 13 and 14 covered the subject of diet for disease prevention and food guides
- Different types of food groupings, whereby a dietitian or nutritionist will indicate specific portions per food group for clients with specific needs
- Food ration scales that are adapted according to the needs of specific groups

In South Africa the policy for institutional food supply, for example, specifies that a hospital diet should provide energy and macronutrients within the following ranges (DOH, 2001b):

| | |
|---|---|
| Energy | 1500–2000 kcal (6300–8400 kJ) |
| Carbohydrates | 204–272 g |
| Protein | 56–99 g |
| Fat | 41–55 g |

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### *2.1.3 Cultural background, religion, and social status*

A menu is compiled in order to provide a service to the client or customer. This means the needs of the clients should be carefully considered *before* a menu is compiled. Eating habits are the tendencies that determine what, when, why, and how a person will eat his meals. The customer's eating habits can be influenced by factors such as age, race, culture, gender, and religion, as well as economic and social factors.

### *2.1.4 Regulations and standards; the meal plan*

In order to standardize and ensure optimal service delivery, governmental policies often determine the minimum amounts, ration scales, and/or the meal plan to be followed by public facilities. In South Africa, the meal plan shown in Table 23.1 is recommended for clients on a normal diet (DOH, 2001b).

**Table 23.1:** An example of a meal plan for relative healthy clients with normal needs

| Meal Time | Food Items |
|---|---|
| Early morning | - Tea/coffee with milk and sugar |
| Breakfast | - Fruit* or fruit juice (150 ml)<br>- Dry breakfast cereal / porridge with milk and sugar<br>- Protein dish (optional)<br>- Brown bread<br>- Margarine<br>- Jam / peanut butter / meat extract<br>- Tea/coffee with milk and sugar |
| 10:00 | - Tea/coffee with milk and sugar |
| Lunch | - Soup (optional)<br>- Main dish<br>- Starch<br>- 2 vegetables OR 1 vegetable and 1 salad<br>- Tea/coffee with milk and sugar<br>- Dessert (optional) |
| 14:00 | - Tea/coffee with milk and sugar |
| Supper | - Soup (optional)<br>- Main dish<br>- Starch<br>- 1 vegetable or salad<br>- Brown bread<br>- Margarine<br>- Jam / peanut butter / meat extract<br>- Tea/coffee with milk and sugar |
| 20:00 | - Tea/coffee with milk and sugar |

**Fruit (1 fruit per day) may be served at another mealtime, rather than at breakfast*

Meal plans, however, can and should differ according to the eating patterns of the community served. Policy makers have the important role of ensuring that nutrient needs are met within the restrictions of cultural eating habits and preferences. A food ration scale should be used with the recommended meal plan in order to provide food in appropriate portions while complying with nutrient needs of patients in a public service institution or facility.

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### *2.1.5 Type of service*

The type of service will determine the type of foods that are suitable for placing on a menu. A food service can function as a conventional food service, a cook-chill food service, or a cook-freeze service. Because community-based facilities generally cater to a relatively small number of clients, a conventional food service is usually used. All food items can be included in the menu provided they can be prepared conventionally on a large scale and retain quality and nutritional value during transport and serving.

### *2.1.6 The number of clients to be served*

The number of clients in a facility determines the type of equipment that is needed to prepare food and, in turn, the type of food that can be served. The larger the number of clients in a facility, the more care that should be taken to ensure that the preparation of a menu item is standardized by making use of tested and standardized recipes that produce the same amount of portions and the same quality every time.

### *2.1.7 Budget and financial resources*

One of the main goals of any food service unit is to provide the best possible food service within the restriction of a limited budget. The available budget is one of the most important factors influencing the type of menu that can be served. Financial planning and accountability within the food service unit are the major responsibilities of the manager; cost-effectiveness is essential for successful operation (DOH, 2001b). The food service manager needs to plan and budget for the four main activities within the food service unit, namely:

- Staff – salaries and training
- Equipment – maintenance and replacement
- Food items – perishables and non-perishables, including tube feeds and infant formula
- Cleaning material

### *2.1.8 Availability of foods*

The food items included in a menu should be available locally or available to be delivered to the facility. Availability of foods may be influenced by the season. It is therefore essential to have different menus depending on the season, such as separate winter and summer menus.

### *2.1.9 Equipment available*

The type of equipment available in a food service unit will determine the type of menu items and the cooking and preparation methods that can be used (DOH, 2001a; DOH, 2001b). Roasted chicken, for example, cannot be included on the menu if there is no oven in the unit.

### *2.1.10 Skill level and number of staff*

The number and skills of staff must be considered when menus are planned. If skilled staff are available, then more complex dishes can be included on the menu (DOH, 2001b).

### *2.1.11 Taste and appearance*

One of the most important factors to consider when compiling a menu is how to satisfy the customers' need in terms of taste and appearance (Spears, 1995). The food in a meal should be combined according to colour, shape, texture, aroma, taste, consistency, and temperature (DOH, 2001b; Brown, 2014).

### *2.1.12 Menu cycles*

A cycle menu is a carefully planned series of menus that offer different items each day for a few days, but more typically one to three weeks. The menus are repeated at the end of the cycle.

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A short cycle is usually used for food services having a frequent clientele turnover, while a longer cycle is necessary for facilities where the clients need to be fed for extended periods of time or where the clients are not able to eat elsewhere. If a cycle with less than 7 days is used, one advantage is that clients will not be able to link a specific menu item to a specific day, but one disadvantage is that a typical light Saturday meal and a traditional Sunday lunch might be scheduled during weekdays. A food service should also make provision for changing menu cycles according to seasonal availability, in order to allow for seasonal differences (Cronjé, 1993; Hudson, 2005; Shugart & Molt, 1993; Spears, 1995).

It is recommended that a facility have a menu cycle of 8 to 21 days in order to accommodate long-term patients and to ensure variety of menu items and preparation methods. The following are advantages of using a cycle menu:

- It saves time for the person planning the daily menus, and once the menu has been planned, only slight changes need to be made.
- It is an effective tool for food and labour cost control, forecasting, and purchasing.
- Repetition of the same menus is often more efficient through repeated use of a familiar recipe.
- Workloads can be distributed evenly.

However, it is important to plan menus carefully and analyze each day's menus in order to alter and correct them before the menu cycle is repeated. In this way client satisfaction can be ensured and a monotonous menu avoided (Shugart & Molt, 1993).

## 2.2 Creating a Menu

The first step in creating a menu is to determine the needs of the facility and its customers. The manager has to determine which meals need to be served (breakfast, lunch, and supper, with or without in-between meals) and the constraints of the system for which the menu is written (Hudson, 2005). According to researchers such as Hudson (2005), possible constraints can include: government regulations and prescriptions; size of the facility; equipment available; skill level of staff; financial resources; number of clients to be served in a fixed period of time; customer demographics (age, religion, income, etc.); health of the clientele; preferences of the clientele; budget; and food availability.

Meal composition is usually directed by policy documents from the governmental department or governing body funding the facility. The composition of meals and the length of the menu cycle to be followed must be determined. This meal plan does, however, still leave room for the creative influence of the manager at the institutional level to apply his or her skills to adapting the menu to satisfy the specific requirements and special circumstances of the facility.

Creating the menu usually starts with the main dish (often, but not necessarily, the protein-rich dish) for the main meal of the day (typically lunch), followed by the main dish for the lighter meal, and then the main dish for breakfast (Hudson, 2005). After the main dishes have been planned, meals should be completed by adding starches, vegetables, fruits, or any other food items to complement the main dish, towards nutritional and sensory completeness. It is important to ensure that the items on the plate are balanced overall in terms of colour, shape, size, texture, and flavour (Hudson, 2005).

Meal plans should preferably be laid out on a spreadsheet; this allows any repetitions to be identified, for which substitutions can then be made. To simplify planning, it can help to use symbols for the planning of main dishes – it is easier to see two repeated symbols than to read and recognize two related types of dishes that are repeated (Cronjé, 1993).

In order to help add variety and to the menus and make them more appealing it is important to ensure the following:

- The same vegetables should not be served at consecutive meals or on adjacent days (e.g., cooked carrots for lunch and carrot salad for supper).
- The main dish should not be repeated in any form at consecutive meals or on adjacent days (e.g., savoury mince for breakfast and meatballs for lunch).

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- The main dish should not recur on the same day of consecutive weeks (e.g., fish on a Wednesday).
- The menu should be viewed as a cycle, with the last week being evaluated in terms of the first week as well as the week that preceded it (Hudson, 2005).
- A specific recipe or dish should not reoccur for the duration of a cycle (i.e., it should only appear once within the cycle).

As soon as the menu is in a draft form, it should be shared with others involved in its implementation to ensure a practical working plan. The dietitian would consider nutritional adequacy, the cook would advise on production feasibility, and an administrative officer would review with respect to availability of products, costing, and the arrangement of contracts (Hudson, 2005).

The final step of creating a menu is its actual testing and refining so as to adapt it as closely as possible to the enjoyment, satisfaction, and needs of the clients before final implementation. Table 23.2 shows an example of a form that can be used to evaluate a menu before implementation.

**Table 23.2:** Form to evaluate the draft menu before implementation

| | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 |
|---|---|---|---|---|---|---|---|
| **Colour:**<br>Contrast<br>Combinations<br>Natural colour<br>Use of garnish | | | | | | | |
| **Flavour:**<br>Contrast<br>Acceptable combinations<br>Balance<br>Not repeated too often | | | | | | | |
| **Texture:**<br>Contrast – firm, crisp, soft, sticky<br>Acceptable | | | | | | | |
| **Form, shape, and size:**<br>Variation – round, long, flat, cubes<br>Serving method (e.g., cubed potatoes, round potatoes). | | | | | | | |
| **Preparation type:**<br>Variation<br>Not too many fried foods, sauces, or same preparation types | | | | | | | |
| **Repetition:**<br>Do not repeat same type of food in the same meal or on the same day of the week | | | | | | | |
| **Temperature:**<br>Include hot and cold foods | | | | | | | |

*Source: Spears, 1995.*

## 3. FOOD SERVICE PROCESSES

Once a menu has been drawn up, various processes have to be put in place to ensure that the food service runs smoothly, effectively, and efficiently. Irrespective of the food system that is used, the following processes are usually followed (Cronjé, 1993):

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- Purchasing, delivery, reception, sorting, and storage
- Pre-preparation of food (washing, cleaning, peeling)
- Preparation of food (cooking, baking)
- Portioning of food
- Distribution of food
- Serving of food
- Clearing dinnerware and leftover food
- Washing
- Removing refuse

The different functions that need to be performed in a food service are described below, as well as the tools available for each.

## 3.1 Purchasing

Food should be purchased according to the already-planned menu (Cronjé, 1993). About 5% to 7% of a health-care facility's supply budget is usually used for food service purchasing, and many facilities try to cut down on this budget as a means to implement cost control (McCann & Bloch, 1997). Effective and efficient utilization of the food service budget is therefore essential. As soon as the food service has determined, within the budgetary restrictions, what is needed to deliver a service, it is important to describe these items, whether they are food items, cleaning materials, or packaging materials.

## 3.2 Specifications

A specification is a description of an item to be purchased, and it needs to be clear so that the purchaser and the supplier know exactly what is required. A specification will typically include the item name, form, quantity, quality, pricing, and any other additional information that is needed. Table 23.3 provides an example of the information that can be included in a specification (Hudson, 2005).

**Table 23.3:** Components to be included in a specification

| Component | Description | Example |
|---|---|---|
| Item name | Name of the product that is needed | Eggs |
| Form | Description of item (weight, size, whether it is fresh, frozen, or canned) and its packaging | Fresh, large, whole eggs, packaged 30 dozen per case |
| Quantity | How many are needed | 60 dozen |
| Quality | Description of the minimum acceptable characteristics for this product | Grade A |
| Pricing unit | Price per item, package, or other unit | Price per case |
| Miscellaneous | Other information for the supplier from the purchaser | Delivery temperature |

A national document with specifications for perishable foods should be compiled to standardize quality, and can be used as a valuable tool when setting up specifications for an institution or facility (DOH, 2001c).

When choosing a supplier, it is important to work in an ethical way. McCann & Bloch (1994) specify the following practices:

- Do not provide confidential information to a supplier's competitor.
- Do not buy supplies without a legal bid system.

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- Do not allow quotes to be shared between bidders.
- Do not put pressure on suppliers to lower prices through veiled threats.
- Do not accept higher quotes without a good reason.
- Do not accept free stock or gifts from suppliers.
- Do not allow suppliers to sponsor parties or meetings.
- Do not allow suppliers to influence or change a decision after an award has been made.
- Do not create the impression that large orders can be expected by the supplier when you will only place a small order.
- Do not place the entire purchasing, receiving, and payment system in the hands of one individual or department.

There are various methods of procurement. Specific procedures are not described in this chapter. Nonetheless, it is important to make sure that suppliers meet basic performance criteria. It is relatively easy in a community setting to identify all possible suppliers and obtain a track record from other users. It is, however, important to provide suppliers with the specifications of the products in order to ensure compliance to the specified standards.

The following questions can be asked in order to collect information for determining the suitability of a possible supplier (McCann & Bloch, 1994):

- Does the supplier deliver on time?
- Does the supplier respond when an emergency order is placed, and how long do they take to fill the order?
- Does the supplier provide stock that does not comply with specifications and therefore has to be rejected?
- How often does the supplier deliver stock late?
- Does the supplier have appropriate delivery vehicles, such as refrigerated vehicles for meat or milk?
- What kind of infrastructure does the supplier have, in terms of telephones, availability, e-mail, faxes, etc., and how fast does the supplier react when messages are sent?
- How does the supplier handle late payments?
- How financially stable is the supplier?
- What is the company's history and how long has it been in business?
- Where is the supplier's warehouse or stores, and how accessible is the stock at short notice?
- How much stock does the supplier have available?
- Will the supplier allow inspections of the premises on a regular basis?

## 3.3 Ordering

Items to be purchased in a food service can broadly be categorized as follows (Hudson, 2005):

*Supplies.* Supplies include office supplies, paper goods, disposable service ware (e.g., disposable plates, utensils, place mats), cleaning supplies, and related items. Adequate quantities can be bought, balancing cash flow and available storage space with the savings for bulk purchasing.

*Groceries/non-perishables.* Groceries include any food products that are purchased in a form that is shelf-stable at room temperature, such as spices, cereals, and canned foods. Each of these products has a defined shelf-life. It is important to adapt ordering frequency and quantities in order to allow for groceries to be used before their expiry date.

*Perishables.* These are foods with a limited shelf-life that require refrigerated or freeze storage (e.g., meat, fish, eggs, and dairy products).

*Equipment.* This can be large, capital-intensive equipment that needs to be budgeted for in advance, or it may be small equipment such as dishes, pots, and pans.

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The menu, with its accompanying standardized recipes, is used to calculate the amount of groceries that need to be ordered.

## 3.4 Delivery

When purchasing agreements with suppliers are arranged, delivery requirements are one of the important issues to agree upon. The frequency and timing of delivery impacts on the staff and security and should be well planned. In general, bigger clients are often given preferential delivery slots, but most suppliers try to accommodate even the smallest clients in order to ensure the supplier's good reputation (Hudson, 2005).

It is important to make sure that standards are adhered to when food items are transported to food service units. It is therefore necessary to indicate to the supplier the specifications for transportation. For example, meat delivery may require that the vehicle keeps the food at an appropriate temperature.

### *3.4.1 Frequency of deliveries*

The location of the institution is an important factor affecting the frequency of deliveries. In rural areas, deliveries might only be possible on a weekly or biweekly basis, while in an urban area, daily deliveries may be possible. Table 23.4 illustrates the impact of delivery frequency on food service actions and planning.

**Table 23.4:** Impact of frequency of delivery on food service actions and planning

| | Daily delivery | Less frequent delivery |
|---|---|---|
| Advantages | - Goods are ordered so that they only arrive when they are needed.<br>- Material goes directly to production.<br>- Less storage space is needed.<br>- Less manpower is needed in storage area.<br>- Cost for maintenance of storage areas is reduced.<br>- Less theft occurs, because very little inventory available. | - Delivery can be planned according to needs of institution and when back-up stock is available.<br>- Facility has better control of stock received because frequency is limited. |
| Challenges | - Production may be delayed if delivery is late.<br>- If items are missing or do not comply with specifications at delivery, there is no back-up stock to support production.<br>- Deliveries taken directly to production area might interfere with rotation of stock into and out of inventory, and stock in storage might become unusable. | - Facility must plan needs for a longer time span.<br>- Facility must ensure adequate stock on hand to allow for contingencies.<br>- Orders are large and storage needs to take place quickly to preserve quality, all of which affects staffing.<br>- Security needs to be tight because the monetary value of stock increases with decrease in delivery frequency. |

*Source: Adapted from Hudson, 2005.*

As can be seen from Table 23.4, a fine balance in frequency of delivery needs to be found in order to make use of the advantages of frequent delivery, but with the safety net of enough stock available to be able to make contingency plans. Perishable products are usually purchased as close as possible to when they are served. Products such as milk and bread are usually delivered on a daily basis, whereas products with a longer shelf-life are delivered less frequently, depending on storage space available (Cronjé, 1993).

### *3.4.2 Timing of deliveries*

The frequency of delivery as well as the timing need to be carefully planned. Planning should be coordinated with production needs as well as the work schedules of staff.

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Most community-based facilities operate 7 days per week. Deliveries at the weekend should in general be avoided or limited to essential perishable items, such as bread or milk. This may help reduce the number of staff required over a weekend and also help prevent financial losses due to theft or poor stock control.

### *3.4.3 Delivery area*

When setting up an agreement with a supplier, you must specify the actual delivery area. Ideally, the delivery area is close to the storage area.

## 3.5 Receiving

Receiving of stock is an important control point for purchasing and should therefore be planned and carried out with care. In community-based facilities, the staff that receive stock are often also responsible for storage and distribution. The persons receiving stock should do all of the following:

- Know the expected delivery time.
- Ensure adequate sanitation at the receiving area.
- Know what was ordered as well as its specifications.
- Control the quantity and quality of stock received by means of weighing, counting, checking temperatures, and inspecting.
- Accept or reject the stock delivered.
- Record in the receiving book the type, amount, temperature, and any deviations that warranted rejection of stock.
- Compare the invoice received with the stock accepted.
- Indicate any differences in quantity, quality, or price on all the copies of the invoice(s) received.
- Sign the invoice(s), keep a copy of any invoice at the facility, and send a copy of all invoices back to the supplier.
- Store stock appropriately.
- Accept responsibility for the security of the stock received.

When stock is delivered, it should always be taken to the storeroom before usage. This helps prevent backup stock ageing in the storage areas.

## 3.6 Storage

Storage areas are planned according to the requirements of the institution for various products and may include dry storage areas, cold rooms, and freezer rooms. The location of storage areas should be determined in relation to receiving, preparation, and production areas.

To prevent wastage, it is necessary to monitor what is in storage and its age. Stock rotation should be implemented, especially for perishables; in other words, old stock should always be used before newer stock. To facilitate this, when new stock is delivered, it should not be stored in front of or on top of older stock.

### *3.6.1 General storage principles*

Other useful rules to follow regarding food storage are (Hudson, 2005):

- Store frequently used stock near the entrance to the storage area, and store rarely used stock further back.
- Store heavy items near the floor, and lighter ones on top or higher up.
- As appropriate assign and label space for each item on the inventory and make sure that it is stored in its assigned space.
- Secure any shelving to the floor, the ceiling, or a wall.
- About 25 cm centimetres should be allowed between the floor and shelves. Therefore, lower shelves should not be mounted directly on the floor.

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- Ensure that a safe exit exists for someone who is locked inside the storage area.
- Expensive or controlled substances should be secured at all times.

### *3.6.2 Dry storage areas*

Separate storerooms or store areas should be planned for various products, such as the following kinds of items:

- Staple food supplies
- Non-food supplies and equipment
- Cleaning material and equipment
- Baked products
- Linen and protective clothing for staff
- Dry garbage and/or recyclable materials, such as empty boxes, cartons, and plastic containers

Hudson (2005) suggests the following requirements and design criteria for dry storage areas:

- Store food items separately from non-food items such as soap, bleach, and pesticides.
- Allow for easy movement of heavy supplies by carts or trolleys.
- Ensure adequate space to view all products directly without having to move other products.
- Ensure proper illumination, ventilation, and security.
- Maintain the temperature at 18 to 20°C. The temperature in dry storerooms should never be higher than 37°C.
- Adequate shelving should be provided to keep food away from floor and walls.
- All items should be kept at least 25 cm above the floor to allow for easy cleaning under lower shelves.
- Use easy-to-clean shelves that can be dismantled and washed in a tub or sink.
- If packaging is vulnerable to penetration by insects and rodents, bins or sealed containers must be used for storage.
- The storeroom should be well lit, well ventilated, and humidity controlled.
- Ensure adequate security to prevent theft.

### *3.6.3 Refrigeration and frozen storage*

Ideally, food services will have walk-in type refrigerators and freezers. In the case of smaller institutions, one cold room and a chest-type or cabinet-type freezer might be sufficient, while larger institutions may need more than one type of cold room for various purposes and a freezer room that has either a separate entrance or else is situated at the back of a cold room. The advantage of having a freezer at the back of a cold room is that it conserves energy; a disadvantage is that it may cause loss of space as a result of requiring extra door space and a path to the freezer.

The requirements and design criteria for refrigerated- and freezer-storage areas are as follows, per Hudson, 2005:

- Install a thermometer that can be read from the outside without opening the door.
- Invest in an alarm to warn against dropping temperatures within the cold storage area.
- Maintain and check cold storage areas regularly.
- Prevent frost build-up inside cold storage units as this may lead to decreased efficiency.
- Keep shelving away from the floor and removable for easy cleaning.
- Separate different products within the same cold room and mark storage space for items clearly.
- Cover all products to prevent transfer of flavours, spills, and cross-infection.
- Mark open packages with the date they were opened and leftovers with the date of production.

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- Let hot food cool before placing it in a cold-storage area.
- Ensure that stock is rotated and used on a first-in-first-out basis to prevent quality losses.

### *3.6.4 Stock control records*

Stock control forms an important managerial function within a food service unit. A stock control system needs to be simple and easy to use in order to ensure that it is indeed used and provides benefits. Stock control should include a physical inventory and a perpetual inventory, as indicated below.

### *3.6.5 Physical inventory*

A physical counting of stock on hand should be done at least once a year, but preferably once a month or once a week, depending on the size of the institution. Usually, two people complete the physical inventory together (Hudson, 2005).

### *3.6.6 Perpetual inventory*

A perpetual inventory uses the data from an initial physical inventory, adds goods that have been purchased, and subtracts goods that have been used. By doing this, it is possible at any given time to know the exact amounts of stock available in the storerooms.

On a regular basis, the perpetual inventory should be compared to a physical inventory for an update and accuracy check. When control is very good, there is 90% to 95% agreement between the two inventories, in which case physical stocktaking can be performed less frequently (Hudson, 2005).

In a community-based facility, the information from stock cards from the stores and invoices from suppliers can be entered on a relatively simple spreadsheet and used as a perpetual inventory. Table 23.5 provides an example of information to be included on a stock control card.

**Table 23.5:** Information to be included on a stock control card

| **Group of items (e.g., breakfast cereals)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Item | Code | Packaging Unit | Max. level | Min. level | Current level | Qty issued | Issuing date | End units | Date of stock checking |
| Oats | 321 | 2 kg | 25 | 5 | 12 | | | | |
| Corn meal | 322 | 1 kg | 24 | 4 | 14 | | | | |
| Lentils | 323 | 1 kg | 24 | 4 | 11 | | | | |

## 4. FOOD PRODUCTION PROCESSES

### 4.1 Pre-preparation

Pre-preparation includes all processing of food before it is cooked, such as washing, cleaning, carving, shredding, measuring, and peeling (Cronjé, 1993). These activities should be planned, controlled, and well timed to ensure smooth operation of the food service unit. Different types of food should be handled in different pre-preparation areas, using separate utensils to prevent cross-contamination.

### 4.2 Food Preparation

Food preparation usually takes place in the cooking area of a kitchen. Peak activity can be expected just before meal times (Cronjé, 1993). For optimal performance, production meetings with the cooks or other food production staff should be held before meal preparation, to discuss the menu of the day and any deviations

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from the menu. Staff involved with food preparation should be trained and provided with standardized recipes to ensure optimal service delivery and prevent losses due to failed recipes.

## 4.3 Enlarging Household-size Recipes

Although many large-scale recipes are widely available, in community-based facilities the recipes used are often small scale, more suitable to food preparation for a family. This is not an ideal situation, as cost-, portion-, and quality control are determined by the recipe that is used. Enlargement of a household recipe to one that reflects the number of clients in the facility is therefore necessary. But first, it is important to ensure that the recipe is suitable for large-quantity production without loss of quality.

Shugart and Molt (1993) and Spears (1995) recommended the following procedures to translate a household recipe for use in a facility setting, rather than simple increase by means of multiplication:

1. Prepare the original recipe, follow all instructions precisely, and note any problems that occur. Use weight measures to increase accuracy.
2. Evaluate the product and adjust the recipe until it is completely acceptable. This may necessitate repeating preparation of the original recipe several times.
3. The next step is to double the recipe and make notes on the changes that are made. Extra cooking time or a reduction in certain ingredients might be needed. The product must now be evaluated for yield, portion size, and acceptability.
4. Double the recipe again and make sure to adapt the quantities to fit the baking tins, containers, or pots that will be used. Evaluate the product and adapt the recipe if necessary.
5. If the product is satisfactory, continue to increase amounts used in the recipe in increments of 25 portions or per pan size. Recipes should be evaluated for acceptability each time a significant yield adjustment is made.
6. Evaluate the final product by using a taste panel before the recipe is included in the menu.

An example of a recipe sheet for documentation of standardized recipes is shown in Table 23.6.

**Table 23.6:** Example of a standardized recipe format

Name of recipe: _____ Code: _____
Yield: (how many portions) _____ Portion size: _____ g / _____ ml
Oven: _____° C Baking time: _____min
Equipment needed: _____

| Ingredient | Amount | Procedure |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

Variation notes:
_____
_____
Analysis per portion:
_____

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| Energy (kJ or kcal) | Protein (g) | Carbohydrate (g) | Fat (g) | Cost |
|---|---|---|---|---|
| | | | | |

*Source: Adapted from Spears, 1995.*

## 4.4 General Principles for Food Preparation

Food should be prepared to meet the following criteria:

- Provides optimal nutritional value with minimum nutrient losses during preparation
- Be microbiologically safe
- Satisfies the psychological needs of the clients

In order to comply with these criteria, the following basic principles should be applied:

- Prepare and serve food that people enjoy.
- Use ingredients that are fresh and of good quality.
- Use a minimum of handling and processing.
- Prevent nutrient losses by using a minimum of cooking fluids, peeling, and heat, and do all preparation as quickly as possible.

## 4.5 Portioning, Distribution, and Serving of Food

Portion control is an essential aspect when preparing food on a large scale, so as to ensure that the needs of clients are met (Spears, 1995). The portion size is usually stipulated in the standardized recipe, making planning easier. Specific serving utensils can be indicated on the standardized recipe so that portions are the correct amount.

Most of the quality losses and temperature losses take place during portioning, distribution, and serving of food (Cronjé, 1993). For example, food may be distributed to an adjacent dining room or to rooms quite a distance from where it is prepared. To minimize losses in quality and temperature, these procedures must take place quickly and efficiently.

In the case of health institutions, such as hospitals, portioning should be done according to the order forms received from wards that indicate the number and types of diets required. With care facilities, portioning is done according to the number of clients to be served.

In order to improve planning, a form should be completed that records meal statistics on a daily basis. This will record the number of meals delivered to each ward for breakfast, lunch, and supper, as well as all rations and snacks. Special meals, staff meals, and therapeutic diets should also be included.

If self-service is allowed, portion control is not possible. Self-service may require extra provision for popular dishes. It makes sense to record surplus and shortages on the recipe page in order to refine planning and preparation for the next time the specific food item is served.

A survey should be carried out at least once each month to ask clients for their opinion on the food service. This can be done by means of a questionnaire or a direct interview. Client satisfaction can also be tested by means of a questionnaire at the end of residence (e.g., in the case of hospitals when the patient is discharged or in the case of hostels at the end of the term). Questions can then be tailored to request feedback on specific areas of concern.

## 4.6 Clearing of Dinnerware and Leftovers

Shortly after a meal, all cutlery, crockery, trays, and leftover food should be cleared, disposed of, or washed. This is not only for reasons of hygiene, but also to enable staff to get everything ready for the next meal or snack.

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Plate waste measurements should be carried out regularly to determine the amount of food left on plates. This is done to measure and monitor acceptability of food items on the menu (Spears, 1995). Plate waste is usually measured per ward, where the total weight of each food item sent to the ward is recorded and the total weight of each food item left on the plate is totalled and also recorded. The figures for one cycle are then recorded and reported on.

The most efficient way to clear dinnerware and leftovers is to make use of a mobile trolley with separation of plates, cutlery, trays, and leftover food. Two containers can be used to separate leftover food and other items (such as serviettes and disposable cutlery) from one another. In this way, items can be quickly cleared and sorted, ready to be washed or discarded. To avoid costly losses, all items of cutlery and crockery that were issued should be accounted for.

### 4.7 Washing and Refuse Removal

Pots, pans, and other utensils are usually washed centrally in the main kitchen. Washing can be done by hand or with a dishwashing machine (if funds and physical facilities are available to install one), depending on the number of dishes to be washed, the size of the kitchen, and the availability of staff. Cups, glasses, and other crockery may be washed on the ward since there is a short time lapse between meals and tea times in many health facilities (Cronjé, 1993). Optimum washing practices should be followed to ensure the best possible hygiene in the food service.

Refuse removal refers to all food refuse from preparation and serving, as well as other refuse such as paper and tins.. Food refuse can contaminate fresh produce and act as a breeding place for pests. It should therefore be placed in a closed container and kept away from food storage areas and the receiving area. It is advisable to store food refuse as needed in a cool area or even a cold room, especially if air temperature is high or daily removal is not possible (Cronjé, 1993). Food refuse can be used for composting. In some locations waste food is collected by pig farmers.

## 5. HYGIENE AND FOOD SAFETY

Safe food is important to ensure health. It is important that for optimal food safety, primary contamination at the food source should be strictly controlled.

### 5.1 Aims of Hygiene Standards

Cronjé (1993) lists the following principles with regard to hygiene standards in a food service unit:

- Keep the environment clean.
- Handle food in a clean and safe way and therefore protect it against contamination from harmful organisms.
- Prevent food from spoiling.
- Avoid food contamination.

### 5.2 Effects of Poor Hygiene and Food Safety

Poor hygiene and food safety can have serious and even lethal effects, especially in high-risk client groups, such as babies, aged persons, and sick patients. But the subject presents a serious challenge, as micro-organisms are not visible to the naked eye and hygiene is not always well understood by illiterate workers. Training is therefore of utmost importance.

The following may result from poor hygiene and/or safety standards:

- An increased risk of food poisoning
- Customers refusing to use the food service
- Claims laid against the food service by customers
- Increased complaints about foreign objects in food
- Loss of reputation of the organization and a loss of income

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- An increase in food wastage and therefore financial loss
- Increases in the presence of pests and rodents with the risk that the food service might be shut down by health inspectors

## 5.3 Basic Hygiene Principles

Food safety is discussed in detail in Chapter 24. The following is a summary checklist of the most important factors that need to receive attention in order to achieve good hygiene, based on Cronjé (1993) and Spears (1995).

Physical facility:

- Walls and floors maintained; free of cracks and easy to clean
- Ceilings easily cleanable
- Windows designed to prevent accumulation of dirt on sills
- Doors, windows, and ventilation openings that do not allow access for birds, insects, or rodents
- Doors that are self-closing and have a smooth finish that is easily cleaned
- All structures and pipes easily reached and cleaned
- Separate areas for preparation of different types of food so as to prevent cross-contamination
- Sufficient drains
- Light fittings that are easy to clean
- Sufficient ventilation to prevent dampness and dust
- Hand basins, and soap, available in food handling areas
- Adequate toilet and washroom/restroom facilities
- Foot pedals provided for operating taps at handwashing basins
- Enough disposable towels available at hand-wash basins
- Clean water available for cleaning and food preparation

Equipment:

- All equipment installed in a such a way as to be easily cleaned
- Installed so that it does not provide a breeding place for insects/pests
- Table tops and working surfaces that are easy to clean
- Work surfaces on which food is handled and all equipment, utensils, basins, or other surfaces that comes into direct contact with food should be made of smooth, rust-proof, non-toxic, and non-absorbent material that does not have open joints or seams
- Cutlery and crockery easy to clean, and without chips or cracks

Personal hygiene:

- Staff should be trained regularly.
- Uniforms should be clean and laundered.
- Lockers should be clean and tidy and available for staff.
- Staff should be healthy and free of coughing, open wounds, or diseases (especially gastro-intestinal diseases).
- Cuts, pimples, or sores should be covered.
- Staff nails should be short and without nail polish, hair should be tied, and skin should be clean with minimum make-up allowed.
- Staff should wash hands after using the toilet, and frequently during food preparation.
- A head cover must be worn at all times by anyone that enters the production area.
- Jewellery may not be worn by food preparation staff.

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- No eating may be allowed in the kitchen and serving areas.

Supplies and receiving area:

- Reputable suppliers
- Clean delivery vehicles
- Area and supplies that are free from dirt and garbage
- Regular inspection of food for quality and freshness
- Perishables immediately stored
- Empty containers discarded immediately
- Perishable products marked for expiry and date stamped
- Canned foods inspected for defects
- Frozen products inspected for signs of defrosting and freezer burn
- Perishables received at the correct temperature, which are checked and recorded

Storage:

- Ventilated within set temperature ranges – no sign of dampness
- Lowest shelf at least 25 cm from the floor and highest item on shelf not touching the ceiling
- No food stored directly on floors
- All containers covered
- Food marked with a date to identify oldest stock
- No spills on shelves or floor – clean surfaces
- Non-food items stored separately
- Sufficient space for cold storage
- Separate storage space for cooked and raw foods (do not allow cross-contamination)
- Boxes should be unpacked immediately and empty boxes discarded to control pests
- Cold rooms and freezers clean and tidy
- Correct temperature set for cold rooms and freezers
- Freezers clean and free from ice build-up
- Door seals of cold rooms and freezers in good condition

Pre-preparation and preparation:

- Separate, colour-coded cutting boards used for different types of food
- Cutting boards washed and disinfected between uses
- All work surfaces and food-handling equipment clean and tidy
- Equipment washed and disinfected between uses
- Can openers clean
- Fruit and vegetables washed before use
- Utensils are used to handle food (hand contact is eliminated as much as possible)
- Clean colour-coded cloths available for cleaning or wiping up spillages, e.g., white for milk area, yellow for chicken area
- Food not kept out of fridge for longer than 2 hours
- Thorough cooking of food, especially protein-rich foods
- Hot food kept at more than 65°C
- Correct thawing procedures followed
- Utensils disinfected after washing and before use
- Control of insects and rodents

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Portioning, distribution, and serving:

- Use of portioning spoons for ensuring standardization of portion sizes
- Food at the correct temperature prior to and during serving
- Staff wear masks during dishing up
- Cold foods kept below 10°C before serving
- Waiting time between preparation and serving kept as short as possible

Cleaning and washing:

- Enough cleaning agents available and used correctly
- Enough hot water available
- Disinfection of all items after washing
- Washed items allowed to drip dry
- Dishwasher cleaned daily
- Wash and rinse temperature of dishwasher correct
- Cleaning materials stored away from food
- Implementation of a routine cleaning programme
- Regular microbiology tests performed, with feedback given to staff

Refuse removal:

- Waterproof, easy-to-clean refuse bins with close-fitting lids, suitable for hygienic storage of refuse until their removal from the food-handling area
- Refuse bins lined with black plastic bags and kept covered with lid
- Enough drainage provided at refuse removal area
- Enough running water available
- Refuse storage area and drums easy to clean and disinfect
- Refuse removed frequently
- Refuse bins washed and disinfected daily

# 6. MANAGEMENT PRINCIPLES

## 6.1 Financial Planning

One of the most important managerial functions in a food service unit is financial administration. The manager should therefore be responsible for developing a business plan that reflects all the needs for the next financial year (Hudson, 2005).

## 6.2 Organizational Planning

Each task in a food service unit needs to be planned and organized carefully (Hudson, 2005). This requires effort and experience. It is the task of the manager(s) to plan diligently so that all other tasks are completed and that each person knows exactly what is expected from them. An organizational chart may be helpful for staff to see where they belong, linking it to their functions and duties.

The menu is the starting point in organizational planning. It is used to compile a programme of the various meals that must be prepared. This is then used to compile an employer work schedule which is then refined to a list of daily functions to be performed and tasks to be completed.

## 6.3 Staffing and Human Resource Management

One of the most valuable resources in any organization is the staff. Like any other resource, staff should therefore be treated as valuable. Although a human resources department usually handles most staffing issues,

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the manager of a food service unit also needs to be involved in staff recruitment, training, retention, and the resolution of issues. The skills of all food service staff should be developed through continuous training in order to improve service delivery (DOH, 2010).

### 6.4 Leadership

Leading is the part of management that involves giving direction and co-ordinating activities of workers. Leading means motivating others, managing activities, communicating, and resolving problems and conflicts. An organization or unit is as successful as its leader and therefore the manager of a food service unit should take on a strong leadership role to ensure guidance and successful operations.

### 6.5 Communication

Good communication within an organization is crucial to the success of all parties concerned. Miscommunication leads to mistakes, misunderstandings, and poor functioning. Maintaining and improving communication within an organization is therefore one of the most important investments a manager can do.

Managers communicate in order to gather information, disseminate information, share information, coordinate activities, and negotiate. Written communication is preferred within a food service unit in order to enable the manager to file information for later referral.

## DISCUSSION QUESTIONS AND EXERCISES

1. Compile a 2-week cycle menu for a 50-bed community hospital by using the current policy guidelines from your country.
2. Design standardized recipes for all the menu items to be served on day 1 of cycle/week 1.
3. Draw up a master ordering schedule for all of the main ingredients needed on day 1 of cycle/week 1.
4. For two food items, compile food specifications that can be used for procurement purposes.
5. Prepare a motivation statement for kitchen staff that explains why good hygiene is essential in a food service unit.
6. Write a job specification for a cook that you can be included in a job advertisement at the food service where you are working.

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## ADDITIONAL RESOURCES

The South African National Department of Health has compiled various policy documents and draft policy documents that have an impact on management of food service units. More information can be obtained from the national office in Pretoria, South Africa, phone: +27 21 395000, or by visiting www.doh.gov.za.

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# CHAPTER 24

# FOOD QUALITY AND FOOD SAFETY

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## *Outline*

- The origins and transmission of foodborne diseases
- The role of pesticides in foodborne illness
- The impact of foodborne diseases
- Safety guidelines for household food preparation
- Concerns surrounding global food safety, including street-vended foods and genetically modified crops
- FAO and WHO strategies to promote global food safety
- Food safety in developing countries

## *Objectives*

At the completion of this chapter you should be able to:

- Summarize the Food Safety and Consumer Protection guideline of the Food and Agriculture Organization of the United Nations (FAO)
- Explain what is meant by the term *foodborne diseases*
- Describe the various types of foodborne illnesses and how they can be prevented
- Describe the causes and extent of foodborne illnesses
- Describe the most important ways to keep food safe and clean in a household
- Explain what safety concerns surround street-vended foods
- Summarize the FAO and World Health Organization (WHO) strategies to promote food safety
- Explain the Hazard Analysis Critical Control Points (HACCP) System
- Describe what actions are being taken in developing countries to deal with the problem of food safety.

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# 1. INTRODUCTION

According to the Food and Agriculture Organization of the United Nations (FAO), food quality is "a complex characteristic of food that determines its value or acceptability to consumers" (FAO, undated). A food's nutritional value contributes to its perceived quality, as do its organoleptic and functional properties. Another element of quality is a food's safety. A safe food is one that is free of any substances that might compromise a person's health (FAO, undated). In ancient times, the chain of responsibility for food safety was very short: it essentially consisted of hunter-gatherers and their families. As societies grew larger and more complex, however, and as trade networks expanded and food began to be shipped long distances, the responsibility for food safety became more diffuse (Gorris, 2005).

Today, food safety is a global concern. With the rapid growth in international trade of food products, consumers in many countries are exposed to a greater variety of food products. At the same time, such trade can introduce new or unfamiliar food safety risks, and the chain of responsibility has become longer and more complex. In order to keep pace with the lengthening food supply chain, food safety management systems continuously need to be improved, so as to ensure that people are provided with safe food products (Gorris, 2005; Unnevehr & Huirne, 2002). Examples of food safety management systems include the Hazard Analysis Critical Control Points (HACCP), Good Manufacturing Practice (GMP) and Hood Hygiene Practice (GHP). Such systems have been implemented in various countries in recent years (Gorris, 2005; Nguz, 2007). Despite all these measures, foodborne diseases are still widespread and an increasing public health problem, in all countries (WHO, 2008b).

Foodborne diseases most commonly produce gastro-intestinal symptoms, but such diseases can also cause neurological, gynaecological, immunological, and other symptoms and can result in multi-organ failure and even cancer. Foodborne diseases thus carry a significant disability, morbidity, and mortality burden (WHO, 2008b).

Following the 1996 World Food Summit (which is convened by the FAO), an intergovernmental working group was established to develop a set of voluntary guidelines to support the efforts of governments in order "to achieve the progressive realization of the right to adequate food in the context of national food security." The FAO adopted these guidelines in 2004. Although the guidelines are voluntary, they provide an additional instrument in the fight against hunger and poverty and thus help to accelerate the attainment of the Millennium Development Goals (FAO, 2005a; FAO, 2005b). Guideline no. 9 (see Box 24.1) encourages the world's nations to establish government controls designed to ensure food safety and to protect consumers.

**Box 24.1:** FAO Guideline No. 9: Food Safety and Consumer Protection

9.1. States should take measures to ensure that all food, whether locally produced or imported, freely available or sold on markets, is safe and consistent with national food safety standards.

9.2. States should establish comprehensive and rational food-control systems that reduce risk of food-borne disease using risk analysis and supervisory mechanisms to ensure food safety in the entire food chain including animal feed.

9.3. States are encouraged to take action to streamline institutional procedures for food control and food safety at [a] national level and eliminate gaps and overlaps in inspection systems and in the legislative and regulatory framework for food. States are encouraged to adopt scientifically based food safety standards, including standards for additives, contaminants, residues of veterinary drugs and pesticides, and microbiological hazards, and to establish standards for the packaging, labelling, and advertising of food. These standards should take into consideration internationally accepted food standards (Codex Alimentarius) in accordance with the WTO Sanitary and Phytosanitary Agreement (SPS). States should take action to prevent contamination from industrial and other pollutants in the production, processing, storage, transport, distribution, handling, and sale of food.

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9.4. States may wish to establish a national coordinating committee for food to bring together both governmental and non-governmental actors involved in the food system and to act as liaison with the FAO/WHO Codex Alimentarius Commission. States should consider collaborating with private stakeholders in the food system, both by assisting them in exercising controls on their own production and handling practices, and by auditing those controls.
9.5. Where necessary, states should assist farmers and other primary producers to follow good agricultural practices, food processors to follow good manufacturing practices, and food handlers to follow good hygiene practices. States are encouraged to consider establishing food safety systems and supervisory mechanisms to ensure the provision of safe food to consumers.
9.6. States should ensure that education on safe practices is available for food business operators so that their activities neither lead to harmful residues in food nor cause harm to the environment. States should also take measures to educate consumers about the safe storage, handling, and utilization of food within the household. States should collect and disseminate information to the public regarding food-borne diseases and food safety matters, and should cooperate with regional and international organizations addressing food safety issues.
9.7. States should adopt measures to protect consumers from deception and misrepresentation in the packaging, labelling, advertising, and sale of food and facilitate consumers' choice by ensuring appropriate information on marketed food, and provide recourse for any harm caused by unsafe or adulterated food, including food offered by street sellers. Such measures should not be used as unjustified barriers to trade; they should be in conformity with the WTO agreements.
9.8. Developed countries are encouraged to provide technical assistance to developing countries through advice, credits, donations, and grants for capacity building and training in food safety. When possible and appropriate, developing countries with more advanced capabilities in food safety-related areas are encouraged to lend assistance to less advanced developing countries.
9. 9. States are encouraged to cooperate with all stakeholders, including regional and international consumer organizations, in addressing food safety issues, and to consider their participation in national and international fora where policies which impact on food production, processing, distribution, storage, and marketing are discussed.

*Source: FAO, 2005b.*

## 2. FOODBORNE DISEASES

Foodborne diseases are usually infectious or toxic and are caused by agents entering the body through the ingestion of food or water. All people can be at risk of foodborne diseases (WHO, 2007a).

One of the main responsibilities of any government is to ensure the safety of the food supply so as to prevent such diseases. Diarrhoeal diseases, carried by food and water, kill approximately 2.2 million people each year and are the leading causes of illness and death in less developed countries, especially in children (WHO, 2008b). The major foodborne diseases are summarized at the end of this chapter, in Appendix 1, while Appendix 2 lists the major types of food poisoning.

### 2.1 The Transmission of Foodborne Diseases

Figure 24.1 illustrates the manner in which foodborne diseases are transmitted. It is clear that poor hand-hygiene practices and viruses (not only bacteria) are also considered major risk factors for foodborne diseases (Rolando, 2011). In food contamination, bacteria growing on the food prior to its consumption can produce toxins that may cause illness (Payne-Palacio & Theis, 2004).

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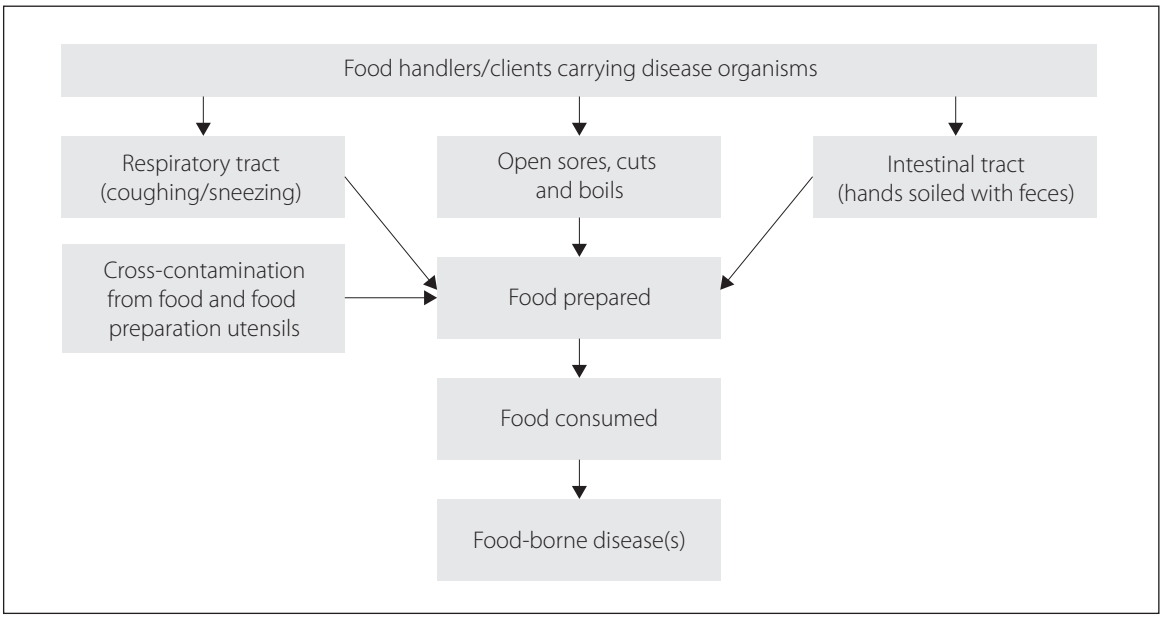


**Figure 24.1:** Transmission of a foodborne illness as a result of cross-contamination.
*Source: Adapted from Payne-Palacio & Theis, 2004.*

Food should therefore not contain any

- harmful micro-organisms (bacteria, viruses, amoebae, fungi, algae, yeasts, or gardia),
- parasites (e.g., worm eggs, larvae, or cysts),
- toxins or poisons, or
- harmful chemicals, such as pesticides.

## 2.2 The Role of Pesticides

The term *pesticides* refers to all chemicals used for killing or controlling pests. In agriculture these include herbicides (poisons to eliminate weeds), insecticides (insects), fungicides (fungi), nematocides (nematodes), and rodenticides (vertebrates). Pesticides have been widely used since the 1950s as a standard method for pest control, specifically where intensive monoculture is practised. Unfortunately, with the benefits of chemistry have also come disadvantages, some so serious that long-term survival of major ecosystems are threatened owing to the disruption of predator-prey relationships and loss of biodiversity, and there are significant human health consequences as well (FAO, 2003).

There is little doubt that pesticides create considerable health impacts all over the world, though the actual toll is difficult to determine given the wide variety of chemicals and types of exposure. Pesticides vary widely in their degree of risk, and their effects can be divided broadly into two categories: acute effects, which appear very soon after exposure; and chronic effects, which may manifest many years later and whose origins are often difficult to trace. The human health effects of pesticide contamination are mainly linked to the causation of various diseases (cancer, birth defects), endocrine disruption, neurotoxicity, and kidney and/or liver damage (Prüss-Ustün et al., 2011).

The main routes of ingestion of pesticides are by

- skin contact, through the handling of products contaminated by pesticides;
- inhalation, by breathing of pesticide dust or spray; and
- ingestion of contaminated food or water.

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The global disease burden for industrial and agricultural chemicals and acute poisonings amounts to at least 1.2 million deaths per year. This contributes 2.0% of the total deaths and 1.7% of the total burden of disease globally (Prüss-Ustün et al., 2011).

## 2.3 The Impact of Foodborne Illness

Malnutrition and infections account for the great majority of mortality in children in developing countries. Furthermore, malnourished infants and children are more exposed to foodborne hazards and risk of diarrhoeal disease. The high prevalence of diarrhoeal disease in developing countries again underlines the importance of food safety issues (WHO, 2007a). Furthermore, severe infections, often associated with unhygienic facilities, also contribute to child mortality. Such infections in turn exacerbate malnutrition, thus resulting in a vicious circle of disease and mortality (Prüss-Ustün et al., 2011). The unacceptably high mortality and poor quality of life of children in many parts of the world constitute great challenges for the public health community, including nutritionists. The 2008 mortality rate for children aged less than 5 years was much higher in developing countries (72 per 1000 live births) than in developed countries (6 per 1000). The major causes of child mortality in developing countries remain pneumonia and diarrhoea, which are both preventable and treatable diseases (UNICEF, 2010). Diarrhoea is thus a major threat to public health. As discussed in Chapter 11, major causes of diarrhoea are the unavailability of potable water, ingestion of unsafe water, inadequate water for hygiene, lack of access to sanitation, overcrowded living conditions, consumption of contaminated foods or poor food storage, and consumption of unwashed fruit (Hénock & Dovie, 2007).

Although it is not well documented, developing countries are believed to show the biggest impact of the problem of foodborne disease, because of the presence of a wide range of foodborne diseases, including those caused by parasites (WHO, 2008b). The high prevalence of diarrhoeal diseases in many developing countries is thus an indication of major underlying food safety problems (WHO, 2007b). Globally, the coverage of safe drinking water increased from 77% in 1990 to 87% in 2008, with only 84% of the population in developing countries having access to improved water sources, compared to almost 100% in developed countries. However, in sub-Saharan Africa (SSA) only 60% of the population has access to clean, safe drinking water (UNICEF, 2010).

Amongst children aged less than 5 years, 70% of deaths are also associated with biologically contaminated food. These contaminations are more frequently caused by foodborne parasites; however, mycotoxin contaminations are more widespread.

## 2.4 Domestic Food Preparation

International studies have demonstrated that unsafe food-handling behaviour during domestic food preparation needs to be addressed. This is especially true in places where unsafe water is used for cleaning and processing of food, poor food-production and handling processes, and the absence of adequate food storage facilities (Prüss-Ustün et al., 2011). Furthermore, people frequently underestimate domestic food poisoning and the frequency of its serious consequences. This may prevent consumers from taking appropriate steps to reduce their exposure to food-related hazards (Redmond & Griffith, 2004). Foodborne illnesses are often undiagnosed as they may present as flu-like symptoms, and the time of onset can be days after ingestion of the offending food. In addition to the traditional foodborne diseases, new pathogens can be transferred from animals to humans, as seen in avian and swine flu outbreaks (Prüss-Ustün et al., 2011).

Table 24.1 provides tips for households on how to keep food safe and clean in order to promote food safety. When purchasing food, the danger signs indicated in Table 24.2 should be heeded as these indicate that food is contaminated by micro-organisms, dirt, or toxins.

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**Table 24.1:** Keeping food safe and clean in the household

1. Buy fresh foods on the day of consumption when possible, or use before the expiry date (if indicated).
2. Do not buy foods with any of the danger signs shown in Table 24.2.
3. Frozen food should be thawed in a refrigerator, not put in warm water or left out to thaw.
4. Store foods at the right temperature and covered.
5. Eat meals as soon as possible after preparation.
6. Use clean covered containers for fetching water.
7. Use a safe water supply, or else boil all water before use.
8. Wash hands with soap and water before food preparation, before eating meals, and after touching animals, dirty areas, or soil or after visiting the bathroom.
9. Keep food covered.
10. Cook food thoroughly or to the correct internal temperature (see Table 24.3).
11. Wash all food preparation and eating utensils thoroughly with water and soap before use.
12. Wash all fruit and vegetables before peeling or eating.
13. Do not cough, spit, or touch the body during food preparation.
14. Keep rubbish bins closed at all times.
15. Keep animals away from food preparation areas.

*Source: Adapted from King & Burgess, 1993.*

**Table 24.2:** Danger signs of unsafe food

| Food type | Food items | Danger signs |
|---|---|---|
| Fresh foods | Fish, meat, dairy products, fruit and vegetables, roots | Bad smell<br>Visible signs of mould<br>Fish with dull eyes, loose scales, soft flesh, pale gills<br>Meat with a bad smell or greyish colour |
| Dry foods | Flour, grains, nuts, legumes, sugar | Damp<br>Mouldy |
| Oils and fats | Vegetable oils, butter, lard | Unusual taste<br>Rancidity |
| Tinned foods | Any | Swollen tin<br>Leaking tin<br>Badly dented tin<br>Food looks, smells, or tastes bad |

*Source: Adapted from King & Burgess, 1993.*

## 3. ENSURING GLOBAL FOOD SAFETY

The food production chain is becoming more complex, providing greater opportunities for contamination and growth of pathogens. Many outbreaks of foodborne diseases that were once contained within a small community may now take on worldwide dimensions (WHO, 2007a). The globalization of trade in food, urbanization, changes in personal lifestyles, international travel, environmental pollution, and deliberate contamination, as well as natural and man-made disasters, all contribute to mounting concerns about food safety.

### 3.1 Street Vendors

Urbanization and changing lifestyles are increasing people's demand for convenience foods prepared outside the home, such as food bought at restaurants and particularly from street vendors (Troedsson, 2009). Street-vended foods (SVFs) are thus a phenomenon of growing international concern. The term encompasses

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"a wide range of ready-to-eat foods and beverages sold and sometimes prepared in public places, notably streets." As in the case of fast foods, "the final preparation of street foods occurs when the customer orders the meal, which can be consumed where it is purchased or taken away" (Winarno & Allain, 1991). Also included in this definition are fruit and vegetables intended for immediate consumption that are sold outside authorized markets.

Although readily accessible and affordable, SVFs are often perceived to be unsafe owing to the environment in which the food is prepared and purchased. Street-vendor locations may compromise food safety as safety requirements are often not met (WHO, 2010). This may result in unprecedented incidences of severe foodborne diseases that make food safety a public health concern as well as a development issue with huge financial consequences (Troedsson, 2009). In view of the number of vendors and their often transitory nature, it is very difficult to regulate SVFs in densely-populated areas, such as major urban centres. A need exists to improve the safety of SVFs through training (WHO, 2010; Winarno & Allain, 1991). Focusing on food hygiene, training should cover the transmission of diarrhoeal pathogens, proper handling of equipment and cooked food, correct hand washing practices, and environmental hygiene (Mensah et al., 2002; Vollaard et al., 2004; WHO, 2010). Attention should also be given to the provision of basic water and waste management, as well as financial assistance through social services affiliations (Azanza et al., 2000). Furthermore, it is recommended that management strategies be implemented with regard to regular visits from health inspectors, and local authorities should also be encouraged to provide the necessary infrastructure to improve the safety of SVFs (Winarno & Allain, 1991).

## 3.2 Biotechnology and Food

Biotechnology has become a major public issue in most countries. The safety of food derived using biotechnology should be carefully considered. In order to provide a scientific basis for decisions regarding human health, there is a need for new methods and policies for such foods to be developed and agreed upon internationally. Health benefits, as well as possible negative health implications, should be included in any assessment. However, clear communication of the basis for safety assessment in this area is often lacking at both the national and international level.

Proper monitoring and assessment are essential as changes in animal husbandry practices, including feeding, may have serious implications for food safety. Likewise, the addition of low levels of antibiotics to animal feed, resulting in an increased growth rate, has raised concern about the possibility that human pathogens may become resistant to these antibiotics (WHO, 2007a).

Furthermore, modern intensive agricultural practices that contribute to increasing the availability of affordable food items, as well as the use of food additives, can improve the quality, quantity, and safety of the food supply, but appropriate controls are necessary to ensure their correct and safe use along the entire food chain. Pre-market review and approval followed by continuous monitoring are necessary to ensure the safe use of pesticides, veterinary drugs, and food additives/residues (WHO, 2007a).

An aspect of biotechnology of particular importance is the development of genetically modified organisms (GMOs), which are organisms whose genetic makeup has been changed by the insertion or removal of new genetic material in order to create or enhance desirable characteristics. This topic is discussed in more detail in chapter 27. The weighing of potential risks and benefits is an important aspect of assessment of foods made from GMOs.

## 3.3 FAO Strategies to Promote International Food Safety

The FAO stresses the importance of adequate food control programmes in all countries to ensure that the populations of the world are food secure in terms of quality, quantity, safety, and affordability. This is essential in order to promote public health. For this reason the Codex Alimentarius General Principles of Food Hygiene was implemented by the Codex Alimentarius Commission in 1995 to provide a firm foundation for food hygiene and to highlight the key control points at each stage in the food chain (Codex Alimentarius, 2012). It further recommends that a Hazard Analysis Critical Control Point (HACCP) system be implemented to improve food safety and suitability for human consumption internationally. The HACCP system works by identifying food hazards and Critical Control Points, that is, points at which measures can be taken "to

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prevent or eliminate a food safety hazard or reduce it to an acceptable level" (FAO, 1997). The FAO (1997) established the following seven procedural principles that together constitute the HACCP approach:

Principle 1: Conduct a hazard analysis.

Principle 2: Determine the Critical Control Points (CCPs).

Principle 3: Establish critical limit(s).

Principle 4: Establish a system to monitor control of the CCP.

Principle 5: Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.

Principle 6: Establish procedures for verification to confirm that the HACCP system is working effectively.

Principle 7: Establish documentation concerning all procedures and records appropriate to these principles and their application.

The HACCP system can be applied throughout the commercial food chain, from the producer to the end user, and results in improved food safety, a more effective use of resources, and timely responses to food safety problems. For the system to be successful, a team approach is needed, as well as the commitment of management and the work force. The HACCP method is compatible with all the other quality management systems, such as the International Organization for Standardization's ISO 9000 series (FAO, 1997).

## 3.4 WHO Strategies to Promote International Food Safety

Food safety authorities globally have acknowledged that ensuring food safety is not only a national concern but should be addressed through closer linkages among food safety authorities at the international level (WHO/FAO, 2011). In 2000, the 53rd World Health Assembly urged the WHO to implement a global strategy to reduce foodborne diseases and to improve food safety practices. In 2007, the Beijing Declaration on Food Safety, a high-level international forum, was adopted by fifty countries (Prüss-Ustün et al., 2011).

In 2006, the WHO Department of Food Safety and Zoonoses, in collaboration with multiple international partners, held an international meeting to launch an initiative, a multi-disciplinary Foodborne Burden Epidemiology Reference Group with the mandate to provide a strategic framework for estimating the global burden of foodborne diseases (Prüss-Ustün et al., 2011). Furthermore, the need was identified for the routine exchange of information on food safety issues and rapid access to information in the event of food safety emergencies. In order to help achieve this, WHO, together with FAO, launched a new International Food Safety Authorities Network (INFOSAN) in order to facilitate collaboration among food safety authorities at the national and international levels (WHO/FAO, 2011). INFOSAN includes a food safety emergency network.

The WHO Food Safety Programme, in collaboration with other WHO programmes and departments, includes the strengthening of food safety systems, promoting good manufacturing practices, and educating retailers and consumers about appropriate food handling. Education of consumers and training of food handlers in safe food handling is one of the most critical interventions in the prevention of foodborne illnesses. In order to promote health, WHO (2006) developed a global food hygiene message with five key steps for the consumer and the food industry – the "Five Keys to Safer Food":

- Keep clean. (This refers to hands as well as all food preparation areas.)
- Separate raw and cooked food.
- Cook thoroughly. (This includes reheating.)
- Keep food at safe temperatures. (see Table 24.3).
- Use safe water and raw materials.

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**Table 24.3:** Temperature guide for optimal food safety

| Temperature (°C) | Action |
|---|---|
| 100 | Boiling point of water |
| 74–100 | Cooking temperature of food at which bacteria are destroyed |
| 65–80 | Keep hot food above 65°C.<br>These are warming and holding temperatures, at which bacterial growth is prevented, but some bacteria will survive.<br>70°C is the optimum temperature for pie warmers and hot closets. Salmonella and lysteria are killed.<br>80°C is the optimum temperature for food served hot. However, this may be detrimental to quality. |
| 52–65 | Some bacterial growth may occur. Most bacteria will survive.<br>South African legislation specifies 60°C as the cut-off point |
| 16–52 | DANGER ZONE for holding and storing perishable food.<br>37.2°C is average human body temperature and the most suitable temperature for bacterial growth. |
| 6–16 | Some growth of food poisoning bacteria may be possible. |
| 5 | Optimum temperature for all food served cold, e.g., sandwiches and salads. 10°C is the maximum temperature to serve cold food. |
| 0–4 | These are appropriate refrigeration temperatures. They will permit slow growth of some bacteria that cause spoilage. Lysteria breed in 46 hours at 0–2°C.<br>Do not store raw meat for >5 days.<br>Do not store poultry, fish, or minced meat for >2 days. |
| -18–0 | These are appropriate freezer temperatures. All bacterial growth is stopped, but some bacteria may survive. |

*Source: Adapted from Payne-Palacio & Theis, 2004.*

## 4. FOOD SAFETY IN DEVELOPING COUNTRIES

Poor food safety is a significant factor in the burden of disease in developing countries. Food systems are not always well organized and developed. Furthermore, adherence to international food safety standards and legislation may be lacking in many places, and the responsibility for food safety in developing countries is often spread among many institutions (WHO, 2007a). They are therefore faced with a number of challenges (FAO, undated; Henson, 2003; WHO, 2007a;, such as the following:

- Problems related to population growth
- Urbanization and change in food intake habits
- Poor sanitation (WHO. 2008a)
- Lack of resources to handle pre- and post-harvest food losses
- Lack of modern food processing infrastructure and technology as well as adequately trained inspectorate and staff members
- Insufficient involvement of scientific expertise and lack of adequate facilities for food safety analyses
- Lack of coherence among different governmental departments, and
- Environmental and food hygiene issues

All of the above factors negatively impact the quality and safety of food supplies. Appropriate food control measures that are based on well-established food regulations pertaining to quality and safety of food should

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be the essence of food legislation throughout the world. Although food quality and safety is the responsibility of the food industry in all countries, governments should provide the supporting infrastructure and take on an advisory and regulatory role (FAO, undated). The responsibility for food safety is thus shared amongst government, the food industry/trade, and consumers (Henson, 2003). The roles of each of these stakeholders are depicted in Table 24.4.

**Table 24.4:** The WHO vision of shared responsibility for food safety

| **Food Safety** | | |
|---|---|---|
| **Government/Public service** | **Consumers/Clients** | **Industry/Trade** |
| - Food legislation and labelling<br>- Industry guidance<br>- Consumer education<br>- Acquiring information and research<br>- Provision of health-related services | - Educated and well-informed public<br>- Discerning and selective consumers<br>- Safe food practices in the home<br>- Community participation<br>- Active consumer groups | - Good food handling practices by primary manufacturers and distributors<br>- Quality assurance and control of processed food<br>- Appropriate procedures and technology<br>- Trained human capital – management as well as food handlers<br>- Informative labelling and consumer education |
| **Commitment to food safety** | | |

*Source: Adapted from Henson, 2003.*

For developing countries to participate in the international food market, they need to have the capacity to meet the food import requirements of the recipient countries. For example, the Food and Drug Administration (FDA) in the United States has a set of food regulations to be met before granting permission for the import of food into that country. Likewise, the European Union also has its own requirements for the importing of food. Furthermore, the recognition of international food standards in the international food markets is an important factor of the World Trade Organization (WTO) agreements; for instance, the mandatory sanitary and phytosanitary certificate as well as the certificate of origin are part and parcel of import documentations. These conventions and regulations were designed to harmonize world food markets and provide a fair chance for developing countries to participate in world markets (FAO, undated; Henson, 2003).

FAO and WHO established the Codex Trust Fund 2004 to assist developing countries to improve food safety and quality in terms of training and facility support systems. This includes a training package for strengthening national food safety systems (WHO, 2004). The rules of the WTO also stipulate that developed countries should assist developing countries to achieve the requisite high level of food safety for international trade. This assistance can result in building or enhancing integrated national food safety systems covering the entire food chain (WHO, 2007a).

## 5. CONCLUSION

Building capacity for food safety is essential in most countries, especially developing countries. Both positive and negative experiences from countries with well-developed food safety systems could be used as a means to improve systems globally. Foodborne disease has a significant impact not only on health, but also on development. Moreover, globalization of food trade and development of international food standards have raised awareness of the interaction between food safety and export potential for developing countries (WHO, 2004).

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## DISCUSSION QUESTIONS AND EXERCISES

1. Human beings have the right to wholesome food that is safe for consumption. Who is responsible for food safety? Looking at (a) the household, (b) the community, and (c) the national government, identify those responsible, and discuss the part they play in ensuring food safety.
2. Discuss the challenges that developing countries face in providing safe food.
3. What is the role of the WHO and the FAO in global food safety? Discuss how the WHO and FAO strategies described in section 3 above can benefit developing countries.
4. How can a Hazard Analysis Critical Control Point (HACCP) system be implemented in developing countries? Discuss the barriers, challenges, and possibilities.
5. What is the essence of the FAO Right to Food Guideline no. 9?

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**Appendix 1:** Food infections (bacterial)

| Disease | Disease organism | Signs and symptoms | Transmission | Prevention |
|---|---|---|---|---|
| Bacillus cereus | *Bacillus cereus*, a saprophytic (bacteria that obtain food by absorbing dissolved organic material), spore-bearing organism widely found in nature | Severe vomiting 1 hour after ingestion, or diarrhoea later. Recovery is rapid. | The disease usually occurs in those who eat restaurant-prepared fried rice that is allowed to cool unsafely. The spore may survive normal cooking and produce vegetative forms during cooling. | Do not allow cooked rice to cool over a long period without refrigerating. |
| **Brucellosis** (Bang's disease, undulant fever, Malta fever) | *Brucella abortus. Brucella melitensis. Brucella suis* | A recurrent or undulating fever, which may rise to 40˚C to 41˚C in the evening, then drop to normal each morning. Sweating, fatigue, muscle ache, constipation. If untreated, symptoms may persist for months. | Consuming infected milk or milk products, or meat from infected animals | Pasteurize milk. Test animals, slaughter those that test positive. |
| Cholera | *Vibrio comma*, a comma-shaped bacillus | Fever, severe diarrhoea, abdominal cramps, vomiting, intense thirst, followed by collapse. If untreated, a 50% death rate is common. Cholera is one of the most acute and violent infections known. | From infected persons and faecal-contaminated food and water | Isolate cholera patients. Destroy by fire material passed by patient. Eat well-cooked food and chlorinate water. Vaccinate. Treatment consists in replacing body fluids and electrolytes. |

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|---|---|---|---|---|
| Clostridium perfringens | *Clostridium perfringens* (also known as *Clostridium welchii* or "the gangrene organism"), a spore-forming anaerobe widely distributed in soil, sewage, and unsanitary food-processing plants | Diarrhoea, which is often accompanied by abdominal pain and headache. Vomiting and fever are uncommon. The incubation period of the disease is 8 to 24 hours. Most patients recover in 24 hours or at the most within a few days. Rarely fatal. | Infected foods, especially meats and gravies that have been allowed to cool slowly for several hours after cooking. The spores are resistant to heat and will survive boiling for as long as 5 hours. | Cook meats adequately. Do not allow foods, especially meats and gravies, to cool slowly after cooking; refrigerate them promptly. |
| **Eschericia coli (E. coli)** infection resulting from food contamination | *Escherichia coli* (*E. coli*) | Acute gastroenteritis in infants, and "traveller's disease," characterized by severe watery diarrhoea | *E. coli* are one of the predominate bacterial flora of the gut, and are excreted in human faeces (and urine to some extent). Infection is spread to foods and food utensils by flies and human hands. Baby formulas prepared under unsanitary conditions are a common route of infection. | Avoid contaminated food and water. Avoid overindulgence in consuming food and alcohol. |
| Leptospirosis | *Leptospira*, so named because it is the smallest and most delicately formed of the spirochetes (spiral-shaped bacteria) | High fever and intense, haemorrhagic jaundice and hepatitis. | By polluted water, from drinking it or swimming in it, or through cuts or scratches on the skin. From exposure to animals or people with leptospirosis. By consuming food or water that has been polluted, usually by rats. | Avoid polluted food or water. Control rodents. |

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|---|---|---|---|---|
| Salmonellosis | *Salmonella typhimurium* is the organism most commonly responsible. However, more than 1600 species within the genus *Salmonella* exist. | Diarrhoea, abdominal cramps, and vomiting, which usually lasts for 2 to 3 days. The incubation period is 12 to 36 hours. Salmonellosis is rarely fatal except in elderly people and infants. | Salmonella bacteria grow rapidly in such cooked foods as meats, eggs, custards, and salads that have been left unrefrigerated for several hours. It may also be transmitted by sewage-polluted water. The organisms may be eliminated 2 to 3 days after the symptoms subside, thereby providing a continuing source of contamination for others. | Refrigerate foods below 4˚C. Food handlers must practise hand washing, scrupulously clean food processing equipment, and avoid use of cracked eggs unless thoroughly cooked. Salmonella in food is destroyed by a temperature of 60˚C lasting for 20 minutes or 65˚C for 3 minutes. |
| **Shigellosis** (bacillary dysentery) | *Shigella* bacteria | Fever, loss of appetite, vomiting, severe abdominal cramps, and massive diarrhoea. Young children and frail adults may become dehydrated; care must therefore be taken to maintain their balance of mineral salts. | Spread by faecal contamination of food, water, clothing, and household objects by infected individuals. House flies are also an active agent in its spread. | Practise good public sanitation and personal hygiene. Control flies. Boil food and water. Pasteurize milk. Wash hands before handling food or eating. Isolate patients and carriers, especially if they are handling foods. |
| **Tuberculosis** (TB) | *Mycobacterium bovis* (tubercle bacillus) | Chronic coughing, usually fever and night sweats, extreme fatigue, loss of appetite, and, eventually, coughing up blood. Enlargement of the cervical and mesenteric lymph nodes. | The bacteria are spread by particles of dust or droplets expelled by a tubercular patient, especially when coughing or sneezing, or introduced into the digestive tract by contaminated foods or objects, such as milk from infected cows or objects placed in the mouth. | Avoid contact with infected people and foods. Pasteurize milk. Eat an adequate and nutritious diet. Have comfortable living quarters and sufficient daily rest. |

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|---|---|---|---|---|
| **Tularemia** (rabbit fever) | *Francisella tularensis* | An ulcer-like sore at the point where the germs enter the skin, followed by headache, aching muscles and joints, weakness, chills, and fever | About 90% of reported cases can be traced to handling infected wild rabbits, but the disease has been found in almost every type of small wild animal. Cats and sheep have also been known to be infected. | Wear protective rubber gloves when handling game. Thoroughly cook meat from game. |
| **Vibrio Parahaemolyticus** (food infection) | *Vibrio parahaemolyticus*, an organism related to the cholera vibrio, which grows in sea water | Profuse diarrhoea and dehydration | Consumption of raw or undercooked sea foods | Avoid contaminated foods. Cook foods well. |

*Source: Ensminger et al., 1994.*

**Appendix 2:** Food poisoning (bacterial toxins)

| Disease | Disease organism | Signs and symptoms | Transmission | Prevention and treatment | Remarks |
|---|---|---|---|---|---|
| Botulism | Clostidium botulinum, a bacteria that is widespread and found in soils. It forms heat-resistant spores, which if not destroyed by heat in cooking, vegetative forms may grow anaerobically and produce one of the most powerful toxins known. | Weakness of the eye muscles and difficulty in swallowing, followed by paralysis of muscles related to respiration, and death. Symptoms usually begin 18 to 36 hours after contaminated food is eaten. | Primarily by eating inadequately cooked meat and non-acidic vegetables such as beans, asparagus, corn, and peas. | Practise adequate cooking. The toxin is inactivated in 10 minutes by heat at 80˚C, but the spores are not destroyed. Do not use food that shows gas production or change in colour or consistency. Discard canned food that shows bulging in one end of the can. | The toxin blocks transmission of the neuromuscular junctions. Botulinus-infected foods do not necessarily taste or smell spoiled. |

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|---|---|---|---|---|---|
| Staphylococcal food poisoning | Staphylococcus aureus, primarily | Vomiting and diarrhoea, which may be severe and accompanied by collapse due to dehydration. Ingestion of contaminated food may be followed by symptoms within minutes to 6 hours. The illness usually lasts 1 to 3 days. Mortality is low. | Ingestion of food or water containing the enterotoxin. Many healthy people are carriers of staphylococcal infections, specifically Staphylococcus aureus. Foods are readily contaminated by carriers and may, under suitable conditions, provide a good culture medium for growth of the organism. A wide variety of foods have been implicated, but the most common ones are ham, poultry, cream, and custard-filled baked products. | Prevent carriers from contaminating food. Refrigerate foods promptly at 4˚C or below. Eliminate flies. Staphylococcus can be killed by heating to boiling temperature, but toxins may not be destroyed by boiling. | This is by far the most common form of food poisoning. Some strains of Staphylococcus produce a powerful enterotoxin that is resistant to heat. |

*Source: Ensminger et al., 1994.*

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# PART 9

## A BROADER PERSPECTIVE

# CHAPTER 25

# THE NUTRITION PROFESSION IN AFRICA

## Meeting Current and Future Challenges

*Tola Atinmo and Oyediran Oyewole*

### *Outline*

- Situation with regard to the training and number of nutrition professionals in Africa
- Strategies to increase the number of well-trained nutrition professionals in Africa
- Difference between dietitians and other nutrition professionals

### *Objectives*

At the completion of this chapter you should be able to:

- Describe the general situation in Africa with respect to the training and number of nutrition professionals
- Suggest ways to increase the numbers of well-trained nutrition professionals in Africa through undergraduate education, advanced training, and research training
- Explain the difference between dietitians and other nutrition professionals


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## 1. INTRODUCTION

Many sub-Saharan African countries face serious nutritional challenges. The importance of adequate nutrition to the development of these nations is hard to exaggerate. Unfortunately, though, these challenges are compounded by both the quantity and the quality of nutrition professionals in the region. Because many of these countries do not have active organizations of nutrition professionals that register their members, reliable information regarding the number of people working as nutrition professionals in sub-Saharan countries is not easy to find. It is more difficult again when the quality of such professionals is in question. All the same, it is evident that sub-Saharan countries lack a sufficient supply of well-qualified nutrition professionals. The relative scarcity of such professionals is evident in the outcome of nutrition programmes, which are too often poorly planned and implemented.

In some cases, nutrition intervention programmes have been almost wholly unsuccessful. It is now becoming obvious that urgent consideration should be given to capacity building among nutrition professionals in developing countries, especially in those countries in which the problem of malnutrition has remained unabated for many years. The UNICEF (1990) Conceptual Framework on the Causes of Malnutrition may accordingly need to place more emphasis on such capacity building as part of tackling the underlying causes of malnutrition in developing countries.

## 2. CHALLENGES CONFRONTING NUTRITION PROFESSIONALS

Despite the importance of the field of nutrition to virtually all aspects of national development, nutrition professionals have a poor image in many African countries (Martorell, 1999). The multi-disciplinary nature of nutrition as a profession – which, at first glance, might seem an advantage – in fact does much to explain its relatively lowly status. Everybody feels associated with nutrition, but few want to give greater recognition to the profession and contribute to its development. Those working in nutrition thus find their position usurped by professionals who specialize in one of the disciplines on which the field of nutrition draws.

At the national level, an inaccurate or incomplete understanding of what nutrition entails has contributed to some of the challenges confronting the profession. Many national governments seem unable to distinguish between food supply and nutrition. As a result, much support is given to increasing agricultural productivity but little or none to nutrition programmes. The notion is that once sufficient food is produced, people will no longer be malnourished. However, food production is not synonymous with good nutritional status (Oyewole, 2007).

The issue of the brain drain is another serious challenge affecting the nutrition profession. Top-quality nutrition graduates from Africa typically apply to universities or institutions outside Africa for graduate studies. Many of them do not return to their home countries.

In sub-Saharan Africa itself, existing educational institutions have only a limited capacity for training people in the field of nutrition. Moreover, the quality of training is often deficient. The curriculum followed in various schools of nutrition varies widely, with the result that graduates from different institutions, all of whom have the same qualification (at least on paper), do not necessarily possess the same command of the subject. For example, some nutrition schools focus mainly on the biomedical aspects of nutrition and do not include the social science components in their curriculum. Graduates from such institutions will therefore find it very difficult to bring the methods and insights of the social sciences to bear on programme planning, implementation, and evaluation. The deficiencies in training that result from the lack of a reasonably standard curriculum have the effect of making the field of nutrition less professional. This in turn contributes to the problem of inadequate remuneration for some nutrition professionals.

Another consequence of uneven curriculum development is that nutrition professionals are often poorly qualified for leadership positions. Perhaps for this reason, very few nutritionists have occupied government positions in African countries of the sort that would allow them to be actively involved with policy development. Indeed, political leaders seem somewhat uncertain about where nutrition departments fit into the structure of government. In Nigeria, for instance, nutrition has been transferred from one ministry to another, most recently to the Ministry of National Planning – although the latest proposal is to place nutrition directly under the office of the president.

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The fundamental question is: To what extent are we preparing a cadre of professionals able to meet the challenges that sub-Saharan countries face in the area of nutrition and to provide the services required at the national level? Some established institutions in Africa are beginning to acknowledge the problems associated with the shortage of qualified nutritionists and are therefore embarking on programmes intended to address this shortage.

## 3. HISTORICAL EXPERIENCE IN INSTITUTIONAL CAPACITY BUILDING

It is important to mention some experiences in Africa and some other developing countries with regard to institutional capacity building in the field of nutrition. Information obtained from the International Union of Nutritional Sciences (IUNS), United Nations University (UNU), and the African Nutrition Leadership Initiative Report of 1999 provides a pertinent in-depth historical perspective. For the last few decades, several national, regional, and international initiatives have drawn attention to the need for institutional capacity building in the area of food and nutrition, with a specific focus on developing countries. Since the UNU's establishment in 1975, it has given highest priority to capacity building, especially south of the Sahara.

A joint UNU and working group of the Administrative Committee on Coordination / Sub-Committee on Nutrition (ACC/SCN; later the Standing Committee on Nutrition) convened in 1984 to address the strengthening of institutions concerned with food and nutrition. The working group recommended that high priority be given to the development of capacity of institutions that have the potential to become centres of excellence. The issue was further discussed at the IUNS meeting held in 1989, in Seoul, South Korea. The subject of institutional capacity building was the title of a workshop held by the IUNS and UNU in 1996. By 1997, it was reported that more than 600 researchers and young scientists, more than 40% of the UNU fellowships awarded, had received post-graduate training in the area of food and nutrition.

The results of institutional building in Africa are a cause of great concern, as generally the initiatives have not been successful. Despite the reported fact that almost 27% of the UNU nutrition fellowships were awarded to people from African countries, only 1.5% of the fellowships were implemented at UNU-associated institutions in Africa. In 1988, a joint UNU and African Association of Universities (AAU) collaboration was initiated involving seven African countries, aimed at strengthening national capacity in food and nutrition. However, the initiative was terminated in 1994 because an evaluation indicated limited impact on strengthening capacity for research and advanced training.

The Swedish International Development Agency (SIDA) has been involved in the strengthening of a number of food and nutrition institutions in Africa; for example, the Ethiopian Health and Nutrition Institute, the Zambian National Food and Nutrition Commission, the Tanzanian Food and Nutrition Centre, and the National Nutrition Unit of the Zimbabwe Ministry of Health and Child Welfare. The outcome of the experiences of Zimbabwe and Tanzania has been considered generally positive in some aspects of the capacity-building process.

The Applied Nutrition Programme (ANP) of the University of Nairobi was launched in 1985 with the support of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), the German agency for technical cooperation. Nearly 100 students from Eastern, Central, and Southern Africa have gone through the MSc Applied Nutrition programmes, trained by highly qualified faculty. The ANP serves as a good example of how to build institutional capacity.

The East, Central, and Southern Africa Food and Nutrition (ECSAFAN) Cooperation, established in 1979 at a conference of health ministers from the Commonwealth Regional Health Community Secretariat for East, Central, and Southern Africa (CRHCS/ECSA), is the oldest networking institution aimed at addressing food and nutrition problems in the ECSA region. It was only in the mid-1990s that the CRHCS/ECSA intensified the effort of institutional capacity building in collaboration with other institutions within the region. These included the University of Zimbabwe, the Pan African Institute for Development, East and Southern Africa (PAID-ESA, based in Zambia), and the international universities of Wageningen Agricultural University (the Netherlands), Emory (USA), and Southampton (UK).

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NATURA-NECTAR is a programme that was carried out by three European universities and coordinated by the Wageningen Agricultural University. It has five modules, each lasting two to four weeks, on different nutrition subjects. These have been developed in partnership with universities in Benin, Ghana, Kenya, South Africa, Tanzania, and Zimbabwe, and the Ethiopian Health and Nutrition Research Institute.

While the efforts of institutional capacity building in Africa have generally not been successful, the initiatives in Latin America and Asia have been relatively successful. In these regions a number of key regional and national institutions have been established. Examples include the Institute of Nutrition of Central America and Panama in Guatemala, the Institute of Nutrition and Food Technology in Chile, and the Institute of Nutrition at Mahidol University in Thailand.

A number of lessons can be distilled from the experience of building or strengthening institutions. The fundamental lesson learned has been that political will must exist. Government support is indispensable for any capacity building to be successful. The other ingredients are

- the development of a core group of professionals who are well trained, have multiple skills, and are highly motivated; and
- a critical mass of well-trained people, with a strong and visionary leader, and long-term budgeting commitment from both the member countries and external financial contributors.

There is much variation in successful institution capacity building initiatives. However, it appears that in Africa, success is more likely when the initiative is implemented at academic institutions than at government institutions (Kuzwayo, 1999).

## 4. THE NEED FOR CAPACITY BUILDING IN THE NUTRITION PROFESSION IN AFRICA

Nutritional problems around the world are rapidly evolving alongside changes in global socio-economic conditions and the interconnected nature of national economies, demographic transitions, and continued population growth. These rapid changes pose many challenges to human health. This creates much need for involvement by nutrition professionals. These professionals must be well equipped to meet the needs of our fast-changing world. In the face of these developments, investment in human and institutional capacity in the field of nutrition should be a priority (UNU/IUNS, 1999). Unfortunately, such investment has been inadequate and uneven in many regions.

Several critically important issues must be considered regarding capacity building of nutrition professionals. One is to ensure that the training is organized such that it makes a tangible difference to nutrition problems. In addition, there is a need to build or strengthen institutions; in particular, it is vital that institutions are sustainable. A variety of approaches have been suggested for advanced training leading to degree programmes in nutrition. In order to achieve successful outcomes when planning nutrition programmes, it is important to set clear and achievable goals. The same applies with respect to institutional capacity building.

Research is the cornerstone of scientific and scholarly work. Therefore, research is an essential component of any strategy that aims to improve a nutrition situation. However, the capacity of research institutions is generally quite weak across Africa (UNU/IUNS, 1999). One of the reasons for this is because many young nutritionists find it extremely difficult to publish their research findings in well-respected journals. Other barriers include limited access to scientific journals and the cost of Internet service.

An effective means of building capacity is to develop partnerships with institutions in developed countries. Unfortunately, relatively few nutrition institutions in Africa have been successful in doing this. Even where this has been accomplished, there is still a negative side, as some of the trainees may stay in the host country, which obviously does little to help with capacity building *in* Africa.

South Africa is the major exception to many of the above problems. That country has numerous high-quality universities and many highly respected nutrition professionals. Relatedly, South Africa also has a large amount of interaction between its universities and other institutions and partners in developed countries.

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# 5. STRATEGIES TO ADDRESS CURRENT AND FUTURE CHALLENGES IN THE FIELD OF NUTRITION

## 5.1 An Overview of the Problem

Meeting the challenges faced by the nutrition profession in Africa will require a great deal of work. In particular:

- institutions of learning need to collaborate with more developed institutions, and
- regional bodies can enter partnerships with established international bodies.

In addition, there is much need for self-development efforts by people on an individual basis.

The following should be viewed as the key strategies in building the field of nutrition:

- Harmonization of the basic nutrition curriculum in schools and colleges that run nutrition programmes
- Creation of minimum standards for qualification as a nutritionist
- Development of a strong advocacy for nutrition, combined with political will
- Defining the main role of nutritionists within the context of the national civil service

It should be noted that in facing current and future challenges, adequate training is needed in the following key areas: nutrition advocacy; development of communication skills; and nutrition programme planning and implementation, as well as the evaluation of all practitioners. In order to advance this agenda and advocate for nutrition promotion a systematic approach to policy development and capacity building is needed. This can be achieved through formal and informal meetings between concerned professionals and other stakeholders.

## 5.2 Nutrition Education

The introduction of similar curricula for nutrition programmes in schools will set the pace for similar examinations for graduating students. This may ultimately usher in registration of successful students with the national nutrition board or some other agency mandated to register professionals in a given country.

The suggested uniform curriculum should include courses in the various areas listed below:

Categories and characteristics of foods

Food science and technology

Food safety and environmental health

Ecology of food and nutrition

Feeding practices of different age groups (lifecycle nutrition)

Food and agricultural systems

Ecology of health and disease

Nutritional physiology and biochemistry

Nutritional behaviour and the social aspects of nutrition

Nutrition-related disorders

Nutrition assessment

Nutritional epidemiology – population-level description of the distribution of nutrition problems

Clinical nutrition

Ethical issues in research

Research design, methods, and interpretation, including epidemiological methods and nutrition surveys

Basic statistics

Health education approaches

Programme planning, management, and evaluation

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Leadership attitudes and skills

Communication, negotiation, motivation, and collaborative problem solving

Principles of reflective practice

Information technology (including the relevant computer software)

In addition, students should be expected to take background courses in disciplines such as economics, political science, anthropology, and psychology, all of which bear on the work that nutrition professionals do. Such coursework will help students understand the systems that contribute to the development of food shortages and nutrition-related health problems and that often complicate efforts to address these problems.

## 5.3 Capacity Building in Nutrition in Africa

The African Nutrition Leadership Forum (ANLP) has been doing a yeoman's job in developing young professionals in the field of nutrition. Good leadership quality is very important in promoting nutrition, especially in Africa, where leaders need more exposure to the subject in order to be able to take well-informed steps in the development of policy. Other national and international bodies with a nutrition orientation and agenda need to be co-opted and sensitized to providing more support that will improve the training of nutrition professionals. Apart from the ANLP, the Federation of African Nutrition Societies (FANUS) may need to do more in terms of playing a leadership role in the promotion and development of nutrition in Africa. A relatively new organization is the the African Nutrition Society (http://www.answeb.org), which was formed in 2008.

Other regional bodies are presently preoccupied with mainstreaming nutrition in the development agenda. These include the Africa Nutritional Epidemiology Conference (ANEC), Information Technology in the Advancement of Nutrition in Africa (ITANA), Food Science Network for Africa (FOSNA), and the Economic Commission of West African States (ECOWAS) Nutrition Forum. These bodies may need to look at providing assistance to young graduates in acquiring training in certain vital areas, namely nutrition advocacy, communication skills, and governance.

Nutrition challenges vary from country to country in Africa. Therefore, any approach to institutional building must be based on reliable and timely information. This requires a situation analysis that provides information on institutional capacities and identifies areas that require strengthening, and determines the level of knowledge and skills, financial support, and physical assets in a given country.

## 5.4 Building Research Capacity

As stated earlier, a need exists for increasing research capacity. The principal objectives for building such capacity are as follows:

- Strengthen the ability to respond to national and regional research needs.
- Increase the proportion of nutrition research conducted by national or regional institutions.
- Identify, focus on, and find solutions for the nutritional problems of most national and regional significance.

These objectives can be achieved through the development of research centres of excellence in institutions that closely link the research mission to educational and training missions. Realization of these objectives should lead to the development of self-sustaining departments, institutes, and/or schools of nutrition capable of conducting research and training future researchers in the region. With a strong commitment, building an academic department where none exists can be done in less than ten years. For institutions where established departments need strengthening in limited areas, the time frame is much shorter.

Limitations of available resources and the requirement for a critical mass of professionals make it imperative that resources be concentrated in a small number of carefully selected academic/research institutions in each region. Appropriate criteria for the selection of regional centres of excellence should include: a demonstrated institutional commitment to focus on priority areas for research in human nutrition; a demonstrated willingness and ability to serve regional needs; and political and economic stability.

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The selected research centres must have a multi-disciplinary orientation, in keeping with the breadth of disciplines required to address most nutrition problems. But at the same time, each unit in the nutrition department should develop its own area of specialization. This expertise should be linked closely to the areas of education and training targeted by the institution. Thus, collaboration within and between regions is essential because no single institution can have the requisite research capacity in all fields that contribute to the solution of nutrition problems.

Developing research capacity may be accomplished in various ways. Whatever approaches are taken to develop this capacity, careful consideration should be given to the disciplinary and interdisciplinary breadth and complementary specialization required for dealing with food and nutrition issues. The most common approach for the formation of future faculty and researchers is through graduate and post-graduate training in universities or other institutions where the desired expertise and multi-disciplinary breadth exists. An additional, highly desirable component of advanced training is the preferential support of newly trained researchers as an important follow-up of doctoral and post-doctoral training. This may take the form of peer-reviewed programmes specially designed for new graduates. It is recommended that training programmes be research based, and that the research be conducted in the country to which the trainee is returning.

The development of mentoring relationships and faculty exchanges is a valuable part of capacity building. Enhancing research capacity through the improvement of highly specific skills may be accomplished through less formal approaches or by adopting short-term training methods.

Another essential component to building research capacity is the development of relevant research agendas. For this discussion it is useful to differentiate between basic and applied research. Basic research is research undertaken for its own sake; in other words, it is not directed at any specific problem. Applied research is directed at a specific problem of interest for one or more stakeholder groups. Applied research agendas should set priorities on the basis of the significance of present and projected problems specific to countries and/or regions. Thus researchers, planners, policy makers, and representatives of those that are affected by the problems of interest and projected solutions must participate in priority-setting.

## 6. DIETITIANS AND NUTRITIONISTS

In this chapter we have mainly focused on nutrition professionals in the broad meaning of the term. It is important to state that the challenges facing Africa with regard to nutrition professionals are more acute with respect to dietitians than for nutritionists in general.

Nutritionists do not necessarily have a formal qualification in nutrition. They may come from a variety of different professions, including medical doctors, home economists, nurses, biochemists, and physiologists working in specialized areas of nutrition. Dietitians, by contrast, normally have a degree in nutrition and specialized training in an area of nutrition practice, such as clinical nutrition or public health nutrition.

Nutritionists within a country typically form a nutrition society that then affiliates with the IUNS. The mission of the IUNS is to promote nutrition research and development through international cooperation globally (http://www.iuns.org). The main scientific activity of the IUNS is to organize the scientific programme of the World Congress of Nutrition, which is held every four years.

Many countries also have a national dietetic association. The most well-known one is the Academy of Nutrition and Dietetics (http://www.eatright.org, formerly the American Dietetic Association). Numerous low- and middle-income countries are members of the International Confederation of Dietetic Associations (ICDA) (http://www.internationaldietetics.org). Nigeria and South Africa are the only two countries from Africa that are members. By contrast, roughly twenty African countries have an active *nutrition* society. This speaks to the lower level of national organization of dietitians compared with nutritionists.

We feel it necessary to end this chapter by re-emphasizing that survival of nutrition in Africa depends on sound capacity building of nutrition organizations and professionals.

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# CHAPTER 26

# THE PROBLEM OF MISLEADING AND UNSCIENTIFIC INFORMATION REGARDING NUTRITION

*Norman J. Temple, Alice N. Brako, and Jacob Setorglo*

## *Outline*

- Marketing of dietary supplements in the United States and Canada
- Examples from South Africa
- Examples from Ghana
- Examples from Kenya

## *Objectives*

By the end of this chapter you should be able to:

- Identify modes of marketing of dietary supplements in North America
- Identify and describe types of dietary supplements
- Recognize misleading and unscientific information regarding supplements
- Understand the difference between *claims* of health benefits and *actual* health benefits
- Understand the general problem of the use of unscientific information for the marketing of untested and unproven treatments, especially herbal treatments, in developing countries
- Describe some health consequences of the abuse of herbal preparations


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# 1. INTRODUCTION

People around the world generally have a poor grasp of biomedical science and of issues related to best practices in the prevention and treatment of various diseases. This leaves people vulnerable to those who distribute misleading and unscientific information. In fact, this problem is extremely widespread in almost all countries and comes in many forms. An important example is the marketing of dietary supplements, a topic examined in the first part of this chapter. The discussion focuses on North America, as that is where this problem has been most carefully examined. Later in the chapter we turn our attention to a range of problems seen in developing countries.

This chapter is not intended to be comprehensive, but to provide numerous illustrations of the problem. Students are encouraged to take the message of this chapter and apply it to their own communities; unfortunately, they likely will have little trouble finding many examples of the sort of problems described here.

# 2. MARKETING OF DIETARY SUPPLEMENTS IN THE UNITED STATES AND CANADA

(section written by Norman Temple)

I reside in Canada and have studied the problem of misleading information in North America, especially in regard to the marketing of dietary supplements (Temple, 2010; Temple, 2013). The situation in North American, especially in the United States, is a paradox. The USA is the home of NASA, Microsoft, Apple, and Boeing. It is also the home to many of the world's leading research centres for the study of the biomedical sciences. Vast amounts of accurate information are readily available to people in the U.S., both in books and via the Internet. The majority of people have ready access to the Internet, and many people go to school to the age of at least 18, with millions more attending college. Yet despite all that, an enormous market exists for books that are patently inaccurate, health food shops everywhere sell dietary supplements, many of which are useless, and millions of people use practitioners of alternative medicine who practice forms of therapy that have no scientific basis. Here we focus on the marketing of dietary supplements.

## 2.1 Types of Dietary Supplements Sold

A great variety of dietary supplements are widely sold in North America. Here we are using the term *dietary supplement* broadly, to include such products as herbs and exotic fruit juices. A few select products illustrate the problems commonly seen with such supplements.

A novel type of dietary supplement is exotic fruit juices, such as acai and goji juices. Sellers claim that these juices are highly beneficial. Health food shops in Canada often charge $50 to $60 per litre for them. By contrast, supermarkets sell other fruit and vegetable juices for less than $3 per litre. Despite this enormous difference in price, there is an absence of credible evidence that exotic fruit juices have any significant nutritional advantage over lower-priced ones.

In North American, herbs are heavily promoted as a class of supplements and are used for a wide variety of reasons, especially as a therapy for various medical disorders. One common problem with herbs is that there can be much variation between different brands of what is supposedly the same herb (Harkey et al., 2001; Draves & Walker, 2003). This may be due to such factors as the actual species of plant used, the part of the plant used, and the extraction method. It is also entirely possible that some manufacturers may simply be using cheap ingredients in place of expensive herbs. As a result, anyone buying these products has little real idea of how medically active they are.

## 2.2 Claims Made in the Marketing of Dietary Supplements

In recent years, I have examined the marketing of dietary supplements in North America. Weak evidence is often presented as proven facts. Sometimes marketers go to the extreme and claim that their product cures almost anything and everything, even cancer. Typically, the marketers of supplements use scientific evidence the way a drunk uses a lamp post: more for support than illumination.

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### *2.2.1 Dishonesty and wild exaggerations*

Dishonesty and wild exaggerations are seen frequently whenever one looks at the marketing of supplements. A few years ago, flyers were distributed promoting a particular product where the person behind it, Dr. Jesse Stoff, was described as "the world's leading viroimmunologist." In fact, this gentleman has apparently never published a scientific paper. In another case, Dr. Earl Mindell, who sells goji juice via multilevel marketing (see Section 2.4 for a definition), was referred to as "Widely regarded as the world's #1 nutritionist" and his product as "The biggest discovery in nutrition in the last 40 years!" Both claims are ludicrous exaggerations. The reason for making these claims is clearly to make the products look like fantastic breakthroughs and thereby create sales.

### *2.2.2 How dietary supplements (supposedly) work*

Claims are often made that supplements have a wide variety of actions in the body and thereby provide the means to achieve health benefits. The supporting evidence is generally weak. Here are some examples.

Many supplements are marketed with a claim of being "rich in antioxidants." The obvious implication is that such products will improve health or prevent disease. There is some logic to this claim, as it is well established that antioxidants are important for protection against tissue damage caused by free radicals. In order to investigate this, large randomized clinical trials have been carried out using the three major antioxidant vitamins: β-carotene and vitamins C and E. The major goal of most of these trials has been to determine whether these substances contribute to the prevention of either heart disease or cancer. However, these trials have failed to demonstrate that supplements of antioxidant vitamins are protective against disease. When the results of these trials have been pooled, we find that these supplements lead to an *increase* of about 2% to 5% in all-cause mortality (Bjelakovic et al., 2012). In short, these findings demonstrate that when sellers of a supplement claim that a product has a high content of antioxidants, this does not mean the product will improve health or prevent disease.

Detoxification is an important biochemical process by which the body eliminates harmful substances. Many herbs are marketed with the claim that they bring about detoxification. This supposedly helps cleanse the body, thereby leading to assorted health benefits. But such claims are without any supporting evidence. Another common claim with herbal supplements is that they stimulate the immune system. The obvious implication of this is that the body will be less susceptible to infections. With few exceptions, the claims lack credibility.

There is a great deal of marketing of supplements with claims that they can induce quick and easy weight loss. Accompanying sales promotion materials will often display a photo of a young woman with a BMI of about 20. For good measure, a mechanism is often added to explain how the supplement supposedly works, such as by stimulating metabolism or blocking the appetite. This marketing is almost certainly highly profitable in view of the huge obesity epidemic that has swept North America, and considering the tens of millions of people desperate for a "cure." But the evidence is thin that such supplements bring about more than a trivial weight loss.

In each of the above cases we see claims being made that the supplement induces a physiological or biochemical change in the body. In each case the mechanism is sufficiently simple that the average layperson can understand it. But it is a huge distortion of biomedical science to make the leap to the conclusion that the supplement can prevent or cure a disease.

### *2.2.3 Weakness of supporting evidence*

A feature of many marketing claims is the exploitation of weak clinical evidence. For example, one or two small studies of dubious clinical significance may have been conducted, but their results are presented in marketing as substantial "evidence." Alternately, a particular herb may have been used for centuries as a treatment for a particular condition. This is exploited as the basis of claims that the herb must be effective. Often such evidence looks impressive but collapses when the results of properly conducted clinical trials appear.

A good example of this is the use of ginseng for helping people to overcome fatigue and boost their energy levels. Claims that ginseng is effective for this go back many centuries. However, according to an

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authoritative source, a "few studies using ginseng extract... report improvements in patients with fatigue of various causes. However, these results are early, and studies have not been high quality" (MedlinePlus, 2009). The case of *Ginkgo biloba* provides another excellent illustration of the problem of giving too much credence to unreliable forms of evidence. This plant is commonly used to help maintain cognitive health in aging, especially for the memory. However, the results of a large randomized, double-blind trial conducted on elderly subjects reported that the herb was no better than placebo for slowing cognitive decline or improving memory function (Snitz et al., 2009).

Similar to weak clinical evidence being cited as substantial evidence, anecdotal evidence is frequently seen in marketing. A typical example might be as follows: "Many of my customers have taken [this product] and the results are amazing!" A slight variation of anecdotal evidence is the use of testimonials, as in this example: "Susan from Miami says: 'I lost 12 pounds in my first month while taking Rapid Fat Burn and never felt hungry.'"

What is missing from the marketing claims for supplements, in the great majority of cases, is hard scientific evidence. In particular, support for claims that a supplement really does work requires positive results from one or more well-conducted randomized clinical trials, preferably with clinical endpoints (i.e., real health benefits). Such evidence is referred to as the "gold standard." For example, if the claim is made that a supplement prevents infections, then the trials should show a reduction in the number of infections, not merely a change in the immune system. Another essential feature of credible evidence is that the results be published in peer-reviewed journals. The study on *Ginkgo biloba* described above is an excellent example of the type of study that is needed for all dietary supplements.

## 2.3 How Dietary Supplements Are Sold

Supplements are sold through a variety of means. In recent years, billions of spam e-mails have been sent out promoting sex-related nutritional supplements. These e-mails typically direct people to a website. While some websites sell just a single product, many others offer a wide variety of supplements.

Multilevel marketing is a form of marketing practiced by many commercial enterprises, such as Avon (cosmetics). The actual salespeople, as well as everyone up the chain, receive a commission. There are many companies operating in North America that sell supplements using this form of marketing.

Most sales of supplements are done directly in supermarkets, chemist shops (drug stores), and health food shops (HFSs). Staff in HFSs seldom have any proper scientific expertise. Nevertheless, whenever a customer asks for advice, the staff are usually quick to recommend the purchase of one or more supplements. Studies done in the USA, Canada, and the UK have consistently shown that most recommendations made by HFS staff are a distortion of the scientific evidence. Moreover, when the same question is asked in different HFSs, there is a huge variation in the advice given (Gotay & Dumitriu, 2000; Vickers et al., 1998; Calder et al., 2000; Buckner et al., 2005). This problem occurs much less often in chemist shops (Temple et al., 2009), which is not surprising since chemist shops normally have a pharmacist on staff. Pharmacists are trained health professionals and must abide by a code of ethics.

## 2.4 Comments on the Marketing of Dietary Supplements

Supplements can sometimes be of much value; in fact, some are critical to good health. In other chapters we have described the value of particular supplements, such as vitamin D. The situations in which supplements can be recommended usually occur in developing countries when dealing with people suffering from malnutrition. (The situation is altogether different when dealing with well-fed people in North America.)

The sale of dietary supplements is highly profitable. This is doubtless the dominant motive for all the deceptive marketing described above. The supplements for which the supporting evidence is strongest cost around $3 to $4 per month. One of the few good examples is vitamin D. But that is not where the peddlers of supplements focus their efforts, as the profits are too slim. Instead, they aim to maximize sales of expensive supplements. For example, a person who walks into an HFS and asks for advice on how to have more energy, cure headaches, and avoid getting cancer will probably be advised to take several different supplements, each costing between $20 and $60 per month. which could easily add up to $100 to $200 per month. And the beneficial effects on health are likely to be trivial at best.

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Supplements are not risk free. Some supplements, especially herbs, can induce harmful side effects (Saper et al., 2008). The number of such cases is estimated to run into the tens of thousands per year in the U.S.A. (Cohen, 2009). Several herbal supplements may interact with drugs. This occurs most commonly with St John's wort, and to a lesser extent with ginkgo (Tsai et al. 2012). Many supplements advertised for improving sex performance are adulterated with possibly harmful drugs (Cohen & Venhuis, 2013).Based on the evidence reviewed here, the general population should be advised that before buying supplements they seek the advice of a qualified health professional, such as a pharmacist or dietitian. Alternately, they could seek information from websites that provide information written by experts. Several excellent websites are listed at the end of the chapter.

Other useful advice is to avoid health food shops as the employees are likely to give inaccurate and misleading advice. Additionally, people should ignore websites of supplement manufacturers and not trust the advice given by people engaged in multilevel marketing. People must use common sense. In particular, everyone should remember the fundamental rule: If things are too good to be true, they probably are.

## 3. EXAMPLES FROM SOUTH AFRICA

(section written by Norman Temple)

The problem of misleading and unscientific information can be seen in all parts of South Africa, but, not surprisingly, its features vary a great deal depending on ethnicity and education level.

For example, one product sold in South Africa is a patch that is placed on the skin with the claim that it draws out toxins. The package contains the following statement: "Chi Detox patches have negative ions (anti-oxidants), release far infrared rays, and has all natural ingredients which stimulate the reflexes and meridians and increase blood circulation." Clearly, the people engaged in the marketing of supplements have learnt well from the United States.

South Africa is little different from most other countries in having a system of traditional medicine that has evolved over time, and there are many traditional healers in that country who target the black population. One healer who operates in Cape Town has shown much enterprise in attracting new business. Leaflets given out on the street describe him as a "Specialist in traditional herbal medicine, fortune teller." His claimed areas of expertise include the following: "penis enlargement, help pregnant women, women who cannot reproduce and those with period problems, reduce women's vagina and big stomach, diabetes, high/low blood pressure, bring back lost lover, court cases, divorce and bad debt, remove bad luck and give good luck, get jobs and promotion, clean homes from bad ghosts, heal mad people and epilepsy."

The most notorious case of bizarre scientific beliefs in South Africa is that of former president Thabo Mbeki. After reading a highly unorthodox website, he decided that the connection between HIV and AIDS was far from proven. His views then became official government policy, with tragic consequences. His health minister, Manto Tshabalala-Msimang, advocated a diet of garlic, olive oil, and lemon to cure the disease.

## 4. EXAMPLES FROM GHANA

(section written by Jacob Setorglo)

Ghana is a developing country located in West Africa. Here I describe some of the myriad problems of misleading scientific information and abuse of herbs and nutritional supplements. While the information is specific to Ghana, the situation is likely to be quite similar in other countries of West Africa.

The global market for herbal medicines is so huge that the World Health Organization (WHO) (2003) has launched strategies to help developing countries do the following:

- Develop national regulatory frameworks
- Ensure the quality, efficacy, safety, and use of traditional herbs
- Make these herbs accessible and available to the population
- Document herbal remedies that are proven

For the developing world, the question is not whether herbal preparations are useful in the promotion of

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health, but how the quality and safety of herbs will be improved for the population. It appears that the use of herbs for the treatment and management of illnesses is here to stay in the developing world.

## 4.1 The Health Delivery System

The health delivery system in Ghana is plural. In addition to conventional/orthodox medical practitioners we also have the Ghana Psychic and Traditional Healers Association (MoH, 2007). Its members include spiritualists, faith healers, priests, and traditional herbalists. The incorporation of these groups into the health delivery system was supposed to help find local antidotes to perennial health problems. Other well-meaning efforts were put in place by the government to enable these healers to acquire formal training and practice safely.

## 4.2 The Legal Framework

A council has been established to register and license traditional healers in Ghana in an attempt to regulate the preparation and sales of herbal medicines and products (WHO, 2001). The Traditional Medicine Practice Council (TMPC) managed to get some herbal drugs included in the national drug list that are prescribed by orthodox doctors (WHO, 2001; MoH, 2004a). In addition, the Ministry of Health developed the traditional health-care system's code of ethics (GNA, 2004). The practice of herbalism and sale of unorthodox herbs have therefore been officially recognized. This act provided the legal basis for the proliferation of herbal preparations and supplements.

## 4.3 Modes of Sale of Herbal Preparations

The financial returns on the practice of selling herbal preparations are high because the majority of Ghanaians (69%) reside in rural areas and patronize traditional healers. Few rural households have access to a doctor (Senah, 2001). Even in regional capitals, herbalists peddle their products from commercial vehicles.

Sometimes the method of preparation of the herbs has been developed by the herbalist and is kept secret or at least passed between family members. The sellers of herbs sell the "magic remedies," often on public transport. Popular among these are those for the treatment of haemorrhoids, diabetes, infertility, various cancers (breast, cervical, and prostrate), arthritis, epilepsy, typhoid, cardiovascular disorders (including hypertension and stroke), HIV, erectile dysfunction, beriberi, and tooth decay. Sellers often claim that one herb can cure/treat numerous ailments. The mode of application depends on the relief sought from the herbal concoction.

There is disparity in health-care financing in urban areas. As a result of the medical pluralism created by the government, herbalists and other groups claim they have medical expertise. On that basis, they prescribe herbal medicines as solutions to nutritional problems. This is often done during phone-in sessions on the radio. Others appear on national television to promote their herbs.

## 4.4 Abuse of Herbs

The growing demand for herbal "drugs" has triggered an increase in quack herbalists who practice ignorantly and endanger lives on the path to enriching themselves. This has resulted in drug abuse, inappropriate use of herbs, and inaccurate dissemination of medical and nutritional information. Reports indicate that secondary school students have also fallen victims to this menace and are increasingly using herbal concoctions. This has resulted in many reports of chronic liver and kidney complications (ABCnewshealth.com, 2007).

## 4.5 The Problem of Lack of Access to Conventional Health Treatment

There is chronic under-funding of the health-care system in Ghana. This problem is compounded by the high fertility rate. Over the years the government has shifted the burden of health-care cost to the consumer, which has affected health-seeking behaviours. Until the early 1980s, medical treatment was virtually free (Frimpong, 1997). But in the 1990s, the policy of "cash and carry" was introduced. Here, patients pay for every service received at government hospitals.

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The pendulum then swung in the other direction. The National Health Insurance Scheme (NHIS), implemented in 2005, was intended to enable all Ghanaians to have access to health care regardless of their ability to pay (Sulzbach et al., 2005). However, not all drugs are covered by the insurance scheme, and with drugs constituting about 60% to 80% of the costs of health care (MoH, 2004b), their affordability became a problem. This is especially challenging as about 45% of Ghanaians live on less than one dollar a day and 35% live in extreme poverty. Compounding the problem, medical professionals often turned patients away because the hospitals had not received NHIS reimbursements for several previous months. There is also a shortage of trained medical personnel. Many orthodox practitioners have gone into private practice, and their fees are often so high that most people cannot afford private health care. Most doctors in Ghana with post-graduate training go into private practice to earn more money, while many others have emigrated (Agyepong et al., 2004).

The combined effect of these various problems is that most people have limited access to orthodox practitioners. There are about 45,000 traditional healers licensed to operate, as opposed to an orthodox doctor-to-patient ratio of a mere 0.15 per 1000 patients, which is a common problem in many developing countries (WHO, 2006). This has enabled herbalists to advance their own interests. As a result, people have continued to patronize traditional herbalists when needing medical and nutritional treatment (IMF, 2005).

### 4.6 Lack of Legal Enforcement

As part of the measures put in place by the government to streamline the activities of herbalists, institutions such as Mampong, a centre for research into plant medicine, and the Kintampo project were established. The plan was that practitioners would take herbs to the centre for analysis of their chemical composition as well as to substantiate health claims. But most herbalists did not cooperate. The national standards and the food and drugs boards were mandated to certify that before any herbs or supplements are sold, they should meet standards set out in the law. However, in practice, all kinds of products are being sold without going through these two bodies. Many herbal preparations are on the market with labels that flout legal requirements. Unsuspecting individuals are persuaded to buy these items, on which all they are likely to find is the name of the herb and a long list of diseases it can supposedly cure.

### 4.7 Commonly Abused Substances

Here are a few examples of the herbs and supplements that are being falsely marketed in Ghana and that are deeply rooted in the culture.

- *Alcoholic beverages:* Alcoholic drinks are part of the culture and are used for various occasions such as naming ceremonies for newborns, marriages, and funerals. But the claim in the adverts is that the drinks improve appetite and sexual performance.
- *Multivitamins:* The advertisements for most multivitamins that are marketed and that are claimed to contain certain micronutrients have no scientific basis. This can occur because the advertisements do not pass through regulatory agencies, so the contents are not checked before entering the public domain. As a result of heavy advertising, widespread misinformation about multivitamin supplements is perpetuated in Ghana.
- *HIV/AIDS remedies:* Reverend ministers and other herbalists have come out publicly and claimed to have the cure for HIV/AIDS. They parade individuals and claim to have treated and healed them. The herbs they use for the treatment are kept secret and have not been subjected to any scientific testing. Those who claim to have been healed do not produce any supporting medical evidence.
- *Garlic pills:* These supplements are advertised as a sure way to relieve all forms of joint pain. They are also supposed to solve sexual dysfunction.

## 5. EXAMPLES FROM KENYA

(section written by Alice Brako)

It is estimated that 80% of the population of Kenya relies on traditional medicine for primary health care,

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with herbs being the most popular form of treatment. This is typical of most developing countries (World Health Report, 2008). An under-resourced health-care system has helped create an environment in which many people view herbal medicines as viable and affordable alternatives. However, herbal supplements are not cheap, as illustrated in the case presented below. The case also shows what often starts as a promise to "cure whatever ails you" ends in disappointment as patients realize that they have spent a lot of money without improvements in health. The case also highlights some of the health risks associated with some herbal remedies.

## 5.1 Leah's Case

Leah is a Kenyan woman in her early eighties who a few years ago, together with her late husband, heard an announcement on the radio that caught their attention. They were told of an herbalist who cured many diseases, such as arthritis, chest pains, asthma, diabetes, and HIV/AIDS. Both husband and wife suffered from painful chronic arthritis for which they had been taking prescription and over-the-counter painkillers, and yet the pain persisted. They welcomed the news as an opportunity to try an alternative treatment, something "natural and free of side effects," as the radio announcer promised.

A few days later, Leah and her husband set out on a day's journey to the nearby town that the radio announcer had directed listeners to go to. They were joined there by many others responding to the same radio message. Once at the "clinic," as the temporary treatment facilities were referred to, each client's weight was taken and their blood drawn. Leah and her husband did not meet with the herbalist for a one-on-one consultation, although he came to the waiting room to applaud everyone for coming to his clinic. He did not inform people of his qualifications.

Leah and her husband were each given 500 grams of three different types of powder, and two different types of tablets. These preparations were not labelled, but they were told that they were herbal supplements. They were instructed to take them three times a day and continue with the regimen until they felt better. If they ran out of supplements before they felt better, they should tune in to the radio for an announcement on when the herbalist would next be in town so they could get refills. After completing the first round of treatment and not feeling relief from pain, Leah decided to stop the treatments. Her husband, however, returned for a second round, but he too stopped taking the supplements when his health condition did not improve after four months. By now, Leah and her husband had paid the equivalent of more than $300, a huge sum of money for the average Kenyan.

This case illustrates how unscrupulous marketers of dubious substances exploit people's vulnerabilities. Many people see herbalists for lifestyle-related chronic diseases for which, even though treatments are available, there are generally no cures. Luckily for Leah and her husband, the remedies they were given had no harmful effect on their conditions. In other cases, however – as, for example, when a person has a disease that needs immediate attention, such as cancer, but postpones seeking conventional treatment while their condition deteriorates – the consequences can be dire.

## 5.2 Common Problems Seen in Kenya

People often combine herbal treatments with conventional medicines they take for chronic conditions, but they should be informed of possible adverse side effects due to herb-drug interactions. Additionally, there may be adverse herb-nutrient interactions (Boullata, 2005).

In Kenya, the Ministry of Culture is responsible for approving certification that allows an herbalist to practice. However, there are no guidelines regarding safety, labelling, product packaging, weights, measures, and dosage information on herbal preparations. As a result, consumers are often unaware of what ingredients are contained in the supplements they are taking. A recent report indicates that some unethical herbalists grind up conventional drugs, mix them with herbal concoctions, repackage them, and pass them off as herbal supplements which they sell at much higher prices (Wesangula, 2009). In another instance, it was reported that a large proportion of Kenyan herbal medicines were found to be contaminated with high levels of disease-causing microorganisms (Okwemba, 2010).

The techniques and equipment used by some herbalists may pose safety risks to their clients. When staff with unknown qualifications draw blood and perform other invasive procedures, there is a chance of transmitting blood-borne infections, especially if they do not use sterilized instruments.

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While there may be some reputable herbalists, many are driven primarily by the profit motive. Such practitioners pose a very real risk of causing harm to their clients. With the rising popularity of herbal clinics and practitioners and the aggressive marketing strategies with which they promote their products, there is an urgent need to educate people as to the dangers they are exposed to. Community nutritionists and other health-care workers should use public forums, such as women's group meetings and churches, to disseminate these important messages regarding the health risks associated with the misuse of herbal supplements.

A concerted effort should be made to train all those involved in the provision of health care at the community level, including nutritionists and nurses, to provide clear and well-informed advice on the misuse of herbal preparations. Efforts to train community health-care workers will be difficult without addressing the chronic shortage of conventional medicines. When the nurses at dispensaries are faced with sick patients and they have no drugs to offer, they are placed in a very difficult position; given this situation, they may suggest herbal remedies of undetermined health benefit.

## DISCUSSION QUESTIONS AND EXERCISES

1. Describe how dietary supplements are marketed in your country. How common is the problem of misleading information in the marketing of dietary supplements?
2. What herbal treatments are widely used in your country? How much reliable evidence is there to support the use of these herbal treatments?
3. Describe three examples of unorthodox and unproven treatments for diseases that are used in your country that are not mentioned in this chapter. What action do you feel your government should take in regulating these treatments?
4. What are the major factors that make people turn to practitioners of unorthodox and unproven treatments for diseases rather than to practitioners of orthodox and proven treatments?

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## ADDITIONAL RESOURCES

There are several health-related organizations that supply reliable information on supplements at their websites. These include the following:

The Mayo Clinic: http://www.mayoclinic.com

MedlinePlus: http://medlineplus.gov/

The National Center for Complementary and Alternative Medicine (NCCAM): http://nccam.nih.gov/

PubMed: http://www.ncbi.nlm.nih.gov/PubMed/

U.S. Food and Drug Administration: http://www.fda.gov/

World Health Organization (WHO): http://www.who.int/en/

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# CHAPTER 27

# NUTRITION CHALLENGES OF A CHANGING WORLD

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## *Outline*

- Population growth and its impact on health, poverty, food security, and potential for conflict
- Climate change: causes and possible solutions
- Effect of agriculture on climate change; effect of climate change on agriculture
- Biofuels
- State of global fisheries
- Shortage of water and its impact on agriculture
- Foods made from genetically modified (GM) plants
- Globalization in relation to nutrition in developing countries

## *Objectives*

At the completion of this chapter you should be able to:

- Describe the challenges created by growth of the world's population, in particular explaining the cycle of increasing population, poverty, and diminishing natural resources, and how this can lead to food insecurity and conflict
- Describe the interrelation between human activities, global warming, and climate change
- Describe the impact of agriculture on climate change
- Describe the impact of climate change on agriculture and food security
- Discuss the rationale for producing biofuels
- Describe the state of global fisheries
- Identify the challenges faced by the growing shortage of water, and discuss potential solutions
- Discuss the issue of foods made from genetically modified (GM) plants
- Explain what is meant by *globalization* and describe its impact on the nutrition situation in developing countries


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In this final chapter, we look at topics of growing importance as the world moves into the twenty-first century. The first five sections of the chapter cover population growth, climate change, global fisheries, water shortages, and genetically modified (GM) foods. These sections were written by Norman Temple and Megan Jamieson. A final section, written by George Winter, contains a discussion of globalization in relation to nutrition in developing countries.

# 1. ISSUES OF POPULATION GROWTH

High population growth has much impact on health, poverty, natural resource exploitation, and the potential for conflicts. Increased access to modern contraceptive methods, more widespread education of girls, and leadership in government all play vital roles in global fertility rates and achieving population stabilization.

## 1.1 Trends in Population Growth

### *1.1.1 Population Projections*

The world population increased dramatically during the twentieth century, from 1.6 billion people in 1900 to 6.8 billion in 2009, with the majority of this increase taking place in the developing world (Cohen, 2006; UN, 2009). It is estimated that by 2050 the global population will be 9 billion, with 88% (7.9 billion) concentrated in developing countries. This estimate assumes an expected drop in fertility in the less developed countries, from an average of 2.7 children per woman in the years from 2005 to 2010 to an average of 2.1 in the period of 2045 to 2050. In the forty-nine least developed countries, an even greater reduction in fertility is anticipated, from 4.4 to 2.4 children per woman. In contrast, the more developed regions had an average fertility rate of 1.64 children per woman in the period from 2005 to 2010.

Another important measure of population growth is the annual rate of population growth. For the world as a whole this declined sharply from 1.8% per year in the period 1950 to 1990, to 1.2% per year after 2005 (United Nations, 2012). But this trend was very uneven around the world. In Europe growth has plunged to a mere 0.2% per year and is actually negative in some countries (i.e., the population is shrinking). In sub-Saharan Africa, by contrast, the rate was about 2% per year in the 1950s, rose to about 2.8% per year in the 1980s, and has only made a modest decline since then, to 2.7% per year after 2005. Success in slowing population growth has been much more impressive in India where the rate of growth went from 2.3% a year in the 1970s to 1.35% after 2005. Similarly, Pakistan went from 3% to 1.8% in those years.

### *1.1.2 Urban versus rural growth*

Half of the global population currently lives in cities, and the majority of the projected population increase is likely to occur in the cities of the developing world (Cohen, 2006). As a result, it has been projected that by 2030 an estimated 61% of the global population, or almost 5 billion people, will reside in urban areas (Cohen, 2006). Over the past century, there has been a huge increase in the number of cities with a million or more people – from 16 to nearly 400 – with 70% of them located in developing nations (Cohen, 2006). Urbanites often have better access to basic public services, education, health care, and employment than do rural residents. But in many cases the rate of urban growth exceeds the capacity of cites to expand basic services and infrastructure. As a result, large numbers of urban dwellers live in slums: an estimated 72% of the urban population in sub-Saharan Africa, 43% in Asia and the Pacific, 32% in Latin America, and 30% in the Middle East and Northern Africa (UN-HABITAT, 2003). A survey of twenty-two countries across sub-Saharan Africa found that as urban population increases so does the risk of under-5 mortality, as a result of poor access to vaccinations and safe water (Fotso et al., 2005).

## 1.2 The Impact of Population Growth

### *1.2.1 Health*

High fertility rates have a direct, negative impact on the health of women and children. Globally, between one quarter and one half of all deaths in women of childbearing age are pregnancy-related (WHO, 2004). The spacing between pregnancies is also important to the well-being of children. Compared to children born

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3 to 5 years apart, those born less than 2 years after the previous child have a 2.5 times greater risk of dying before the age of five (Setty-Venugopal & Upadhyay, 2002). This is largely due to the mother's inability to completely recover nutrient stores from the previous pregnancy within two years, which thus contributes to premature births, underweight babies, slow development, and greater risk of infant mortality and of an infant contracting infectious diseases in childhood (Rustein, 2005).

### *1.2.2 Poverty*

Higher fertility rates are strongly associated with poverty (Leete & Schoch, 2003), which leads to population growth and more poverty, creating a vicious cycle. When population growth slows, governments have more money available per capita for social programmes. Also, having fewer children means parents are better able to provide for the health and education of each child, while women are more able to work outside the home and generate an income (Haddock et al., 2008). A study of urban Kenyan women illustrates the close interrelationship between poverty and fertility. Fotso and colleagues (2007) found that economically disadvantaged women were three times more likely to have an unmet need for family planning, and three times less likely to use contraception. This was due to both financial barriers and lack of knowledge. Not surprisingly, they had three times more children than their more affluent counterparts. As such, the gap in fertility between rich and poor increases the likelihood that more children are born to poorer families.

### *1.2.3 Food supply and natural resources*

There is sufficient food in today's world to feed every person on the planet. So why is there still so much hunger and malnutrition? Several answers to this question exist. An obvious one is that most people who are undernourished are poor and simply cannot afford to buy enough food. Another major cause is local conflict or changes in conditions, such as drought. An important factor in hunger and malnutrition is not simply lack of food but lack of political will to deliver the food to those who need it. However, whenever possible, it is preferable to improve the local food supply. For reasons discussed in this chapter, the coming decades are likely to be times of great challenge. We should therefore give high priority to tackling the various factors that threaten food security.

Population growth is clearly an important factor that places strain on the local food supply. Between the years 1985 and 2005 the number of food emergencies doubled to more than 30 each year, whereas it has tripled in sub-Saharan Africa, where one third of the population is undernourished (Haddock et al., 2008). Clearly, major increases in food production are required to feed this fast growing population. However, this should be achievable (Alexandratos & Bruinsma, 2012). But growth in population and of food production comes at a steep price. Human pressure on natural resources, such as cropland, freshwater, fisheries, and forestry, is unprecedented and escalating. A larger population results in fewer natural resources available per person and is one of the biggest hurdles to the preservation of ecological systems.

Sustainable development has been widely promoted as a solution to this crisis. Such a system entails not simply economic growth, but a sharing of resources among all groups. In 1986 the UN World Commission on Environment and Development issued *Our Common Future*, often called the Brundtland Report. It strongly advocated for sustainable development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN-WCED, 1987). Equitable economic growth across all sectors is seen as an important factor that leads to a slowing of population growth. an economic asset to the poor.

### *1.2.4 Conflict and security*

When resources are in short supply, the potential for civil conflict increases, creating a greater imperative for persons to migrate. During the 1990s, the likelihood of civil conflict was 40% for those nations with rapid urban population growth and a large proportion of young adults, coupled with lack of cropland or freshwater (Haddock et al., 2008). In general, those countries in the early to middle stages of a demographic transition are much more vulnerable to conflicts, insurgencies, and terrorism than those in later stages (Haddock et al., 2008).

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## 1.3 Solutions to Population Growth

### *1.3.1 Breaking the cycle*

The factors discussed here show many interactions at work. Poverty leads to population growth while, conversely, population growth leads to poverty. Population growth inevitably places pressure on natural resources and strain on the local food supply, and contributes to malnutrition, all of which worsen population health. Population growth, coupled with pressure on natural resources, often results in civil conflict. Clearly, these are cycles that need to be broken. In marked contrast to these cycles, equitable economic growth is often associated with slow rates of population growth. Likewise, sustainable development is one way to relieve pressure on natural resources, and it can facilitate greater food security. Clearly, there are many interactions at work, amongst a wide variety of factors. People working in a community, including nutritionists, should therefore avoid taking a simplistic view of population growth.

### *1.3.2 Family planning and contraceptive availability*

Increasing access to reproductive health care, including family planning, is a cost-effective measure to not only help stabilize fertility rates, but to also reduce maternal and child mortality, alleviate poverty, and increase the universality of primary education (UN, 2009). An estimated 215 million women worldwide are at risk of having an unwanted pregnancy because they are sexually active but are not using or do not have access to reliable contraception (Singh et al., 2009). The study found that it would cost US$4 billion to make contraceptives freely available, and for every dollar spent on contraception, health-care spending could be lessened by $1.40 through the reduction of unplanned births and abortions. An estimated 68,000 women die each year from unsafe abortions, while tens of thousands more experience serious complications resulting from them (WHO, 2004). Common barriers to family planning include lack of knowledge about contraception, cost, social stigmas, high child mortality, and government policy (Kristof, 2010).

### *1.3.3 Education*

Education, especially of girls, has been shown to reduce fertility as well as mortality of the mother and the foetus or baby. Education can expand a young woman's employment options, which may lead her to delay marriage and childbearing in favour of earning an income. Women with some formal education tend to have longer intervals between pregnancies and stop childbearing earlier than their less educated counterparts, which leads to smaller families and fewer births after age 40 (Gelbard, 2007). A higher income can improve nutrition, sanitation, and the affordability of birth control, all of which contributes to reduced child mortality and thus makes smaller families more feasible.

### *1.3.4 Leadership*

Whether by promoting or restricting childbirth, government policies regarding fertility have directly affected population dynamics throughout history (Haddock et al., 2008). Kristof (2010) observed that women in the Congo must bring their husbands with them into clinics or hospitals before staff will sell them contraceptives. Regions in which women are able to choose their family size generally have lower fertility rates than regions in which women have a low status (Haddock et al., 2008).

# 2. CLIMATE CHANGE

## 2.1 What Is Climate Change?

Over roughly the past century, the average global temperature has increased by about 0.75$^{o}$C. (IPCC, 2007). The warmest years of the past 130 years have occurred since 1998. Mean global temperatures are expected to increase by a further 2$^{o}$C by 2050 (compared with the average during the period from 1986 to 2005) (Carrington, 2014). Things then go from bad to worse: by the end of the twenty-first century global temperatures are projected to be warmer by 3.7C. These estimates are based on current trends and assume that no major interventions take place to slow this process. These estimates were made in 2014 by the Intergovernmental

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Panel on Climate Change (IPCC). The IPCC is the leading international body for the assessment of climate change (IPCC, 2014). It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). The report was prepared by thousands of scientists from all over the world. The IPCC includes 195 countries.

While Earth's average temperature as a whole is increasing, regional variations in climate patterns mean that different places may experience warming, cooling, or little change in temperature and varying changes in weather and climate patterns. Temperature increases are expected to be greater at higher latitudes and higher altitudes (Barker et al., 2007). The increasing average temperature is causing gradual melting of glaciers and of the polar ice caps. Indeed, much of this ice is expected to melt by later in the century. As a result of the combination of increasing average global temperature (which causes sea water to expand) and vast amounts of melted ice, sea levels are expected to rise, probably by between 30 cm and 1 m. These changes to sea level and global temperature are causing widespread changes to the climate patterns around the world. The frequency, type, amount, and intensity of precipitation are expected to continue to change, leading to a greater number and increased intensity of extreme events, such as droughts, heat waves, floods, and hurricanes.

More than half of the world's largest cities are located near the sea, and a third of the global population lives within 96 km of a shoreline. Inundation of fertile lands by rising seas will be compounded by changing weather patterns. Countries that are often hit by weather-related events are likely, in coming decades, to be even more vulnerable to extreme weather events induced by climate change (Haines et al., 2007). Heat waves, floods, and droughts are expected to disrupt agriculture across the globe. Especially vulnerable countries are those, such as Bangladesh, in which low-lying areas contain a large percentage of the country's population and agricultural lands (Costello et al., 2009).

These changes are often referred to as "global warming." Because the above effects are so wide-ranging, the term *climate change* is preferred as it is much broader in scope and more accurate in terms of the anticipated effects.

## 2.2 Climate Change and Global Warming

One of the ways that climate can change is through modulation of the Earth's natural greenhouse effect. Some of the energy from the sun is absorbed by the Earth's surface, which radiates much of this energy back out to space. A portion of this outgoing thermal radiation is absorbed by the atmosphere, including clouds, and reradiated back to the surface, thus warming it. This natural greenhouse effect is vital to life on Earth because it keeps the average surface temperature warm enough to sustain life. Gases that contribute to this effect are called greenhouse gases (GHGs), the most powerful of which are water vapour ($H_2O$) and carbon dioxide ($CO_2$). Other gases, such as methane ($CH_4$), nitrous oxide ($N_2O$), and ozone ($O_3$), can also contribute to the greenhouse effect. Scientific evidence shows that human activities, particularly since the Industrial Revolution, have increased the atmospheric concentration of these gases and thus intensified this natural greenhouse effect.

Over the past 650,000 years, $CO_2$ concentrations have stayed between 180 and 300 parts per million (ppm) (IPCC, 2007). But $CO_2$ levels are now close to 400 ppm and rising overall, and the rate of increase is unprecedented in history (IPCC, 2007). This increase has been primarily a result of the burning of fossil fuels (e.g., coal, gasoline, natural gas) and the removal of very large amounts of forest, which take in $CO_2$ and act as carbon sinks. Likewise, methane concentration has risen to about 1800 parts per billion (ppb); this is between two and five times higher than historic levels. Methane is generated by human activities, such as waste disposal in landfills, from cattle and other ruminants raised as livestock, and burning of coal, natural gas, and biomass for energy generation. Methane is 20 times more potent than $CO_2$ in promoting climate change (US-CCSP, 2006).

Many climate experts believe that not only are the effects of climate change getting stronger, but in coming decades they will also strengthen at an increasing rate. This is because of several events that may accelerate global warming: (1) As the amount of sea ice melts, more sunshine will be absorbed by the sea (which is darker than ice), instead of being reflected into space. (2) Less snow cover on land will have the same effect as decreasing sea ice. (3) A vast amount of methane that is presently locked in frozen Arctic areas will be released as land thaws out, entering the atmosphere where it will act as a GHG. These events are considered "tipping points," after which global warming accelerates beyond any human ability to mitigate it.

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## 2.3 What Can Be Done?

Major policy changes are needed in order to promote energy conservation, renewable energy development, and better land use. Future ecological integrity and food security are dependent on a global shift away from fossil fuels and a drastically more environmentally friendly energy ethos among the biggest users (Jess, 2010).

High-income countries consume 1.5 to 4.5 times the energy per person than the global average. At the same time, rapidly developing economies, such as China's, are generating vast amounts of GHGs. Many millions of people in developing countries who never used cars before now do. Given the current policies of the largest economies, rapid economic growth in many developing countries and projected population growth, GHG emissions are expected to continue increasing rapidly (Barker et al., 2007). Accordingly, the world needs to drastically alter the amount and type of energy it uses. However, many of the largest GHG emitters have, as yet, done little or nothing to reduce emissions. It is difficult to be anything but pessimistic when looking at the present situation.

## 2.4 Climate Change and Agriculture: A Two-Way Street

### *2.4.1 The contribution of agriculture to climate change*

Agriculture accounts for less than one quarter of GHG emissions. However, a serious and growing problem is clear when we look at livestock production. As incomes of people in developing countries rise, they eat more meat. This creates several major problems related to climate change (McMichael et al., 2007; Steinfeld et al., 2006). For example, about 8 kg or more of feed is required to produce 1 kg of meat. One consequence is a massive and fast-growing global demand for grain to feed livestock, mainly pigs and cattle. Indeed, livestock are estimated to consume at least one third of the world's cereal output (Garnett, 2009). Because of its high energy content, soya meal is a major constituent of feedlot livestock production in Brazil, China, and the United States (Brown, 2006).

These enormous quantities of grain and soya beans must be grown somewhere. Today, huge areas of Brazil, most notably ever-growing parts of the Amazon rainforest, are being turned into farmland, both to grow soya beans and to create vast cattle ranches (McAlpine et al., 2009; Steinfeld et al., 2006). This contributes to climate change in several ways. First, the Amazon forests are an enormous sink for $CO_2$. As a result of deforestation, this vast sink is destroyed, and all the $CO_2$ formerly stored in it is also released into the atmosphere. Second, modern farming requires large quantities of petroleum products, which then release $CO_2$ and other GHGs. Third, cattle produce large amounts of methane, another GHG.

### *2.4.2 Effect of climate change on agriculture*

The interaction between agriculture and climate change works in both directions: not only does agriculture contribute to climate change, but climate change also has a large impact on agriculture.

Changes in temperature and rainfall distribution alter crop physiology, the availability of arable lands, and the quality of rangelands – all of which affect food security, especially for the poorest people. Computer models predict that global warming will most likely cause yield reductions for seasonally dry and tropical regions, while mid- to high-latitude regions will experience an increase in crop production for wheat, rice, and maize (Barker et al., 2007). However, if the rise in temperature exceeds 3°C, all regions are expected to suffer reduced agricultural production (Easterling et al., 2007).

As a result of expected climate change, crops will be variably affected depending on local weather changes and the varieties grown. Some regions will see an increased opportunity for double-cropping (Asseng et al., 2009). Liu and colleagues (2008) predict that as a result of climate change, wheat yields will decrease and millet yields will increase overall by 2030 in sub-Saharan Africa, while rice, cassava, sorghum, and maize will be less affected. However, some of the the largest developing countries – China, India, Mexico, South Africa, and Brazil – will likely see a net decrease in agricultural production as a result of climate change. Based on computer models, India is expected to suffer a 30% to 40% reduction in agricultural output (Cline, 2007). Accordingly, there may be great potential impact on the food security of smallholders and pastoralists who rely on agriculture for their livelihoods. Effects of climate change are likely to be more severe in marginal croplands where poverty is already high.

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In their model, Jones and Thornton (2009) predicted that the increasing frequency of drought, heat, and flooding in arid and semi-arid areas of Africa may result in a shift from growing crops to raising livestock in response to a reduction in reliable crop-growing days. However, climate-induced changes to plant growth will also variably affect the quality and quantity of feeds and forage for livestock. An increased incidence of heatwaves could also reduce production and substantially increase mortality of livestock (Sirohi & Michaelowa, 2007).

Although all regions will be affected differently, any reduction in the area of land available for farming will have an impact on global food production and will contribute to food insecurity for vulnerable populations.

### *2.4.3 Production of biofuels*

Several countries currently grow crops, such as maize (corn) and sugar cane, for production of biofuels. The rationale is that partially replacing fossil fuels with biofuels helps to reduce $CO_2$ generation. However, the production of biofuels currently requires a large input of fossil fuels. This has lead to controversy regarding the extent to which biofuel production actually reduces $CO_2$ generation. In general, the equation is more favourable in the case of cane sugar in Brazil than with maize in temperate climates.

Growing crops for biofuels can divert land away from growing other crops. While difficult to accurately estimate, it is thought that this was a major cause of the jump in food prices that occurred in the years from 2006 to 2008 (Mitchell, 2008; FAO, 2008b). Biofuel production also represents another diversion of water away from food production (De Fraiture et al., 2008). For these reasons, more research is required to determine under what circumstances biofuel production is a sound policy.

## 3. THE CURRENT STATE OF FISHERIES

Overexploitation, habitat degradation, and other stressors have caused a decline in numerous fish stocks, to the point that we now face a global crisis. At least 30% of marine fisheries have collapsed, meaning they produce less than 10% of their original potential (UNEP, 2010). The United Nations Environment Programme forecasts that unless immediate action is taken, virtually all commercial fisheries will collapse by 2050. This would have additional environmental ramifications because fishing has a smaller ecological footprint than does raising animals for meat production (Garcia & Rosenberg, 2010).

Climate change is expected to reduce the capacity of both fish stocks and fisherfolk to adapt to change in general, especially if current fishery declines continue. Ocean acidification due to increased atmospheric $CO_2$, along with warming and other factors, affect water microflora and biochemical constituents, the availability and distribution of fish, and seafood safety (FAO, 2008a). Fluctuations in the abundance and distribution of stocks have already been observed in waters across the globe, and models predict that climate change could cause many local extinctions in the tropics, sub-polar regions, and semi-enclosed seas (Cheung et al., 2009). Indeed, climate-induced changes have already been reported in various fishing grounds (Badjeck et al., 2010).

## 4. WATER AND AGRICULTURE

### 4.1 The Worsening Shortage of Water

Several factors are combining to create severe strains on the world's water supplies. One major factor is population growth and the resulting demand for more food. Agriculture consumes roughly 70% of withdrawals of freshwater globally, a figure that can reach up to 90% in some countries (WWAP, 2009). The expansion of irrigation and agriculture has fuelled the tripling of water withdrawals over the five decades between the 1950s and the 2000s (WWAP, 2009). An important factor is the growing demand for meat, which requires 8 to 10 times more water than that required for crops (WWAP, 2009). By 2025, an estimated 60% of the global population is expected to suffer water scarcity (Chapagain & Hoekstra, 2003) and many nations will have to use non-traditional sources to meet their needs. Unless efficiencies are achieved, water supply may be 40% less than demand by 2030 (UNEP, 2010). Increasing demand is expected from municipalities, from industry, and to maintain ecological function of water basins. These factors are expected to decrease the water available for agriculture by 18% worldwide by 2050 (Strzepek & Boehlert, 2010).

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Compounding the above problems, climate change will additionally lead to local water shortages (Menzel & Matovelle, 2010; Tirado et al., 2010). However, this is expected to be highly variable around the world and difficult to predict. While many regions may experience increased rainfall, the intensity and duration of droughts is expected to increase in the tropics and subtropics (Trenberth et al., 2007), including many parts of Africa (Boko et al., 2007). Adding to this problem will be rising sea levels and the attending inundation of coastal areas and salinization of freshwater.

As noted previously, climate change is already causing a reduction in the size of snow packs and glaciers. This in turn reduces the volume of water produced by melting and that subsequently flows to areas where it can be used for farming (Kundzewicz et al., 2007). This is a vital source of water for one sixth of the global population. This problem is projected to become steadily more acute later in the twenty-first century.

In short, it therefore seems likely that growing water shortages in coming decades will limit food production.

## 4.2 Meeting the Challenge of Freshwater Demand

In light of such enormous challenges, ways must be found to maintain water supplies and thereby sustain agriculture. Improved water-use efficiency of agriculture is needed. This is especially the case for poorer nations in which large amounts of water become lost. Better means are required for capturing rainfall and run-off. For areas with pronounced seasonal variations in precipitation, this captured water can be stored for use during dry periods and for application during critical plant stages. It has been estimated that small reservoirs could increase cereal production in Asia by 30% and almost double production in Africa without large investments in infrastructure (Wisser et al., 2010). Numerous techniques can be used to divert and capture run-off for agriculture (Qadir et al., 2007).

Another potential solution is to expand the amount of land being irrigated. This may be feasible when water is available but underutilized, as is the case in parts of sub-Saharan Africa and Latin America. However, the cost of infrastructure and competition from other demands for water are obstacles to irrigation projects (Hoff et al., 2010).

Urban growth and higher living standards have increased the amount of wastewater generated in many developing nations. Provided that it is treated and suitably managed, this water could be reused for a variety of purposes and would be a cost-effective option for providing irrigation in water-scarce nations (Qadir et al., 2010). However, sufficient infrastructure must be in place to treat the water and to ensure the safety of producers and consumers. Irrigation using treated wastewater would then be particularly useful for farmers in peri-urban areas of many developing nations, especially those growing high-value edible crops for urban markets.

Another option is desalinization (removal of salt from seawater) to produce more freshwater. This is done by many countries around the world. While it remains too expensive for use in traditional food production, desalinization can be economically viable as a means of irrigating high-value greenhouse crops (Qadir et al., 2007; WWAP, 2009).

## 4.3 Virtual Water

The importing of food saves countries large amounts of water that are expended (in the country of origin) to produce the food, and essentially amounts to the importing of "virtual water" latent in the food crop (Qadir et al., 2007). Globally, this can save consumptive water for growing crops by shifting some production tocountries that have better water supplies and where less irrigation is required, and thus allowing water-poor countries with purchasing power access to foods they cannot produce domestically (Hoff et al., 2010). While climate change may affect which regions benefit from these trades (Fader et al., 2010), such crops are expected to become important to the more efficient use of water (Hoff et al., 2010).

## 4.4 Effects of Climate Change

Quite apart from causing local water shortages, climate change is expected to have other important water-related effects in coming decades. Flooding caused by extremely high rainfall is a significant cause of morbidity

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and mortality, especially in developing nations. Its impact on health continues long after the flood has past, in the form of crop losses, population displacement, damage to infrastructure, and increased incidence of respiratory and diarrhoeal diseases (St Louis & Hess, 2008). As a result of climate change, diarrhoea caused by disease is expected to become more common in low-income regions, in coming years (McMichael et al., 2004).

# 5. GENETICALLY MODIFIED PLANTS

## 5.1 Genetic Engineering

*Biotechnology* is a general term that refers to any application of technology to living systems. With respect to food production, biotechnology encompasses such activities as spraying pesticides on crops and administering hormones and other chemicals to cattle to accelerate growth. Genetic engineering (GE) is the most recent development in the area of biotechnology.

Humans have, of course, been selectively cross-breeding animals and cross-fertilizing plants for thousands of years. The varieties of wheat we eat today and the cows we see in fields are the result of selective breeding intended to produce strains with desired traits. In one sense, GE could be viewed as a high-tech form of selective breeding. But there is a difference. Selective breeding is limited in scope, in that it only allows for the selection of the genes already present in a species. But, with GE, scientists can now "jump over" the species barrier. They can take a desired gene, called a transgene, from one species and insert it into a different species, thereby creating a genetically modified (GM) plant or animal. This gene can then be inherited by subsequent generations, just like all the other genes in the plant or animal.

The focus here is on GM plants, often known as genetically modified organisms (GMOs). To date, development of GM animals has not reached the point where any are being used for food production.

## 5.2 The Commercial Use of GM Plants

Several GM plants are now grown commercially in various countries. The United States has the most GM cropland, followed by Brazil, Argentina, India, Canada, and China (James, 2009). African countries are far behind in their adoption of GM plants; South Africa is the clear leader in this respect. The most widely grown GM crops are, in decreasing order of occurrence, soya beans, cotton, maize, and canola (rapeseed). In 2009, GM soya beans constituted more than three quarters of soya beans grown worldwide (James, 2009).

## 5.3 Claims and Counterclaims

There is great controversy over the wisdom of using GM plants. Here we take a brief look at some of the arguments and some of the evidence.

### *5.3.1 Improved yield*

GM crops are often touted as the only means of increasing the global food supply sufficiently to feed the growing world population. Often the development of GM crops is based on giving the plant increased resistance to attack by viruses, bacteria, or insects. A U.S. study found little evidence that use of three particular GM crops (herbicide-tolerant soya beans, herbicide-tolerant maize, and insect-resistant maize) generated significant improvement in yields (Gurian-Sherman, 2009). The popularity of GM crops is likely due to the ease of herbicide application in the case of the herbicide-resistant varieties and insurance against pests. In the review, Gurian-Sherman (2009) made the point that in the case of insect-resistant corn, a slight yield advantage was seen in years of very high insect infestation over conventional crops treated with pesticides.

### *5.3.2 Improved nutrient profile*

A deficiency of various micronutrients is a common problem in many developing countries (see Chapter 9). GM plants are being investigated as a potential tool to help counter this problem. The GM food that is closest to becoming widely available is "golden rice" (Segal et al. 2012). It contains a transgene that causes

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the rice to produce beta-carotene, a vitamin A precursor. Golden rice has now moved out of the lab and test plots and into the fields of farmers in some countries in Asia, and a GM solution to the challenge of vitamin A deficiency may thus soon become a reality. GE may also be exploited so as to use rice or other plants as a tool to boost intake of other nutrients. Of particular note, GM rice with an increased iron content has been developed (Segal et al. 2012).

### *5.3.3 Biosafety*

There has been a huge amount of controversy concerning the safety of GM foods. Many thousands of articles have been written expressing concern as to the potential dangers of GM foods. The standard accepted in many countries is based on the concept of "substantial equivalence." This means that if the GM food is essentially identical to the non-GM version of the plant, other than specific changes that result from the transgene, then it should be acceptable for marketing. There has been much speculation that GM plants have altered proteins, derived from the plant that donated the transgene, and this may induce allergic problems in consumers. Despite a huge amount of research into possible dangers to health, no solid evidence has appeared to indicate that GM foods pose any particular health hazard. Indeed, expert committees from different countries are in widespread agreement that GM food poses no risk to health (Freedman, 2013).

## 5.4 Regulations on GM Foods

A great deal of opposition has arisen in many countries to the sale of foods prepared using GM plant products. In this regard, a major difference exists between North America and Europe. The governments of both the USA and Canada have accepted the argument of "substantial equivalence." Accordingly, in those countries there is no requirement to indicate on a label whether a food contains any GM plant products. But in Europe the opposition to GE has been much stronger, and as a result the presence of GM plant products must be stated on food labels. Moreover, only two GM crops (maize and potato) are allowed in the countries of the European Union while eight countries have banned GM foods (Freedman, 2013). This has caused a major decrease in the market for GM plant products.

## 5.5 Cost and Intellectual Property Rights

The new world of GE has had the effect of turning living organisms into "inventions" that can be patented. By this means, a patent owner has legal control over who can profit from the sale of the GM plant. Indeed, some companies are even going so far as to patent plant varieties that are obtained from the wild. Serious concern has been expressed that these legal procedures might allow large multinational corporations to gain control of key parts of the food supply and thereby reap billions of dollars of profit. The extent to which six large multinational corporations control intellectual property related to agricultural research is a cause for much concern (Piesse & Thirtle, 2010).

The cost of GM seeds is greatly influenced by a country's laws regarding patents and intellectual property rights. Often, farmers must sign agreements that place restrictions on how they may use the seeds. This certainly has important implications for how GM plants will be adopted by farmers in developing countries, but precisely what the impact will be is still far from clear (Paarlberg, 2000).

## 5.6 Some Questions for Decision-makers

Here are some questions for consideration when deciding whether to plant GM crops for food and feed:

- Is the use of GM plants likely to face opposition on political, legal, or ethical grounds?
- Are GM seeds available for locally important staple crops?
- Are GM seeds suitable for the local climate?
- After carefully examining relevant factors (such as cost of seeds, amount of herbicides needed, and expected yield) does it make good financial sense to use GM seeds?

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- What legal restrictions will be imposed on farmers as a result of contracts when GM seeds are purchased? Will farmers be allowed to save seeds from the GM crops to plant the following season?
- Will the intended customers be reluctant to buy GM plant products?

## 6. GLOBALIZATION AND NUTRITION IN DEVELOPING COUNTRIES

(section written by George Winter)

Science, knowledge, goods, culture, and people are increasingly on the move. We call the consequences of such multi-dimensional movement "globalization." In one sense globalization is not new at all since religions, political techniques, people, and languages have been spreading from one place to another for millennia. At the same time, globalization is not as global as we might think: most Britons live within 10 miles of where they were born, only one in ten Americans has a passport, half the world has never made a phone call (Legrain, 2004), and some countries (Afghanistan, North Korea, Iran) remain distinctly "out of the loop." Moreover, the so-called rogue states tend to be confronted with a flight of capital, economic and cultural stagnation, a loss of external support, and acute poverty (Falk, 1999); this is the price of nationalism.

Globalization, as a contemporary ideology, is one of those controversial concepts that means different things in different contexts and to different people. The word clearly means something different to the G20 leaders at their meeting in Toronto in June 2010 and to the protesters burning police cars outside the security fence. Stiglitz put it in another context: "Are they talking about the same phenomena?" (Stiglitz, 2006).

But globalization is not controversial just because definitions vary, it is controversial because the institutions underlying its tremendous influence are undemocratic and frequently unfair. If these institutions were judged by the Havel criterion, they would be found wanting; Vaclav Havel, former president of the Czech Republic, believed a society should be judged by how it treats Roma (Gypsies) – that is, its most vulnerable inhabitants (Falk, 1999).

What do we gain from globalization? What do we give up? Do global markets engender global equality? It may be too glib to say, "markets give us the goods but not the lives we want." Globalization, in practice, deprives individuals and nation states of local control. The "free movement of labour" – like it or not – produces the multicultural, multi-ethnic, multi-religious big cities characteristic of our modern world. When some parts of the world are turbulent, migration of people conveys turbulence to other countries. This has been called unmooring (Sassen, 2004). And, whether justified or not, persons, regions, and countries unable to compete globally may be filled with resentment and bitterness as they find themselves stranded by forces beyond their influence or control. In some cases, these and other resentments and opportunities appear to have fuelled an unanticipated level of violence – North Korean torpedoes, Somali pirates, Al-Qaeda bombers – in geopolitical policies (Wright, 2006).

In the 1990s, the economy of globalizing countries grew an average of 5% per year. The economies of non-globalizing countries, in sharp contrast, declined by 1% per year during the same years (Legrain 2004). Furthermore, globalization appears to have increased income disparity. The poorest 20% of the world people now obtain only 1.75% of world gross domestic product (GDP), down from 2.5% in 1996 and 4.5% in 1960. The wealthiest persons and countries have moved ahead, but the rising waters have not "floated" all poor country boats.

How did globalization come about? While the trend toward globalization is of long standing, the development of certain world institutions has been crucial. Late in the Second World War, the allied powers convened a meeting at Breton Woods in 1944 and agreed on the formation of major international institutions: a World Bank (WB), the International Monetary Fund (IMF), and the General Agreement on Tariffs and Trade (GATT). GATT gave rise to the World Trade Organization (WTO). Globalization has come about in the context of these agencies. While their governance was never clearly articulated, the United States is the de facto dominant governor (Stiglitz, 2006). It needs to be clearly understood that these Breton Woods agencies are not part of the United Nations. Henry Kissinger said, "What is called globalization is really another name for the dominant role of the United States" (Rothenberg, 2006).

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How do the Breton Woods institutions work? The WTO, for example, supported by 120 signatory nations, sets up panels to act as judges over economic issues, placing themselves above national sovereignty and outside control by any nation. Elected by no one, and drawn from the corporate world, these panels meet in secret (Parenti, 2006). Should a country refuse to change its laws when a WTO panel so dictates, the WTO can impose fines or trade sanctions, thereby depriving the resistant country of needed markets and materials (Parenti, 2006; Stiglitz, 2006).

A vital component of globalization is low tariffs on traded goods. GATT was instrumental in reducing tariffs on manufactured goods from 40% in the 1930s to about 4% today (Legrain, 2004, p. 14).

*Globalization* implies a world in which capital, goods, and labour lose national identity; national authorities simultaneously lose control and influence, even within their national boundaries. Under globalization, everything is connected to everything else. The effort of the USA to produce biofuels stimulated demand for edible maize (and wheat) and this increased the price of grains in the USA (which may well have been intentional) and of food around the world (which was not intentional).

Over the years, the roles of these dominant world institutions – the World Bank, the IMF, GATT, and the WTO – changed with the changing economic attitude of the USA and Britain. During the Reagan-Thatcher era, the world institutions increasingly promoted privatization and business interests (Moberg, 2006). Given the continuing permissive attitude toward lobbying in Washington, the powers of American corporations became almost irresistible. Nobel Laureate Stiglitz said, "The West has driven the globalization agenda, ensuring that it garners a disproportionate share of the benefits at the expense of the developing world" (Stiglitz, 2006). Thus, the policies of the major transnational institutions promote the interests of the major corporations, the wealthiest individuals, and the wealthiest countries, while simultaneously exacerbating the already extremely unequal distribution of world wealth.

But there are many positive effects of globalization. Within and between countries, food trade has replaced the bleak alternative of starvation or migration. Moreover, globalization has been associated with a rapid decline in exploitation of children. Labour force participation of children aged 10 to 14 in developing countries is down, from 23% in 1980, to 12% in 2000 (Wolf, 2005). There has been a vast increase in freedom of trade, which has improved the standard of living as well as the standard of nutrition throughout the world.

While there are still a great many undernourished people in the world, it is now understood that the problem is not so much shortage of food as inadequate distribution – meaning inadequate income of the poor and underemployed. The Food and Agriculture Organization (FAO) estimates that the number of people suffering chronic undernutrition has dropped from 35% of the population of developing countries in 1969–1971, to 17% by 1997–1999 (Wolf, 2005). But poverty is not the same as malnourishment, and the actual number of people worldwide who are living in poverty increased by 100 million between 1990 and 1998 (Stiglitz, 2006).

The following three abbreviated case studies (per Rothenberg, 2006) are not intended to be representative of globalization's impact. Rather, they have been chosen as examples of what happens "when things go wrong." These case studies illustrate two fundamental problems: (1) the lack of democratic recourse and (2) the imbalance of power.

**Case 1.** For some time Haiti was self-sufficient in rice production, a staple of the Haitian diet. But when Haiti sought to borrow development funds from the World Bank, it was confronted with the demand that Haiti's borders be opened to imports of American rice. This might seem a reasonable request under terms of multi-national trade agreements. Haiti capitulated to this demand only to be confronted with subsidized US product. Haiti's rice producers could not compete with the US treasury. And Haiti's once healthy industry was thus destroyed.

**Case 2.** Despite the convincing evidence that breast milk is nutritionally superior to substitutes, manufacturers of these products have engaged in much marketing of them to mothers in developing countries. Many mothers in less developed countries believed the advertising that it was best for their babies and switched from breast milk to substitutes. The World Health Organization (WHO), in an attempt to overcome this danger to health, defined a set of permissible marketing criteria, which include a prohibition of marketing programmes that depict babies or giving away samples of milk replacers.

Gerber, which had long marketed a breast milk substitute using a beautiful baby face on its packages, objected, and its position was supported by the US government. Guatemala passed legislation in support of

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the WHO criteria despite threats from the USA of suspension of "most favoured nation" status under GATT. However, the challenge was accepted by the pressured Guatemalan courts, and Gerber was thus permitted to continue marketing its product using the Gerber baby face. Even as late as 1998, manufacturers of breast milk substitutes were still promoting these products by giving away free samples in 39 countries in blatant disregard of the WHO criteria (Bhagwati, 2004).

**Case 3.** The WTO has the responsibility and authority to oversee trade agreements. The Bolivian government, under pressure from the World Bank and the IMF, finally agreed to privatize the municipal water system of its third largest city, selling it to a private company largely owned by the US construction giant Bechtel (Moberg, 2006). Within two months, water rates were tripled and made up as much as one quarter of the expenditure of the poorer citizens. The resultant huge protests led to cancellation of the contract. But then the WTO regulations came into play, under which the corporation could sue for loss of profit opportunities. Bechtel surreptitiously added new investors and by this means made the Bolivian agreement subject to a prior agreement with the Netherlands. As a consequence, Bechtel (which had invested less than $1 million) was entitled to sue for more than $25 million to compensate for the profit it might have made. Some development assistance!

The stories go on. In the name of "freedom of trade," Japan has been forced to accept greater pesticide residues in imported food, and forced to reverse laws intended to protect endangered species. A ban on imports of hormone-treated beef from the USA into the European Union – a ban very widely accepted among European consumers – was overturned as an illegal restraint on trade. The WTO ruled that the US corporation Rice Tec holds the patents to many of the Basmati rice varieties that Indian farmers have grown for centuries. Similarly, the Neem tree, whose extracts contain natural pesticides and medicines, has been cultivated for centuries in India, but pharmaceutical companies filed monopoly patents and those companies now have exclusive control over substances obtained substances obtained from the tree. Formerly independent Indian farmers now work for the pharmaceutical companies (Parenti, 2006). These are examples of how the state as an instrument of human welfare, "has been [pushed] by degrees and to varying extents into a subordinate relationship with global market forces" (Falk, 1999, p. 50).

The question thus arises, as Falk somewhat imprecisely phrases it: "How can the state be pulled back from its current tilt toward market driven globalism... toward people driven globalism?" (Falk, 1999, p. 52).

There is an impact of globalization on food sources, environment, diversity of supply, control, and cost. The improved liberalization of trade has helped improve income for some and nutrition for most. But there are also changes in profit and control, food constituents, diets, eating habits, and food adequacy. One tends to give credit to globalized food markets for achieving the economic goals of the food system and for provision of better nutrition as well as better distribution. But one is left with a nagging concern that the economic, social, and cultural alienation resulting from globalization of food supply has been harmful (Stiglitz, 2006). Perhaps the Toronto protesters have a point.

## DISCUSSION QUESTIONS AND EXERCISES

1. Using the solutions to overpopulation presented in section 1.3 as a guide, compile a list of resources in your community that are available to those wanting to have fewer children. What resources are lacking? What are some other options not discussed in the chapter?
2. What barriers exist in your community or country that impedes efforts to slow population growth?
3. Determine where the water for your community comes from.
4. Discuss what factors put your community at risk of a water shortage. What are some ways that people can conserve water? Determine some options that would increase your local water security.
5. Discuss the positives and negatives of GM crops. Using the questions for decision-makers in section 5.6 as a guide, assess whether and under what conditions (e.g., cost, type of plants) your community would be open to using GM crops.

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## ADDITIONAL RESOURCES

### Further Reading

Alexandratos N & Bruinsma J. 2012. FAO (Food and Agriculture Organization of the United Nations). World agriculture towards 2030/2050: the 2012 Revision. http://www.fao.org/docrep/016/ap106e/ap106e.pdf. This document contains a detailed analysis of projections of growth in agricultural output and world food supplies in the years to 2050.

Falkenmark M & Rockstrom J. 2004. *Balancing Water for Humans and Nature: The New Approach in Ecohydrology*. London, Earthscan.

Food Security: Feeding the World in 2050. Theme issue of *Philosophical Transactions of the Royal Society B.* 2010*,* Vol. 365, Issue 1554. http://rstb.royalsocietypublishing.org/content/365/1554.toc

Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). 2013. http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm. The website has many links to other sites as well as government websites with outreach material.

New Scientist collection of information on climate change http://www.newscientist.com/topic/climate-change

"Room for Debate." 2009 article from the *New York Times* regarding GM food. http://roomfordebate.blogs.nytimes.com/2009/10/26/can-biotech-food-cure-world-hunger/

*The GMO Emperor has no Clothes. Synthesis Report*. 2011. Navdanya International.

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Report with much information and commentary highly critical of GM food production. http://www.navdanyainternational.it/

Water Encyclopedia: Science & Issues. 2009. http://www.waterencyclopedia.com/index.html

**Websites**

Global Footprint Network http://www.footprintnetwork.org

Population Action International http://www.populationaction.org

The Cartagena Protocol on Biodiversity http://www.cbd.int/biosafety/

United Nations Environment Programme http://www.unep.org/publications

UNEP Green Economy Initiative http://www.unep.org/greeneconomy/

Worldwatch Institute http://www.worldwatch.org

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# APPENDIXES

## APPENDIX I

### *Sources of Reliable Information on Nutrition*

#### *Websites*

The following websites make enormous amounts of information readily available to anyone at no charge:

The American Academy of Pediatrics. Information on all aspects of paediatrics, including nutrition.
http://www.aap.org

The American Diabetes Association. Extensive information on all aspects of diabetes. (The website also contains information in Spanish.)
http://www.diabetes.org

The American Dietetic Association. Resource for nutrition information.
http://www.eatright.org

The American Heart Association. Another resource on heart disease. (The website also contains information in Spanish.)
http://www.amhrt.org

The Food and Agriculture Organization of the United Nations (FAO). The FAO website provides many publications on areas related to food and agriculture. (The website also contains information in French and Spanish.)
http://www.fao.org

Food and Nutrition Technical Assistance II Project (FANTA-2). This organization is financed by the U.S. Agency for International Development (USAID). It provides many documents on nutrition programmes *around the world.*
*http://www.fantaproject.org*

HEALTHFINDER. A source of health information on many topics. The website is run by the U.S. Department of Health and Human Services. (The website also contains information in Spanish.)
http://www.healthfinder.gov

International Food Policy Research Institute, based in Washington, D.C., USA. The website provides many publications on issues related to agriculture. (The website also contains information in French, German, and Spanish.)
http://www.ifpri.org

Mayo Clinic. This American website provides much information on health and disease, including diet and supplements. Books written by Mayo Clinic experts may be purchased via the website.
http://www.mayoclinic.com

MEDLINE. This website provides direct access to a database of more than ten million articles published in thousands of scholarly journals in all areas of the biomedical sciences. Operated by the U.S. National Library of Medicine.
http://www.ncbi.nlm.nih.gov/PubMed
Note: For most articles only an abstract is provided. The full article can often be obtained at no cost by sending an email request to the first author.


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MEDLINEPLUS. This website is operated by agencies of the U.S. government and provides extensive information on many aspects of health and medicine. Operated by the U.S. National Library of Medicine. (The website also contains information in a variety of languages.)
http://medlineplus.gov

National Cancer Institute. This provides extensive information on all aspects of cancer. This agency is a branch of the National Institutes of Health, an agency of the U.S. government. (The website also contains information in Spanish.)
http://www.cancer.gov

The National Center for Complementary and Alternative Medicine provides information on a wide variety of dietary supplements. This agency is a branch of the National Institutes of Health, an agency of the U.S. government. (The website also contains information in Spanish.)
http://nccam.nih.gov

The National Heart, Lung, and Blood Institute. This website provides much valuable information on heart disease and related subjects. This agency is part of the U.S. Department of Health and Human Services. (The website also contains information in Spanish.)
http://www.nhlbi.nih.gov

The National Institute on Aging is a source for health and research information on older adults. This agency is a branch of the National Institutes of Health, an agency of the U.S. government. (The website also contains information in Spanish.)
http://www.nia.nih.gov

The United Nations Children's Fund (UNICEF) is located in New York. The international organization is committed to evidence-based child survival and nutritional interventions. The website provides much useful information on issues related to children, including nutrition. (The website also contains information in French and Spanish.)
http://www.unicef.org

The Weight-control Information Network (WIN) provides information on all aspects of weight control. This agency is a branch of the National Institutes of Health, which is a part of the U.S. government. (The website also contains information in Spanish)
http://win.niddk.nih.gov

The World Bank, based in Washington, D.C., USA. This provides documents on a wide range of issues, including nutrition, agriculture, water, health, energy, environment, and trade. (The website also contains information in French and Spanish.)
http://www.worldbank.org

The World Health Organization (WHO). This website provides many publications on areas related to health around the world. (The website also contains information in French and Spanish.)
http://www.who.int/en

There are several websites that provide a detailed analysis of a diet and the nutrition content of large numbers of foods. The links to several free websites were given in Chapter 22, section 3.3 (Diet Analysis) and section 10 (Additional Resources).

## *Books*

The following books may be purchased:

Semba RD & Bloem MW, eds. 2008. *Nutrition and Health: Nutrition and Health in Developing Countries*. 2nd ed. Totowa, NJ, Humana Press.

Temple NJ, Wilson T & Jacobs DR, Jr, eds. 2012. *Nutritional Health: Strategies for Disease Prevention,* 3rd ed. New York, Springer Press.

Wilson T, Temple NJ, Bray GA, Boyle Struble M, eds. 2010. *Nutrition Guide for Physicians*. New York, Humana Press (Springer). The second edition will be published in early 2017.

List compiled by Norman J. Temple and Alice N. Brako

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# APPENDIX II

## *Aids to Calculations*

### *Weight*

1 gram = 0.035 oz
1 kg = 2.20 lb
1 oz = 28.35 grams
1 lb = 454 grams

### *Length*

1 cm = 0.393 in
1 meter = 39.37 in
1 in = 2.54 cm
1 ft = 30.4 cm

### *Volume*

1 pint (US) = 0.473 L = 16 oz
1 pint (Imperial) = 0.568 L
1 quart (US) = 0.946 L = 32 oz
1 fluid oz = 29.57 mL
1 L = 2.11 pints (US)
1 British Imperial gallon = 1.201 US gallons = 4.546 L
1 cup = 8 oz = 236 mL (commonly rounded to 250 mL)
1 teaspoon (tsp) = 5 mL
1 tablespoon (tbs or T) = 3 teaspoons = 15 mL

### *Temperature*

To change Fahrenheit (°F) to Celsius (°C), subtract 32, then divide by 1.8
To change °C to °F, multiply by 1.8, then add 32
Boiling point 100°C = 212°F
Body temperature 37°C = 98.6°F
Freezing point 0°C = 32°F

### *Energy*

1 kcal = 4.2 kJ (kilojoules)


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## *Energy in food components (kcal per gram)*

Fat: 9
Carbohydrate: 4
Protein: 4
Alcohol: 7

## *Body Mass Index (BMI)*

BMI = weight (kg) divided by height $(m)^2$ ***or*** [weight (lb) x 703] divided by height $(in)^2$

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# APPENDIX III

## *Dietary Reference Intakes (DRI)*

Dietary Reference Intakes (DRI) consists of four tables, as explained in Chapter 14. Here we present actual values in a simplified form. The numbers are for Recommended Dietary Allowances (RDA) or Adequate Intakes (AI). These values indicate a target amount (quantity per day) for each nutrient, depending on age and sex.

The full tables include: values for people aged from birth to 18 years; values for energy, fat, carbohydrate, water, and 11 other nutrients; and values for Tolerable Upper Intake Levels. For the full tables go to the following website: http://fnic.nal.usda.gov, then click on "Dietary Guidance."

| | | Male | Female | | | |
|---|---|---|---|---|---|---|
| | unit | >18 yr | 19–50 yr | >51 yr | Pregnancy | Lactation |
| Dietary fiber | g | 38[a] | 25 | 21 | 28 | 29 |
| Protein | g | 56 | 46 | 46 | 71 | 71 |
| Thiamin | mg | 1.2 | 1.1 | 1.1 | 1.4 | 1.4 |
| Riboflavin | mg | 1.3 | 1.1 | 1.1 | 1.4 | 1.6 |
| Niacin | mg | 16 | 14 | 14 | 18 | 17 |
| Vitamin $B_6$ | mg | 1.3[b] | 1.3 | 1.5 | 1.9 | 2.0 |
| Folate | µg | 400 | 400 | 400 | 600 | 500 |
| Vitamin $B_{12}$ | µg | 2.4 | 2.4 | 2.4 | 2.6 | 2.8 |
| Vitamin C | mg | 90 | 75 | 75 | 85 | 120 |
| Vitamin A | µg[c] | 900 | 700 | 700 | 770 | 1300 |
| Vitamin D | µg | 15[d] | 15 | 15[d] | 15 | 15 |
| Vitamin E | mg | 15 | 15 | 15 | 15 | 19 |
| Potassium | mg | 4700 | 4700 | 4700 | 4700 | 5100 |
| Calcium | mg | 1000[e] | 1000 | 1200 | 1000 | 1000 |
| Magnesium | mg | 420 | 315 | 320 | 355 | 315 |
| Iron | mg | 8 | 18 | 8 | 27 | 9 |
| Zinc | mg | 11 | 8 | 8 | 11 | 12 |
| Iodine | µg | 150 | 150 | 150 | 220 | 290 |
| Selenium | µg | 55 | 55 | 55 | 60 | 70 |
| Copper | µg | 900 | 900 | 900 | 1000 | 1300 |

[a] 30 g at age >50 years
[b] 1.7 mg at age >50 years
[c] 1000 µg of vitamin A = 3300 IU. The unit µg indicates micrograms; IU is international units.
[d] 15 µg (600 IU) at age 51–70; 20 µg (800 IU) at age >70 years
[e] 1200 mg at age >50 years


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