CHAPTER 8

NUTRIENT REQUIREMENTS AND FACTORS AFFECTING NUTRITIONAL STATUS IN OLDER ADULTS

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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
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
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,
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 prevalence 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.
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.

Figure 8.1: Prevalence of food poverty in South African households (N = 28,704).
Let us 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
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 B₁₂ 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

<table>
<thead>
<tr>
<th>Change in body composition or physiological function</th>
<th>Impact on nutrient requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>↓ Muscle mass (sarcopenia)</td>
<td>↓ Need for energy</td>
</tr>
<tr>
<td>↓ Taste and olfactory (smell) acuity</td>
<td>↑ Need for energy</td>
</tr>
<tr>
<td>↓ Bone density (osteopenia)</td>
<td>↑ Need for calcium, vitamin D</td>
</tr>
<tr>
<td>↓ Calcium bioavailability</td>
<td>↑ Need for calcium, vitamin D</td>
</tr>
<tr>
<td>↓ Gastric acid (atrophic gastritis)</td>
<td>↑ Need for vitamin B₁₂, folate, calcium, iron, zinc</td>
</tr>
<tr>
<td>↓ Skin capacity for cholecalciferol synthesis</td>
<td>↑ Need for vitamin D</td>
</tr>
<tr>
<td>↓ Hepatic uptake of retinol</td>
<td>↑ Need for vitamin A</td>
</tr>
<tr>
<td>↓ Efficiency in metabolic utilization of pyridoxal</td>
<td>↑ Need for vitamin B₆</td>
</tr>
</tbody>
</table>

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.
Table 8.2: Major risk factors for nutritional conditions in older persons

<table>
<thead>
<tr>
<th>Social factors</th>
<th>Physical factors</th>
<th>Psychological factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Poverty</td>
<td>- Dental problems and/or dysphagia (difficulty swallowing)</td>
<td>- Widowed or bereaved</td>
</tr>
<tr>
<td>- Isolation (living alone or living in a remote area)</td>
<td>- Diminished sense of smell or taste and/or xerostomia (dry mouth)</td>
<td>- Depression</td>
</tr>
<tr>
<td>- Poor nutrition, difficulty with food preparation, poor knowledge of food safety</td>
<td>- Effects of medications</td>
<td>- Loneliness</td>
</tr>
<tr>
<td>- Elder abuse and neglect</td>
<td>- Impaired absorption of nutrients</td>
<td>- Dementia</td>
</tr>
<tr>
<td>- Institutional environment (hospital or old-age home)</td>
<td>- Increased metabolism (as in Parkinson’s disease)</td>
<td>- Alcoholism</td>
</tr>
<tr>
<td></td>
<td>- Chronic disease or chronic infection</td>
<td>- Fear of choking and other food-related anxieties</td>
</tr>
<tr>
<td></td>
<td>- Severe problems with vision</td>
<td>- Anorexia (loss of appetite)</td>
</tr>
<tr>
<td></td>
<td>- Physical disabilities and/or impaired performance of basic daily activities (including food shopping, cooking, and eating)</td>
<td></td>
</tr>
</tbody>
</table>

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 90° angle.

doi:10.15215/aupress/9781927356111.01
Table 8.3: Assessment of weight loss in older persons over time

<table>
<thead>
<tr>
<th>Time</th>
<th>Significant weight loss (%)</th>
<th>Severe weight loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One week</td>
<td>1–2</td>
<td>&gt;2</td>
</tr>
<tr>
<td>One month</td>
<td>5</td>
<td>&gt;5</td>
</tr>
<tr>
<td>3 months</td>
<td>7.5</td>
<td>&gt;7.5</td>
</tr>
<tr>
<td>6 months or longer</td>
<td>10–20</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

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):

\[
\text{Men: height (cm) = (2.08} \times \text{knee height (cm)} + 59.01
\]

\[
\text{Women: height (cm) = (1.91} \times \text{knee height (cm)} - (0.17 \times \text{age}) + 75
\]

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).
Table 8.4: Mid-upper-arm circumference reference values for older persons

<table>
<thead>
<tr>
<th>Men and women of African origin(^a)</th>
<th>Asians/Caucasians</th>
<th>Nutritional status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>&gt;24.0</td>
<td>&gt;22.0</td>
<td>&gt;22.0</td>
</tr>
<tr>
<td>23.1–24.0</td>
<td>22.1–23.0</td>
<td>20.1–22.0</td>
</tr>
<tr>
<td>22.1–23.0</td>
<td>21.1–22.0</td>
<td>19.1–20.0</td>
</tr>
<tr>
<td>&lt;22.1</td>
<td>&lt;21.1</td>
<td>&lt;19.1</td>
</tr>
</tbody>
</table>

\(^a\) 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:

\[
\text{MUAMA} (\text{cm}^2) = (\text{MUAC} (\text{cm}) - [\pi \times \text{TSF} (\text{mm})/10])^2 / 4\pi
\]

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
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>
<thead>
<tr>
<th>Serum values</th>
<th>Severity of nutritional deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mild</td>
</tr>
<tr>
<td>Serum albumin (g/dl)</td>
<td>3.2–3.5</td>
</tr>
<tr>
<td>Transferrin (mg/dl)</td>
<td>180–200</td>
</tr>
<tr>
<td>Total lymphocyte count (n/mm³)</td>
<td>1500–5000</td>
</tr>
</tbody>
</table>

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
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

<table>
<thead>
<tr>
<th>Clinical sign</th>
<th>Possible deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hair</td>
<td>Protein</td>
</tr>
<tr>
<td>Can be pulled out easily, sparse</td>
<td>Protein</td>
</tr>
<tr>
<td>Skin</td>
<td>Essential fatty acids</td>
</tr>
<tr>
<td>Xerosis</td>
<td>Niacin</td>
</tr>
<tr>
<td>Pigmentation</td>
<td>Protein</td>
</tr>
<tr>
<td>Flaky dermatitis</td>
<td>Water</td>
</tr>
<tr>
<td>Poor tissue turgor</td>
<td>Protein, thiamine</td>
</tr>
<tr>
<td>Oedema</td>
<td>Protein, thiamine</td>
</tr>
<tr>
<td>Purpura</td>
<td>Vitamins C, K</td>
</tr>
<tr>
<td>Pallor</td>
<td>Folate, iron, vitamin B₁₂</td>
</tr>
<tr>
<td>Pressure sores</td>
<td>Protein-energy</td>
</tr>
<tr>
<td>Poor wound healing</td>
<td>Protein-energy, zinc, vitamin C</td>
</tr>
<tr>
<td>Perifollicular haemorrhage</td>
<td>Vitamin C</td>
</tr>
<tr>
<td>Lips, oral mucosa</td>
<td>B-complex, iron, protein, riboflavin</td>
</tr>
<tr>
<td>Angular fissures, stomatitis</td>
<td>Vitamin B₁₂, niacin, riboflavin, protein</td>
</tr>
<tr>
<td>Cheilosis</td>
<td>Vitamin B₁₂, niacin, riboflavin, protein</td>
</tr>
<tr>
<td>Swollen bleeding gums</td>
<td>Vitamin C</td>
</tr>
<tr>
<td>Tongue</td>
<td>Riboflavin</td>
</tr>
<tr>
<td>Magenta colour</td>
<td>Niacin</td>
</tr>
<tr>
<td>Fissures, raw</td>
<td>Pyridoxine, folate, iron, vitamin B₁₂</td>
</tr>
<tr>
<td>Glossitis</td>
<td>Folate, vitamin B₁₂</td>
</tr>
<tr>
<td>Fiery red colour</td>
<td>Riboflavin, niacin, iron</td>
</tr>
<tr>
<td>Atrophic papillae</td>
<td>Chromium, iron</td>
</tr>
<tr>
<td>Nails</td>
<td>Spoon shape</td>
</tr>
<tr>
<td>Muscles, extremities</td>
<td></td>
</tr>
</tbody>
</table>
### Clinical sign

<table>
<thead>
<tr>
<th>Muscular pains</th>
<th>Biotin, selenium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular twitching</td>
<td>Pyridoxine</td>
</tr>
<tr>
<td>Muscular weakness</td>
<td>Sodium, chloride</td>
</tr>
<tr>
<td>Pain in calves, weak thighs</td>
<td>Thiamine</td>
</tr>
<tr>
<td>Muscle cramps</td>
<td>Sodium, chloride</td>
</tr>
</tbody>
</table>

#### Neurological

<table>
<thead>
<tr>
<th>Disorientation</th>
<th>Thiamine, sodium, water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased vibratory sense, ataxia, optic neuritis</td>
<td>Vitamin B₁₂</td>
</tr>
<tr>
<td>Weakness, paraesthesia of legs</td>
<td>Thiamine, pyridoxine, pantothenic acid, vitamin B₁₂</td>
</tr>
<tr>
<td>Mental disturbances, psychosis</td>
<td>Niacin, magnesium, vitamin B₁₂</td>
</tr>
<tr>
<td>Depression, lethargy</td>
<td>Biotin, folate, vitamin C</td>
</tr>
<tr>
<td>Peripheral neuropathy</td>
<td>Pyridoxine</td>
</tr>
</tbody>
</table>

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
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.,...
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,
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\textsubscript{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\textsubscript{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
Nutrient Requirements and Factors Affecting Nutritional Status in Older Adults

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<sub>12</sub> 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<sub>12</sub>, 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 (Scaarmeas 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...
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.
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.
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.
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.

REFERENCES


ADDITIONAL RESOURCES


ACKNOWLEDGEMENT

This chapter is based in part on a chapter from an earlier book:


doi:10.15215/aupress/9781927356111.01