13
Nutrition in Older Adults

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Key messages

- Globally, the demographic profile is shifting towards a more elderly population.
- Although individuals of industrialised nations who are over 65 years of age are healthier than ever before, chronic degenerative diseases and other illnesses still affect older adults increasingly with advancing age.
- Changes that often accompany the ageing process, such as hearing and vision loss and anthropometric changes, create challenges to nutritional assessment in the older adult population. Determining the most appropriate outcome measures, such as longevity or quality of life, is also challenging with this age group.
- Nutrition screening and assessment using biological and social determinants of nutritional status are critical to implementing effective nutritional or other interventions to ameliorate diet-related health complications.
- Nutritional interventions vary from medical nutritional therapy to social meal programmes and exist both at the individual and community levels.
- Challenges remain for public health nutrition in older adults, including the development of stronger evidence-based dietary reference standards, nutritional interventions and means for maintaining functional status and quality of life.

13.1 Introduction

The ageing population

The simultaneous decline in birth rate and the rise in life expectancy both at birth and age 65 years in many countries are creating a worldwide demographic shift in which older adults constitute a greater and greater proportion of the population than at any other time in history. In 2000, approximately 7% of the world population was aged 65 years or older – which represented an increase of 5% from 1950. This trend is expected to continue, and the proportion of older adults is expected to reach nearly 16% by the year 2050 (Figure 13.1) (United Nations, 2013). In contrast, the share of the population worldwide made up of persons under age 15 years is anticipated to drop from 26% in 2013 to 21% in 2050. This demographic process, in which the proportion of older persons in the population increases and that of the younger persons lessens, is known as population ageing.

Although, historically, it was the highly industrialised nations that had the greatest proportion of older adults in their population, and the proportion continues to grow, today the most rapid increase in the number of older adults is occurring in the developing world. Europe is the 'oldest' region in the world and it is expected to maintain this title well into the twenty-first century, as it has had the highest population proportion of adults aged 65 years and over for several decades. The proportion of older individuals in the USA also continues to rise. From 2005 to 2030, the number of older adults in the USA is predicted to nearly double, so that it will then constitute 20% of the country's residents (Figure 13.1) (United Nations, 2013). Worldwide population ageing makes the public health challenge to increase the number of older adults who lead high-quality, productive and independent lives globally relevant to all.

Conditions and diseases affecting the health of older adults

In Europe, the USA and highly industrialised countries elsewhere in the world, advances in modern medicine and public health have largely eliminated the infectious

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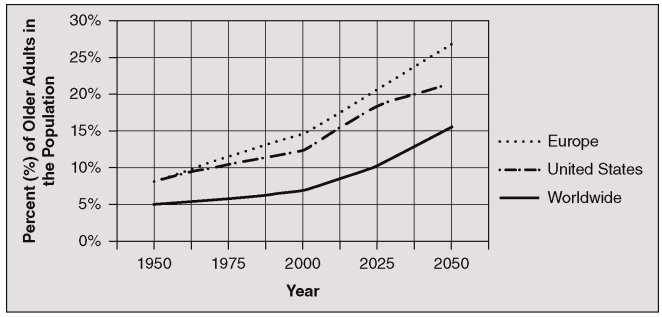

Figure 13.1 The percentage of adults 65 years old or older in the total population of Europe, the USA and worldwide from 1950–2050. *Source*: adapted from United Nations (2013).

diseases of childhood and many communicable diseases in adults, such as tuberculosis. As a result, in Europe, people reaching the age of 65 years are expected to live an average of 15.5 years more, while life expectancy at birth of the typical American has increased by 30 years in the last century. Although the decline in infectious diseases and acute illnesses has allowed more individuals to live longer, the prevalence of age-related chronic degenerative diseases and illnesses is rising, simply because life expectancy has increased so much and in spite of the fact that at least until the eighties, people at any given age are healthier than ever before. Heart disease and cancers are now the major killers of those living in the highly industrialised world, along with other chronic degenerative diseases such as chronic obstructive lung disease, stroke, Alzheimer's disease and diabetes mellitus – some of which are exacerbated by or contribute to poor nutrition (Figure 13.2). These chronic diseases have caused the number of healthy life years (HLYs) to remain unchanged in recent years despite the increase in average life expectancy of approximately 0.25 years annually; unfortunately, because the number of HLYs remains unchanged, Europeans still spend 20–25% of their lives in poor health.

Chronic degenerative diseases and conditions have a great and long-lasting negative impact on the quality of life of older people. For example, approximately 80% of older US adults are living with at least one chronic condition, and 50% are living with at least two. Within the World Health Organization (WHO) European region, the proportion of disease burden due to chronic disease reaches about 95% in people aged 60 years and older. These individuals are at a greater risk for having a lower quality life than their healthy counterparts since chronic disease is so often associated with a decline in functional ability and mental status, and greater likelihood of limitations in performing usual activities. The lessening of physical capabilities creates challenges in performing normal tasks of self-care in daily life that are measured with a scale called the activities of daily living (ADLs), such as self-feeding,

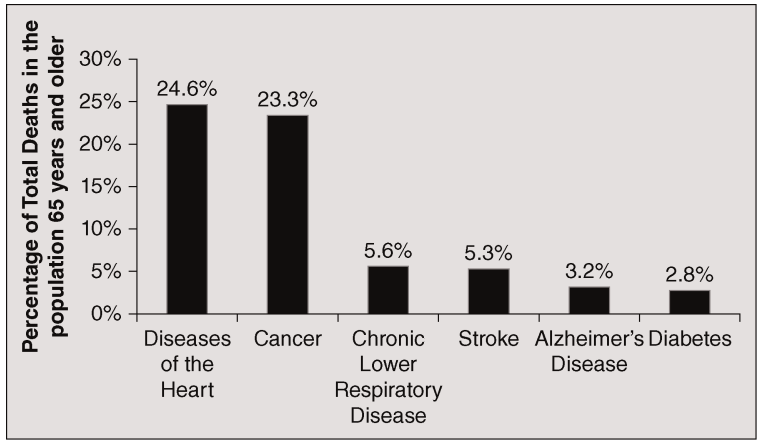

Figure 13.2 Percentage of total deaths from various chronic conditions in adults 65 years and older in the USA, 2008–2009. *Source*: adapted from Heron (2012).

Table 13.1 Percentage of persons 18 years and older having limitation in ADLs, instrumental ADLs (IADLs), and percentage of those who are limited as a result of one or more chronic conditions, USA, 2010.

Age group (years)	Limited in ADLs (%)	Limited in IADLs (%)	Limited in usual activities due to one or more chronic conditions (%)
18–44	0.6	1.4	5.8
45–64	1.9	3.7	16.5
65–74	3.7	6.5	25
≥75	11	18.8	42.5

Source: Adams *et al*. (2011).

toileting and managing personal hygiene (Table 13.1). The presence of these limitations can mean a loss in independence and a need for institutionalised care. In addition to the decline in physical functional status, emotional and mental problems may affect an individual's performance of the IADLs. Although IADLs are not necessary for physical functioning, they represent important activities that must be carried out if the individual is to be able to live independently. IADLs include an individual's ability to complete household chores, take medications, manage basic finances, use various mechanisms for communication and transport his/herself within the community. Chronic disease can also restrict an individual's engagement in life, social interactions and enjoyment with family and friends.

The WHO quantifies the burden of disease using disability-adjusted life years (DALYs), a metric that calculates the number of years of healthy life by considering years lost due to poor health, disability and premature death. When the measure is summed across a population, it indicates the difference between current health status and an ideal scenario in which the average population lives free of disability and disease to an advanced age. DALYs provide a means to compare between countries, and, if the effects of interventions on these parameters are known, to evaluate their relative significance on public health.

Prevalence of morbidity and functional limitations in older adults

Since adults are living longer than ever before, it is important that morbidity and functional limitations be avoided or compressed into the fewest number of years possible, so that quality of life is maintained to the greatest extent. However, US and European health statistics show that some debilitating conditions, many of which have a dietary component, are on the rise within the older population. For example, in Europe, it is estimated that 18.5 million people aged 60–79 years in the EU27 have diabetes, while the prevalence of diagnosed diabetes in US adults over 65 years of age has increased by almost 10% in only 30 years. Currently, approximately 30% of older US adults are diagnosed with diabetes, and it is estimated that nearly another 10% of this population remains undiagnosed, and thus unmanaged, setting them up for a higher likelihood of experiencing diabetes-related health complications later in life. The current disability measures are particularly discouraging for the older population, as approximately two-thirds of older adults report that they are limited in their ability to complete at least one basic or complex activity. Physical limitations and disease increase the risk of a variety of poor health outcomes, including poor nutritional status, which may result in a downward cycle of health and quality of life.

Dietary standards for the older adult population

Health Canada and the National Academy's Institute of Medicine (IOM) in the USA provide nutrient requirements in the dietary reference intakes (DRIs), a compilation of nutrient reference standards by life stage and gender and their rationales. Table 13.2 provides relevant

Table 13.2 The DRIs and their definitions from the US IOM

DRI reference value	Definition
Estimated average requirement (EAR)	The average daily nutrient intake level that is estimated to meet the requirements of half of the healthy individuals in a particular life stage and gender group.
Recommended dietary allowance (RDA)	The average daily dietary nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97–98%) healthy individuals in a particular life stage and gender group
Adequate intake (AI)	The recommended average daily intake level based on observed or experimentally determined approximations of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate; used when RDA cannot be determined.
Tolerable upper intake level (UL)	The highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects increases.

Source: Otten *et al*. (2006).

Table 13.3 DRIs from the IOM of the National Academies in the USA. RDAs and AIs for macronutrients for adults aged 51 years and older.

Gender and age (years)	Carbohydrate (g/day)	Total fibre (g/day)	Fat (g/day)	Linoleic acid (g/day)	α-Linolenic acid (g/day)	Protein (g/day)
Men						
51–70	130	30[a]	ND	14[a]	1.6[a]	56[b]
>70	130	30[a]	ND	14[a]	1.6[a]	56[b]
Women						
51–70	130	21[a]	ND	11[a]	1.1[a]	46[b]
>70	130	21[a]	ND	11[a]	1.1[a]	46[b]

Source: The Institute of Medicine of the National Academies (2002/2005).

ND: not determined.

[a] AIs are shown when the information to determine an RDA is insufficient.

[b] Based 0.8 g per kilogram body weight per day for the reference body weight.

definitions. The recommendations provide a scientific foundation for the development of food guides and nutrition education to meet the needs of healthy individuals at all life stages, including old age. Worldwide, similar dietary standards exist; the EU produced population reference intakes in 1993, which have been undergoing review since 2010. In the UK, the series of dietary reference values (established in 1991) are used. In 2003 the WHO European region published its *Food Based Dietary Guidelines* (WHO, 2003), while Australia and New Zealand produced nutrient reference values in 2006. In the USA, the RDA is one of the DRI standards that represents the average daily intake of a nutrient that is sufficient to meet the nutritional requirement for 97–98% of healthy individuals within the specific reference population. The equivalent reference value in the UK is the reference nutrient intake. When data are insufficient to determine an RDA on the functional criterion of interest, an AI is suggested by the IOM. The specific US RDAs and AIs for men and women aged 51 years and older are given in Tables 13.3, 13.4 and 13.5. The corresponding UK values are listed in this book's Appendix.

As ageing occurs, the body undergoes physiological changes, and the requirements for some nutrients alter as a result. Within the population of older adults there are specific concerns about intakes of several macronutrients (including energy, protein and alcohol) and micronutrients (including vitamin B_{12}, vitamin D and calcium).

Energy

With ageing, energy requirements usually decrease due both to a reduced resting metabolic rate (which is due chiefly to the decline in lean body mass) and reduced energy expenditure (because of declines in physical activity). In 2011, the UK Scientific Advisory Committee on Nutrition (SACN) revised its dietary reference values for energy for all population groups including for those aged 65–74 years and ≥75 years (Scientific Advisory Committee on Nutrition, 2011). The SACN noted that age-related changes in lifestyle and activity are very variable, and that in mobile older adults the energy

Table 13.4 DRIs from the IOM of the National Academies in the USA. RDAs and AIs for selected vitamins for adults 51 years old and older.

Gender and age (years)	Vitamin A (μg/day)	Vitamin C (mg/day)	Vitamin D (IU/day)	Vitamin E (mg/day)	Vitamin K (μg/day)	Thiamin (mg/day)	Riboflavin (mg/day)	Niacin (mg/day)	Vitamin B_6 (mg/day)	Folate (μg/day)	Vitamin B_{12} (μg/day)
Men											
51–70	900	90	600	15	120[a]	1.2	1.3	16	1.7	400	2.4
>70	900	90	800	15	120[a]	1.2	1.3	16	1.7	400	2.4
Women											
51–70	700	75	600	15	90[a]	1.1	1.1	14	1.5	400	2.4
>70	700	75	800	15	90[a]	1.1	1.1	14	1.5	400	2.4

Sources: Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes (1997), Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and its Panel on Folate, Other B Vitamins, and Choline (1998), Institute of Medicine (US) Panel on Dietary Antioxidants and Related Compounds (2000), Institute of Medicine (US) Panel on Micronutrients (2001) and Ross *et al*. (2011).

[a] AIs are shown when the information to determine an RDA is insufficient.

Table 13.5 DRIs from the IOM of the National Academies in the USA. RDAs and AIs for selected elements for adults 51 years old and older.

Gender and age (years)	Calcium (mg/day)	Chromium (μg/day)	Copper (μg/day)	Fluoride (mg/day)	Iodine (μg/day)	Iron (mg/day)	Magnesium (mg/day)	Selenium (μg/day)	Zinc (mg/day)
Men									
51–70	1000	30[a]	900	4[a]	150	8	420	55	11
>70	1200	30[a]	900	4[a]	150	8	420	55	11
Women									
51–70	1200	20[a]	900	3[a]	150	8	320	55	8
>70	1200	20[a]	900	3[a]	150	8	320	55	8

Sources: Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes (1997), Institute of Medicine (US) Panel on Dietary Antioxidants and Related Compounds (2000), Institute of Medicine (US) Panel on Micronutrient (2001) and Ross *et al*. (2011).

* AIs are shown when the information to determine an RDA is insufficient.

requirements are unlikely to differ substantially from younger adults; thus, reference values can be described in the same way. For individuals with reduced mobility and older people who are not in good health, energy requirements can be based on the less active 25th centile physical activity level (PAL) value of 1.49, recognising that for some groups of older people with specific diseases or disabilities and for patient groups who are bed-bound or confined to a wheelchair, the PAL value may be consistently lower than this. For older adults as a group, US national survey data show that the decline in energy need roughly parallels a decline in energy consumption. In the population-based US National Health and Nutrition Examination Survey (NHANES), the average adult aged at least 60 years consumes approximately 25% less energy than the population of 20– to 39-year-olds, in which energy intake is the highest.

Unfortunately for many older individuals, with ageing, the energy intakes do not decline as much as do energy outputs, and elevated energy intakes contribute to overweight and obesity with their attendant health risks. In the NHANES time series, among the 60–74 years age group, despite declining intake with age, average energy consumption rose over the last few decades. From the early 1970s to 2000 in the USA, the mean daily energy intake of men and women increased by11% and 20% respectively, correlating with the rise in prevalence of obesity in this age group. Indeed, from the early 1970s to the year 2000, the prevalence of obesity in US men increased by 25% and in women by 16%. In Europe, studies such as the Scottish Health Survey 1999–2008, the French ObEpi survey 1997–2006 and the Spanish ENRICA study 2008–2010 predicted that the prevalence of obesity among older people in Europe would reach 20–30% by 2015 (Mathus-Vliegen *et al*., 2012). The recently published UK National Diet and Nutrition Survey provides evidence for the predicted increase in bodyweight with 29% of all older UK adults now classified as obese (Bates *et al*., 2014).

Although a somewhat higher body mass index (BMI) in elderly people may have some protective health effects in populations with some diseases and conditions, such as end-stage renal disease, overweight and obesity are typically associated with significant impairments in health-related quality of life, and therefore weight control is desirable. Overweight and obesity also contribute to the severity of several chronic diseases including, type 2 diabetes, hypertension, osteoarthritis and certain cancers (breast, prostate, colon and endometrial). Therefore, it is important to achieve energy balance as energy needs decrease with age. Recently, however, a specific condition in the elderly has been described; the term 'sarcopenic obesity' was used to characterise the confluence of excess fat coexisting with low lean body mass (Roubenoff, 2004). In sarcopenic obesity, muscle mass is low relative to the total weight. Loss of muscle quantity and quality is observed with decreased number and size of muscle fibres, reduced mitochondrial function and decreased synthesis of muscle protein. These changes result in decreased functional capacity and quality of life, increased risk of disability, morbidity and mortality, and increased risk of frailty, falls and loss of independency. Thus, obesity and sarcopenia in the elderly may potentiate each other, maximising their effects on disability and morbidity.

In addition to overweight and obesity, some older persons are underweight with very low BMIs, and underweight may be so marked that it is associated with protein–energy undernutrition. This condition is linked with multiple poor outcomes, including increasing frailty and liability to infection, a greater risk of institutional placement and an increased risk of morbidity and mortality. The decline in energy intake is often associated with deteriorating intakes of essential nutrients. This is particularly true when energy-dense but nutrient-poor high-fat foods with added sugar are plentiful and replace nutrient-dense foods in an older person's diet. Dietary guidelines in highly industrialised countries that provide

recommendations for promoting health and preventing diet-related disease encourage consumption of nutrient-dense foods, which provide vitamins and minerals with relatively few calories to meet nutrient needs within energy needs. Public health professionals need to be alert to signs of excessive as well as deficient energy intakes and take steps to correct them whenever possible.

Protein

As is the case with energy intakes, in cross-sectional studies, protein consumption is highest in middle-aged adults and lower in older adults. NHANES data from 2009–2010 show that average protein intake was lower than the highest intakes by 31% (74 g/day) in men and 14% (60 g/day) in women older than 70 years. Since NHANES is a cross-sectional survey, and not a longitudinal study of the same individuals, this does not imply that all older individuals have lower protein intakes than younger adults. However, it does suggest that decreases in intakes are likely with advancing age, although it should be noted that mean intakes are still adequate. The current IOM recommendations for protein are for an RDA of 0.8 g of protein per kilogram body weight per day for non-pregnant, non-lactating adults 19 years or older, or 56 g of protein for men and 46 g for the average woman. IOM recommendations do not suggest that higher intakes are needed for older persons. The UK Committee on Medical Aspects of Food and Nutrition Policy 1991 recommendations are similar to those of the IOM with the reference nutrient intake set at 0.75 g of protein per kilogram body weight per day, equating to approximately 56 g/day and 45 g/day for men and women respectively. The European Food Safety Authority recommends a population reference intake of 0.83 g of protein per kilogram body weight per day for adults of all ages applicable both to high-quality protein and to protein in mixed diets. The most recent nitrogen balance studies do not indicate that requirements are increased in healthy older adults, or that the timing of protein intake throughout the day may be important to maximise utilisation, but further research is needed with more sophisticated measures of protein metabolism before the issue can be definitively resolved (Volpi *et al.*, 2013). Moreover, not all elderly adults are healthy. Thus, there is currently much controversy about appropriate protein intakes for older individuals and whether in fact recommendations should be higher to maximise parameters other than nitrogen balance, the criterion used in the DRI. The rationale for suggesting that a higher intake may be appropriate for elderly adults is based on a large longitudinal study, the ABC study, in the USA in older adults that showed better function among those with higher protein intakes as measured with a food frequency questionnaire. Some also claim that higher intakes will help maintain muscle mass and avoid sarcopenia. With pronounced sarcopenia, mobility may be impaired and the risk of falls and fall-related fractures rises. Although the pathophysiology of sarcopenia is not well understood, it may be associated with catabolic responses to illness. Furthermore, the anabolic response of muscle to dietary protein requires more protein with increasing age. Dietary protein also positively affects hormone levels and calcium absorption, both of which may facilitate muscle and bone synthesis. Studies using isotopic tracers suggest that needs may be higher than those estimated by nitrogen balance studies to maintain homeostasis. However, it remains to be seen if the increased intakes are linked to improvements in functional status. On the basis of these considerations, some experts now recommend intakes in the range of 1.0–1.2 g of protein per kilogram body weight per day for healthy individuals aged 65 years or more (Bauer *et al.*, 2013). Protein quality, timing of intake and amino acid supplementation may be considered so as to achieve the greatest benefits from protein intake, but further studies are needed to make explicit recommendations. Even higher protein intakes are suggested for individuals with moderate to severe acute or chronic disease, and for any older person exhibiting protein–energy malnutrition. The notable exception to these recommendations is older persons with severe chronic kidney disease, not undergoing regular dialysis, who cannot tolerate such protein loads (Bauer *et al.*, 2013).

The findings on protein requirements in older people remain tantalising hypotheses until more experimental data on requirements and outcomes in terms of functional status are available to resolve the issue. In the meantime, it is important to remember that the vast majority of healthy older people living in highly industrialised countries, including the USA and Europe, have protein intakes that far surpass the RDA. Nevertheless, there may be some frail and ill individuals whose energy and protein intakes are so low they are catabolic, and metabolise dietary protein for energy. These individuals need to be identified and treated by provision of adequate amounts of energy and protein to prevent sarcopenia and frailty. It may not be possible to reverse the catabolic process by nutritional interventions among older persons who are suffering from wasting or other disease processes, but adequate dietary intake may help to ameliorate the secondary malnutrition.

Alcohol

Although age does not dramatically affect the rate of absorption or elimination of alcohol from the body, other age-associated changes may cause adverse events at a relatively low level of alcohol consumption in older

adults. The decrease in lean body mass and increase in adipose tissue that are associated with ageing correspond to a decrease in total body water. Since alcohol is water soluble and distributes throughout total body water, the volume of distribution is less, and alcohol concentration higher, in elderly individuals. Thus, an equivalent amount of alcohol administered to an older and a younger individual of similar size and of the same gender produces a higher blood alcohol concentration in the older individual. Moreover, many older adults take medications that may interact with alcohol and alter cognition. Finally, illness, death of loved ones and other adverse life events may lead to heavy drinking or binges to deal with the crises.

The 2012 US National Survey on Drug Use and Health (NSDUH) found that approximately 41% of older adults reported at least one incident of alcohol use in the month prior to survey completion; this is nearly 12% less than the population aged 55–65 years and 28% less than among those 21- to 25-year-olds whose alcohol use is the highest. The NSDUH also found the reported prevalence of 'binge' and 'heavy' alcohol use was lower in older adults than all other adult age groups. The European VINTAGE (Good Health into Older Age) study highlighted that older Europeans generally drink less than their younger counterparts, drink less hazardously and suffer less harm, but that within their drinking volumes the older persons' drinking patterns, determinants and associations appear no different from the younger population. This study confirmed the paucity of data on the topic and the need for more specific research. It was also noted that older persons seem to respond equally well to alcohol policy, screening instruments and brief interventions, as do younger people.

However, alcohol abuse remains a problem in a substantial minority of older adults. The US National Institute on Alcohol Abuse and Alcoholism has targeted older adults as a distinct group in which alcohol consumption, especially binge and heavy drinking, presents increased risks of health problems. Heavy alcohol intake is associated with a poor diet, and this is a particular concern in elderly adults whose age-associated decline in energy intake already makes adequate consumption of micronutrients difficult (Breslow *et al*., 2013). Additionally, many chronic diseases, including diabetes, chronic obstructive pulmonary disease, hypertension, heart failure, stroke, Alzheimer disease and other types of dementia, and mood disorders like depression, become more difficult to treat or are worsened by alcohol consumption. Public health professionals need to encourage primary care providers and those staffing emergency rooms to be alert for signs of alcohol abuse and treat it when it occurs, and to routinely screen for alcohol-related behavioural pathology.

Vitamin B_{12}

There is little evidence to suggest that vitamin B_{12} intakes decrease with age, and yet low serum levels are more common in old age than in younger adults. One reason for this is malabsorption of vitamin B_{12} due to atrophic gastritis, a condition that decreases secretion of gastric acid, which is an increasingly common phenomenon with ageing. Since naturally occurring vitamin B_{12} is mainly found bound to the proteins of animal products, low secretion of gastric acid that occurs with ageing may result in an inability of the body to release vitamin B_{12} from food proteins, making it unavailable for absorption. Decreased hydrochloric acid levels may also cause an overgrowth of intestinal bacteria that use vitamin B_{12} in the stomach, further reducing the nutrient's availability to the body. Another cause of vitamin B_{12} deficiency in ageing can be the excess use of proton pump inhibitors for gastroesophageal reflux, which neutralise gastric acid. Additionally, the prevalence of pernicious anaemia, a rare autoimmune disease that causes the destruction of parietal cells in the stomach whose secretion of intrinsic factor is required for the absorption of vitamin B_{12}, increases with age.

Vitamin B_{12} status is important because the nutrient is a cofactor for enzymatic processes and is critical for blood formation and cognitive function; an inadequate supply may result in neuropathy, including numbness and tingling in the hands and feet, confusion, dementia, megaloblastic anaemia and gastrointestinal symptoms such as constipation. Prevention of poor vitamin B_{12} status is particularly important because the reversibility of these neurological complications depends on the duration of deficiency before receiving treatment. To avoid insufficient vitamin B_{12} levels, older persons are advised to consume fortified foods, such as vitamin-B_{12}-fortified cereals, as well as vitamin B_{12} supplements, in addition to naturally occurring sources of vitamin B_{12}. Intake of sources where vitamin B_{12} is not protein bound (as it is in naturally occurring sources) is more likely to prevent deficiency in older adults where the prevalence of atrophic gastritis is high. Individuals with pernicious anaemia need medical therapy with pharmacologic doses of vitamin B_{12}, but for other individuals this is not necessary. Periodic screening and early intervention to correct inadequate vitamin B_{12} status in older adults has also been suggested as a mechanism to reduce deficiency in the population.

Vitamin D

About 80% of the body's vitamin D is synthesised de novo when skin is exposed to ultraviolet light, and remaining stores are obtained from dietary intake and supplements. Vitamin D (see Chapter 20) originating from food and supplements is biologically inert and must

undergo subsequent activation by the liver and then the kidneys. Older adults are commonly deficient in vitamin D because both the skin conversion from irradiation and the kidneys' ability to convert the nutrient into the active hormone form decrease with age. Additional common risk factors for vitamin D deficiency in older adults include a decrease in dietary intake of vitamin-D-containing foods, impaired intestinal absorption, reduced sun exposure and the use of sunscreen. The recent review by Cashman and Kiely (2014) provides evidence for the prevalence of vitamin D deficiency across Europe.

Vitamin D promotes bone mineralisation through its role in intestinal absorption of calcium and phosphorus and their uptake into bone. Without adequate levels of vitamin D, individuals are at a higher risk of osteomalacia, osteoporosis and osteoporotic fractures. Thus, vitamin D is especially critical in ageing since bone mineralisation decreases with age. Muscle function in older adults may also decrease with inadequate vitamin D intake. Supplementation of vitamin D to adequate levels appears to improve muscle strength, walking distance, and overall functional ability in the elderly (Cashman and Kiely, 2014). Over the last decade, the scientific community has had an elevated interest in vitamin D's potential to prevent or ameliorate chronic degenerative diseases other than those related to bone. Researchers have suggested a relationship between the vitamin and health outcomes, such as increased immunity and prevention of colon or other cancers and diabetes. At present, these relationships are based largely on epidemiological data, and causal inference is difficult. The IOM in 2010 noted that current evidence supports the role of vitamin D in bone health, but that more research was needed to determine the role (if any) of vitamin D in other health conditions. The review by Cashman and Kiely (2014) summarises the US and European recommendations for vitamin D and suggests dietary strategies for increasing vitamin D intake and status. From the public health standpoint, it is important for all elderly individuals to achieve RDA levels from foods, fortified foods and dietary supplements. This strategy, combined with moderate exposure to sunlight, will help ensure adequate vitamin D status and contribute to bone health and, if these other health outcomes prove to be linked to vitamin D status, to them as well.

Calcium

Over 99% of calcium in the body is found in bone or teeth, where it provides strength to these hard tissues. Maintaining an AI of calcium can reduce the rate of age-related bone loss, although this is challenged by a decrease in calcium absorption with increased ageing. Evidence suggests that in postmenopausal women with low dietary calcium intake, calcium supplementation reduces the rate of bone loss. Other research has shown calcium and vitamin D supplementation given to deficient institutionalised elderly patients helps to preserve bone mineral density and reduce the risk of hip fracture.

Bone loss begins in adulthood, at around 30–40 years of age and is more severe in women than men due to the decade period of rapid bone loss that occurs with the onset of menopause, typically when women are in their early to mid fifties. In the seventh decade of life, this accelerated rate of bone loss declines, and from then on individuals of both sexes undergo continuous age-associated loss through the rest of their lifespans. Advancing age and its associated loss of bone result in a decrease in bone density that increases risk of fractures. The difference in men's and women's rate of bone loss correlates with an 11.5% lower lifetime risk of hip fracture at age 50 years in men than in women. Older persons who have fractures are often hospitalised and usually require a long convalescence, and full independence may never be regained. Fractures in the elderly are also linked with a shortened life expectancy, and have an overall negative socio-economic impact on the population.

In order to accommodate the age-related changes surrounding calcium and its role in bone health, the IOM recently reviewed the evidence for re-establishing calcium's DRIs, and set the RDA at 1000 mg/day for men aged 51–70 years old and 1200 mg/day for women 51–70 years old. The RDA was established at 1200 mg of calcium per day for all individuals above the age of 70, when the effect of ageing on bone loss appears to be similar in both men and women. From the public health standpoint, it is important to ensure that relatively inexpensive dietary sources of calcium, both naturally occurring and fortified, are available, and if needs are not met by food alone, to use calcium supplements. Also, although risks of fracture increase with poor calcium and vitamin D status, and thus intakes should be optimised, it is also important to remember environmental measures to prevent falls and broken bones.

13.2 Associations between diet and disease in older adults

Challenges to dietary intake assessment in older adults

One problem in dietary assessment of older adults is that their health is often poor due to decreases in mobility, sensory processes and cognitive function. These same changes often make dietary assessment of older persons difficult. For example, sensory impairments are quite common in the elderly population. In US adults over 65 years old, approximately 15% of individuals report

difficulty seeing. Cataracts, which cause cloudy vision, are a common cause of faulty eyesight in the elderly. Of adults who live to 80 years, half will have cataracts that impact their vision. Auditory problems are even more frequent in older adults. Almost 50% of men and over 30% of women over 65 years note having some difficulty hearing. Vision and hearing impairments may impede an older person's ability to understand assessment questions, read materials and communicate with health practitioners.

Cognitive changes are also associated with ageing. Dementia, a syndrome involving impairments in memory, thinking and judgment to the extent that normal cognitive function may be interrupted, is more prevalent in adults of older age. The UK Alzheimer Society estimates that 1 in 14 people over the age of 65 years in the UK suffer from dementia. This estimate increases to one in six people for those who are over 80 years old. Alzheimer patients face a higher risk of poor nutritional intake, so it is important to circumvent memory deficits to assess dietary intake and avoid falsely low intakes. Successful interviews with those who have issues with memory may require probing, additional time and extra information or diet records kept by a caregiver.

Appropriate dietary standards for older adults

A second set of problems in dietary assessment of the elderly involves determining appropriate anthropometric, biochemical and clinical standards to use. The measurement of height, and thus the derivation of BMI, is difficult in ageing persons who suffer from scoliosis and loss of height. For this reason, measured rather than reported height is to be preferred. Also, measured weight is more accurate than reported weight. The current consensus on anthropometric standards is that some, such as BMI, remain approximately the same for older and younger adults, although a slightly increased weight may be advantageous in those with certain diseases. Overweight and obesity, which can be identified by BMI over 25 kg/m^2 and 30 kg/m^2 respectively, are associated with an increased risk of disease and premature mortality in younger adults, and it is generally agreed that the relationship exists in most older adults as well. Guidelines to categorise the weight status of all adults use the same BMI cut-offs (Table 13.6). However, the most favourable weight for optimal longevity may be higher for the elderly who are affected by chronic conditions, such as end-stage kidney disease, heart failure and obstructive lung diseases. This phenomenon of higher BMI categories associated with improved survival in specific populations is sometimes referred to the 'obesity paradox' or a 'reverse epidemiologic event'. Although the phenomenon was first described in dialysis patients in the early 1980s and it has been observed in multiple populations since, the association is not yet well understood and remains controversial, creating challenges for determining appropriate anthropometric guidelines in these diseased groups (Flegal and Kalantar-Zade, 2013). Standards for other anthropometric measures, such as skinfolds, are even more difficult to interpret in the elderly.

Table 13.6 The standard weight status categories associated with BMI ranges for all adults.

BMI (kg/m^2)	Weight status
<18.5	Underweight
18.5–24.9	Normal
25.0–29.9	Overweight
≥30	Obese

Source: CDC (2015).

Nutritional status is evaluated using a variety of tools, including biomarkers. Biochemical indices of nutritional status may be altered by medications and disease and thus may be nonspecific, reflecting poor health, medication usage or hydration status, as well as poor nutritional status, in older adults. For example, serum proteins, such as albumin, prealbumin and transferrin, are commonly measured as indicators of protein nutriture, but results can be difficult to interpret since they decrease with acute illness even in the face of good protein nutritional status. Chronic disease is a risk factor for protein–energy malnutrition, and low serum protein levels often indicate its presence rather than low protein intakes. Many chronic conditions, such as those of the liver and kidney, may independently lower serum protein levels even among persons in good nutritional status, making it challenging to distinguish the root cause of the biochemical alteration. Medication use, which is common in older people, is another example of how biochemical indices may be altered in the elderly. According to the US Centers for Disease Control (CDC), 9 out of 10 elderly people reported using at least one prescription drug in the last 30 days and nearly 7 out of 10 had used three or more. In Europe, use of potentially inappropriate medications among frail, community-dwelling elderly persons appears to be common, and the negative effects can be observed on dietary intake and nutritional status.

Medication use can also increase the risks of dehydration in the elderly. Dehydration makes the interpretation of biochemical data challenging because indicators become more concentrated within the body fluids. Excessive hydration and haemodilution as well as abnormal hydration of the lean body mass may occur with some

renal diseases and congestive heart failure, both common among the elderly (Mentes, 2013).

Challenges to outcomes assessment in older adults

A final challenge in assessing the nutritional status of older adults is determining the most appropriate measures for judging health– and nutrition-related outcomes. Traditionally, health outcomes have been measured in terms of age-specific morbidity and mortality rates, but these have little meaning to individuals. Longevity alone is a futile criterion if quality of life and functional status are poor. Although DALYs, as discussed previously, take into account some of these factors on a wide scale, more outcome assessment measures should reflect the natural human desire to maintain well-being and quality of life in old age. Frailty, which may result from poor nutrition or other pathological processes, is a specific example of a clinical outcome linked to disability, and that may be a useful concept to consider for outcomes.

Quality of life and well-being

In addition to longevity, maintaining a positive sense of well-being, which subjectively incorporates social, mental and physical health, is a significant outcome from the perspective of the elderly population. Aside from meeting basic needs and having good health, being included and involved socially and having positive personal relationships are among the strongest positive influences on maintaining a sense of well-being and quality of life. For example, older individuals who experience exclusion in social situations are more likely to have a lower quality of life and less likely to feel empowered and satisfied with life. In order for the older adult to live a long life with vitality, rather than just a long life, western society needs to acknowledge and care for all the components of an individual's well-being in a collective manner. Measures of well-being and quality of life are starting to gain recognition for their value as statistics that provide a more holistic impression of older adults' health. For example, in public health surveillance, the CDC in the USA uses a variety of self-report surveys to capture statistics on the population's well-being. However, converting the information gathered from assessment techniques into cost-effective public health interventions to improve elderly well-being remains a challenge.

Frailty and the 'frailty phenotype'

Frailty is a particularly problematic clinical outcome in the elderly population because it increases vulnerability to many negative health outcomes. Although there is consensus that treating frailty is important for both the individual and from a public health angle, a well-established tool is not available to define and identify the condition. The concept of frailty is recognised in advanced care facilities, like hospitals and nursing homes, where patients had possibly arrived as a result of a frailty-related consequence, such as a fall. Recently, the 'frailty phenotype' has been developed, which provides an operational definition of frailty to improve screening for the condition and prevent such outcomes. The phenotype consists of five clinically measurable components, and an individual is determined to be frail if three or more of these criteria are met. They include: 'shrinking' (indicated by weight loss), 'weakness' (indicated by grip strength), poor endurance and energy (indicated by self-report), slowness (indicated by walking speed) and low physical activity level (indicated by a weighted score of kilocalories expended per week). The public health realm will benefit from greater use of additional outcome measure assessments in older people, such as of the 'frailty phenotype', that help to distinguish individuals that need a targeted intervention to improve their health status.

13.3 Approaches to nutritional screening and assessment

Older adults bear a disproportionately higher nutritional risk – which is the risk of poor health as a result of nutritional problems – than do the younger population. This is because the ageing process tends to give rise to characteristics such as a greater disease burden that are associated with an increased likelihood of poor nutritional status. Limitations to an older adult's access to food or ability to prepare or consume food, as well as changes in appetite, absorption or metabolism of nutrients, may increase their chances of malnutrition (Table 13.7) (White *et al.*, 1991; Bernstein and Luggen, 2010). Many poor outcomes are associated with malnutrition in older adults, including a loss of lean muscle mass resulting in frailty, pressure ulcers with delayed wound healing, diminished immunity, infection and sepsis, respiratory and cardiac complications, and ultimately death. Between half and two-thirds of malnourished elderly patients are unrecognised as such. Therefore, tools to identify malnutrition and avoid these complications are important components of elderly health care (Elia *et al.*, 2005).

Nutrition screening

Nutrition screening quickly differentiates those who have characteristics known to increase the risk of nutritional problems to determine whether a detailed

Table 13.7 Risk factors associated with poor nutritional status, including elements by which risk is assessed, in the ageing population.

Characteristic or problem associated with poor nutritional status	Example
Inappropriate, inadequate or excessive food intake	• Quantity, quality or both with respect to intake of dairy products, meat/meat substitutes, fruits and vegetables, breads and cereals, fats, sweets and alcohol • Dietary modifications (prescribed or self-imposed) • Alcohol abuse
Poverty	• Low income • Low food expenditures or inadequate food resources • Reliance on economic assistance programme for food or other basic needs
Social isolation	• Reduced social contact • Isolate or inadequate (relative to cooking, food storage or transportation) living arrangements
Chronic medication use	• Prescribed/self-administered • Polypharmacy • Nutritional supplements
Dependency/ disability	• Functional status, ADLs, IADLs • Disabling conditions, lack of manual dexterity, use of assistive devices
Acute/chronic diseases or conditions	• Abnormalities of body weight • Alcohol abuse • Cognitive or emotional impairment, depression, dementias • Oral health problems • Pressure sores • Sensory impairment • Others
Advanced age	

Source: White *et al*. (1991).

assessment of nutritional status is necessary (Mueller *et al*., 2011). A problem with screening for malnutrition in older individuals is that it is difficult to separate changes in nutritional status that are preventable or treatable by nutritional means from those that are due to underlying pathological processes. Also, screening is crude because it identifies individuals at risk of nutritional complications as well as those who have already developed malnutrition. When a nutrition screen reveals that an individual has few risk factors, then additional effort is unnecessary at that time, although a follow-up for re-screening may be advisable, particularly in older populations where age itself is a risk. Conversely, when a screen flags an individual as being nutritionally vulnerable, that person can then be referred into the nutrition care process for a full nutrition assessment and intervention to correct nutritional inadequacy, if necessary. Screening and assessment are worthless if there is no follow-up. Therefore, public health programmes need to include all components: screening, assessment, diagnosis, intervention and monitoring or follow-up.

Tools to screen and inform groups about possible nutritional risks

The Nutrition Screening Initiative

The Nutrition Screening Initiative (NSI) was developed in the USA in 1990 as part of a national effort to improve nutritional care of older Americans. This collaboration between the American Academy of Family Physicians, the American Dietetic Association and the National Council on Aging resulted in a two-tiered tool for nutrition screening and assessment.

The 'Determine Your Nutritional Health' checklist and the level I (LI) screen make up the first tier of NSI. Older individuals or their carers answer simple questions cued from the mnemonic 'DETERMINE', which is based on some common nutrition risk factors in older adults:

Disease
Eating poorly
Tooth loss or oral pain
Economic hardship
Reduced social contact
Multiple medications or drugs
Involuntary weight loss or gain
Needs assistance with self-care
Elderly person is older than age 80.

Mini Nutritional Assessment

The Mini Nutrition Assessment (MNA) is a nutrition screening tool designed for older adults that can be completed in the community by the patient, a loved one or caretaker. Health-care professionals can also incorporate the screen into encounters with older patients. Completion of the screen yields a score derived from answers to diet and health related questions, none of which requires laboratory data.

The MNA is similar to the NSI, in that it has two tiers: the MNA short form (MNA-SF) and the more complex 'full' MNA. The MNA-SF consists of six questions, requires a height and weight, and takes about 3 min to administer. The maximum score is 14 points, with a score of 11 or more providing strong evidence that malnutrition is not present. Any score below 11 indicates a risk of undernutrition. In a recent review of 10 nutrition screens, this one was deemed the most reliable and valid in evaluating the nutritional status in community-dwelling older adults (Phillips *et al*., 2010).

If the MNA-SF score is less than 11, then nutrition risk may be present and it is recommended that the full version of MNA be completed for further evaluation. Theoretically, MNA is good at identifying at-risk frail elderly because it considers both the physical and mental aspects of health that may have an impact on nutritional status. It focuses chiefly on identifying undernutrition and protein–energy malnutrition and has predictive validity for adverse health outcomes, length of hospital stay and mortality.

Malnutrition Universal Screening Tool

The Malnutrition Universal Screening Tool (MUST) was developed in 2003 to screen all adults, using surrogate measures of height and weight when actual measures are unavailable. Supported by the British Association of Parenteral and Enteral Nutrition, the British Dietetic Association and other European health organisations, MUST is frequently used in Europe, especially in the UK. Although it was originally developed for community-dwelling older adults, it has predictive validity in the hospital environment as well, where it has proved to be convenient and faster to administer than most screens, taking only 3–5 min to complete. The MUST consists of five easy steps that classify malnutrition risk as low, medium or high on the basis of BMI, history of unexplained weight loss and acute illness. When screening patients 65 years or older, MUST has been shown to have 'good' agreement with full dietetic assessment for detecting malnutrition while also correlating with other nutrition screening tools, including MNA (Stratton *et al.*, 2006).

Nutrition assessment

Nutrition assessment is a comprehensive review of nutritional status that employs medical, nutritional, and medicinal history, physical examination, and anthropometric and laboratory data to diagnosis nutritional problems (Mueller *et al.*, 2011). Currently, there is no 'gold standard' for assessing and diagnosing nutritional depletion of older adults.

Tools to assess older adults

Nutrition Screening Initiative level I and II screens

The NSI LI screen, to be administered by a health or social service professional, provides information on possible signs of nutritional risk. If it indicates possible risk, then a physician or qualified health professional performs a level I (LII) screen in a clinical setting by completing a comprehensive review of the patient's nutritional status, including diagnostic material. Although this portion of NSI is termed the 'LI and LII screen', the detailed nature of tier 2 actually qualifies it as a nutrition assessment tool. To date neither tier has been validated; until they are, other methods may be more appropriate.

Subjective Global Assessment

The Subjective Global Assessment (SGA) tool was first developed in 1982 as a tool for clinicians to assess a patient's nutritional status, particularly wasting and protein–energy malnutrition, at the bedside without need to have detailed information on body composition. Components of the assessment include a history and physical examination. The section on history considers weight and dietary intake changes, gastrointestinal symptoms, functional capacity or energy level and disease as it relates to nutritional status. The physical examination notes the presence of oedema, ascites, muscle wasting and the loss of subcutaneous fat. All information from the assessment is combined to provide a letter grade of A (well nourished), B (suspicion of malnutrition) or C (severely malnourished) being assigned to the patient.

Assessment Lexicon: ABCDEF

Another tool for individual nutritional assessment is the mnemonic 'ABCDEF' that cues the clinician to indicators that comprise the core elements of nutrition assessment. The included elements are anthropometry, biochemical data, clinical observations, dietary intake (and use of drugs/medications), extra information (such as exercise and physical activity patterns, socioeconomic, family and cultural issues) and functional status (Dwyer, 2001).

- *Anthropometry* Certain anthropometric measures are simple, non-invasive and inexpensive methods for assessing and monitoring nutrition status. Weight and height are two measurements to obtain that provide useful information. When available, measured weight and height should be used to calculate BMI. With ageing, height tends to decline by 0.5 to 1.5 cm per decade because the vertebrae compact, so the measure may be somewhat imprecise, but nevertheless indicates grossly deviant values. A dramatic and unintentional weight loss is a predictor of risk and may indicate malnutrition. A change in BMI by more than one unit in either direction is cause for concern and should be investigated further. It may be associated with oedema or ascites as well as with excess fat. Very high and very low BMIs are associated with an increased mortality risk.

  Complications may arise when evaluating many other aspects of body composition in older adults because age-related changes in body composition make the reference standards that are derived from

younger adult populations inappropriate. Other standards, such as fat folds, are more difficult to interpret. For example, relative to younger adults, individuals of the older population tend to have less fat-free mass and more fat, resulting in a decrease in total body water, and adipose tissue redistributed to the trunk from the extremities. Mid-arm muscle circumference and triceps skin-fold measures can also be used, but for the aforementioned reasons they may be less reliable in older adults. Standards have been published for elderly adults, and they should be used.

- *Biochemical data* Biomarkers such as serum or urine levels of nutrients can often be measured to provide indicators of nutritional status. Biomarkers are somewhat more objective than subjectively reported dietary intakes, and can often provide accurate measures that reflect nutritional status.

  Since micronutrient deficiencies may not produce clinical signs or tell-tale and specific symptoms until they are severe, biochemical tests using these biomarkers allow for earlier detection. However, as discussed previously, it is important to evaluate biochemical data in older individuals critically because it may be affected by medication usage, acute illness and chronic disease, as well as hydration status.
- *Clinical assessment* Clinical assessment of the elderly individual should include a brief review of medical history and physical examination to develop a more complete picture of factors that may affect nutritional status. The medical history is important to review because certain chronic diseases may affect nutritional status through physiological mechanisms or by influencing an individual's dietary choices. Further, older adults managing chronic disease may take one or more medications that have the capacity to alter nutrient absorption or metabolism.

  The physical examination for clinical signs and history of symptoms of malnutrition can reveal dietary excess, such as obesity, and also the classical signs of malnutrition. The classical signs may be seen in a patient's hair, eyes, skin and mouth, but these can be rare and difficult to recognise in elders, and are therefore often missed. The oral cavity may provide an indication of nutritional status, and poorly fitting dentures or a lack of teeth can alter food intake.
- *Dietary and drug history* All older patients should be asked about their food intake, patterns of consumption and usage of dietary supplements, such as multivitamins, as well as any prescribed or over-the-counter medications taken on a regular basis. Food records, 24-h dietary recalls and food frequency questionnaires may be utilised to develop an understanding of the eating habits of older people. The diet history may make risk factors for malnutrition apparent, such as regular meal skipping or poor variety of food intake. Some medications, such as digitalis, are associated with decreased food intake, and these should be noted and changed if possible to others that do not do so. The physiological changes in taste and smell that occur with ageing should also be considered, as well as the effects that some medications can have on taste sensations and olfactory function.
- *Extra information* Extra information obtained in the interview focuses on important factors that influence energy and nutrient intakes, such as exercise and physical activity, as well as aspects such as socio-economic status and social, family or other cultural or religious beliefs that may affect food intakes (see Table 13.7). For example, with respect to exercise and physical activity in the USA, Canada and Europe, declines in physical activity and intake are usually associated with ageing. However, physical activity levels vary dramatically in the older population, so it is important to gain an understanding of the amount and intensity of activity, as well as the strength of each individual. It is also important to note a downward trend in physical activity and exercise, if it is present, as a decrease may reflect a health status change. Age- and condition-appropriate activities should be encouraged if this is possible. Likewise, changes in socio-economic status, such as reduced/loss of pension funds, or changes in the living situation, such as death of a spouse, can have major implications for energy and nutrient intakes. Health- and nutrition-related beliefs as well as the effects of advertising can be powerful influencers of dietary intake and should be considered in undertaking a comprehensive nutritional assessment (Bernstein and Munoz, 2012).
- *Functional status* Assessment of functional status is important to ascertain whether or not an older adult needs assistance or services. Functional status can be assessed by an elderly individual's ability to complete ADLs, like bathing, dressing and feeding oneself, and IADLs, such as meal preparation, house cleaning and handling money. If an older individual struggles with these activities, it is possible that functional impairments also challenge that individual's ability to obtain and prepare food.

Nutrition Care Process Model

The US Academy of Nutrition and Dietetics has developed a framework for the provision of nutritional care that incorporates four components; nutritional assessment, nutritional diagnosis, nutritional intervention and monitoring. The purpose of the nutritional assessment is to obtain, verify and interpret data needed to identify nutrition-related problems, their causes and significance. It is comprised of five categories of data, which can come

directly from the patient/client through interview, observation and measurements, a medical record, and the referring health-care provider.

- *Food- and nutrition-related history* This domain examines food and nutrient intake (composition and adequacy of food and nutrient intake, meal and snack patterns, current and previous diets and/or food modifications, and eating environment), food and nutrient administration (current and previous diets and/or food modifications, eating environment, and enteral and parenteral nutrition administration), medication and complementary/alternative medication use (prescription and over-the-counter medications, including herbal preparations and complementary/alternative products used), knowledge, beliefs and attitudes (understanding of nutrition-related concepts and readiness to change nutrition-related behaviours), behaviour, food and supply availability, physical activity and function, nutrition-related patient/client-centred measures (patient's/client's perception of impact of nutrition intervention on life).
- *Anthropometric measures* This domain includes measures of height, weight, weight change, BMI and body compartment estimates.
- *Biochemical data, medical tests and procedures* These include assessment of blood and urine biochemical tests (acid–base balance, electrolytes, etc.), metabolic rate, inflammatory status, review of major systems (endocrine, gastrointestinal, renal profiles) and clinical signs and symptoms of malnutrition, such as anaemia.
- *Nutrition-focused physical findings* The findings from this domain include the evaluation of body systems, muscle and subcutaneous fat wasting, functional status, oral health, suck/swallow/breathe ability, appetite and affect.
- *Client history* Includes current and past information related to personal, medical, family and social history.

The nutrition assessment data are compared with criteria, relevant norms and standards for interpretation and decision-making. Nutrition assessment findings are documented in nutrition diagnosis statements and nutrition intervention goal setting. While the nutrition assessment component of the Nutrition Care Process Model (NCPM) has considerable overlap with the ABCDEF model of nutrition assessment, the NCPM is increasingly being used in the USA, Australia and Europe as a standardised method of nutritional care.

Tools for screening and assessing groups of older persons in the community

Demographics and vital statistics

Certain demographic characteristics of older adults are known to be associated with a higher risk for nutritional problems. National, state and local-level statistics on mortality, morbidity and altered functional status often have nutritional implications. These serve as community-level nutritional screens by indicating vulnerable subpopulations that may have modifiable risk factors for poor nutritional status. Although chronological age and functional ability do not necessarily correspond precisely, the oldest old are often at highest nutritional risk because progressive disability and functional impairments contribute significantly to malnutrition in the elderly. The identification of high-risk groups who have high rates of diet-related problems provides the evidence-based need for targeted community-based nutrition programmes and policies.

Free-living older adults

Although the prevalence of malnutrition within free-living older adults is thought to be lower than in older populations living in residential facilities or nursing homes, some malnutrition nevertheless exists. The high rates of malnutrition on admission to hospital indicate that nutritional problems leading to malnutrition can and do occur in the community setting. For this reason, it is important that health and social care professionals and carers should routinely monitor for malnutrition using the screening tools and information described above, even with patients who seem to be relatively well off economically.

Older adults in sheltered housing

Although older people who reside in sheltered housing have more support than community-dwelling adults, this population is not exempt from nutritional risk. In most US states and in Europe, clear standards on food and nutrition quality within sheltered-housing facilities do not yet exist, and only the most basic nutrition aspects of care, such as food safety, are regulated and enforced with high priority. Many important aspects of nutritional care, such as menu nutrient analysis and nutrition assessment, are often only loosely regulated. Food quality is extremely important in this setting because most residents depend virtually completely on their facility to meet their nutritional requirements.

Another problem with sheltered-housing facilities is that many elderly prefer living in these rather than a nursing home or hospital, even if they are ill, because of the greater freedom that these facilities provide. Thus, many older people who are actually quite ill and incapacitated are living in sheltered housing and they can be missed if nutritional screening is not performed. There is often little monitoring done by the operators of these facilities to identify such persons who are slipping into malnutrition. More regulation of sheltered-housing facilities is clearly in order.

Residential care and nursing homes

Relative to free-living and sheltered-housing facilities, rates of malnutrition are higher among elderly individuals living in residential care and nursing homes. Estimates, using a variety of methods, suggest that between 17 and 97% of residents in long-term care facilities in Europe are at risk or already malnourished. Data collected by the British Association of Parenteral and Enteral Nutrition indicate that over 40% of residents in residential care homes are at nutritional risk. However, much of the malnutrition is the result of disease processes and it cannot be reversed by diet alone. Guidance documents on nutritional recommendations also exist; for example, guidance produced by the National Institute for Health and Care Excellence in the UK in 2006 and reviewed in 2011.

In both the USA and UK, residential care facilities, nursing homes and hospitals have clear standards set down for them by governmental regulatory authorities (e.g. the Care Quality Commission in the UK), and these settings are also better monitored than sheltered-housing facilities. Such regulations specify that these facilities are required to provide residents with meals that meet the age- and gender-specific RDAs. These must be prepared so that the nutritional value is preserved and that they are 'palatable' and 'attractive' to the consumer. Specifications protect more vulnerable patients by requiring that a feeding assistant, special utensils or other feeding devices be provided to any individual who requires such support. If the patient's nutritional requirements are still not met, the regulations note that further assessment is necessary to determine the next appropriate intervention, such as a naso-gastric feeding tube. In the USA, in order to verify that nutritional needs are being met, nursing home residents are also to be assessed for appropriate biochemical and anthropometric status.

Nutritional interventions and management

Goals: USA and Europe

Healthy People 2020 is the federal blueprint for preventive health services in the USA. The goal for older adults is to improve their function and quality of life. It provides specific objectives for the behavioural-, social- and health-services-related determinants of health in older adults, and includes many nutrition-related objectives. The entire report is web based at http://www.healthypeople.gov/2020/. In Europe, the WHO provides recommendations for the 53 countries of the European region in its policy framework and strategy document *Health 2020*. These recommendations support those of the EU to increase the number of HLYs by 2 years by 2020 (World Health Organization, 2013).

Nutrition interventions for older adults

Nutrition screening and assessment tools are worthwhile only if subsequent actions are taken to improve the status of those identified with nutritional risk. In many developed countries, a variety of specific nutrition interventions exist, from nutrition education to inform older adults about healthy eating to community-level programmes, such as free or subsidised home-delivery meal services (known as meals-on-wheels in the UK), which are often geared to low-income or frail individuals. However, provision is often determined by local authority policy. Interventions are most effective when they are focused and personalised towards groups with the highest need.

- *Individual nutrition education* Theoretically, nutrition education for older adults should make it possible to improve their health and quality of life. However, some believe that nutrition education is not useful because they believe older adults will refuse to change their well-established behaviours; but this may be a false assumption. Many older people are highly motivated to alter their diets in more healthful directions, and age is not necessarily a limiting factor for nutrition education. However, it is true that behaviour changes and health outcomes resulting from nutrition education vary between individuals. The most positive nutrition education outcomes are thought to occur when messages are limited to one or two central ideas that are simple, practical and targeted to meet the older person's specific needs, combined with behaviour modification techniques to make better food choices for healthful ageing. The Age UK 'Fit as a Fiddle' programme showed demonstrable benefits in terms of improvements in healthy eating, physical activity and mental well-being in a large cohort of older adults (http://www.ageuk.org.uk/health-wellbeing/fit-as-a-fiddle/about-fit-as-a-fiddle/), and the initiatives developed have now been funded to continue in a new programme 'Fit for the Future' (http://www.ageuk.org.uk/health-wellbeing/fit-as-a-fiddle/fit-for-the-future/).
- *Community nutrition intervention programmes* In the USA, the Older Americans Act includes provisions for several community nutrition intervention programmes; for example, the Supplemental Nutrition Assistance Program, which provides eligible low-income participants with monetary benefits to purchase qualified nutritious food. Part of the Older Americans Act also includes home-delivered meal services that bring nutritionally adequate meals to home-bound frail older adults, while also checking on elder health status, and providing social support. In both the USA and UK, meals-on-wheels agencies serve communities across the country, targeting older adults with some of the highest

nutritional risk. Priority is given to individuals who are low income and home-bound or disabled, making the alternative of institutionalisation likely if such a service is not provided. Although such community meal services are available throughout most developed countries, the legislation supporting their nutritional quality varies greatly between countries (O'Dwyer *et al.*, 2009). In the UK, the Malnutrition Task Force provides good examples of shared learning and good practice in hospital, community (including care homes) and food and beverage providers (http://www.malnutritiontaskforce.org.uk).

13.4 Challenges to nutrition in older adults

The increasing population of very old and very frail

While the population of older adults grows, those over 85 years – known as the 'oldest old' – constitute the most rapidly increasing group within the population. Although frailty can occur in younger adults, it is concentrated in this age group. Frail adults are among the most vulnerable groups in society, and therefore require a disproportionately high amount of care within the health system. Frailty is linked with a higher risk for falls, disability, hospitalisation and mortality. Minimising nutritional and other health risks of frail older adults may have a significant impact on improvement of their health-related quality of life. Studies are ongoing to assess this. Improvements in health promotion programmes that encourage a healthy lifestyle, including healthy nutrition, as well as advancements in medical care that incorporate frequent nutrition screening and assessment, will help to decrease the risks that these individuals face. Thus, nutrition will continue to be vital component of care as more individuals age past 85 years. The health system will be increasingly faced with providing services that minimise disability, such as frailty, and maximise healthful ageing in a cost-effective fashion. Such a health system needs to be highly organised and have a comprehensive infrastructure which supports older people living in their own homes and allows for transition between levels of care that accounts not only for the physical and mental needs of older people, but also their social and emotional needs.

Generational investment strategies favour the young

Public health and social welfare programmes other than social security and other old age cash distribution programmes tend to favour the young over older adults in most western countries. As described earlier, with the ageing of populations worldwide, there is a global need for a more comprehensive investment strategy to assure the quality of life and health of older people, and a more extensive infrastructure to encourage 'ageing in place' in one's own home, rather than institutionalisation.

Applying emerging science in ageing

There is much interest in the significance of the microbiota on human health, and studies on the effects of ageing, disease, diet and medications, both over the counter and prescribed, upon the microbiome of the elderly are only now beginning. Another topic of great interest is whether there is a place for functional foods or ingredients that have potentially beneficial effects on health beyond those of nutrients alone. In the EU, several studies addressing this issue are being covered in the NU-AGE project under the direction of the European Commission (see http://www.nu-age.eu). Some similar projects are also getting under way in the USA and Canada.

13.5 Conclusion

Older people are a nutritionally vulnerable group and they have some nutritional needs that are unique from those in the general population that must be dealt with on a public health basis. Many older adults are afflicted with chronic and acute diseases and conditions that may alter their nutritional status, and changes in their functional status may impair their ability to live and eat independently and look after their health needs. The associations between diet and disease in the elderly clearly exist. Dealing with increasing frailty and other nutritional complications that result from disease through nutritional and other means is a major challenge in all countries. Methods for screening and assessing older people as individuals or on a community basis must be put into place and used more routinely to identify those in need of special nutritional care and interventions.

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References

Adams, P.E., Martinez, M.E., Vickerie, J.L. and Kirzinger, W.K. (2011) Summary health statistics for the U.S. population: National Health Interview Survey, 2010. *Vital and Health Statistics. Series 10, Data from the National Health Survey*, (251), 1–117.

Bates, B., Lennox, A., Prentice, A. et al. (2014) National Diet and Nutrition Survey: Results from Years 1, 2, 3 and 4 (Combined) of the Rolling Programme (2008/2009-2011/2012). A Survey Carried Out on Behalf of Public Health England and the Food Standards Agency. Public Health England, London. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/310995/NDNS_Y1_to_4_UK_report.pdf (accessed 6 December 2016).

Bauer, J., Biolo, G., Cederholm, T. *et al.* (2013) Evidence-based recommendations for optimal dietary protein intake in older people: a position paper from the PROT-AGE Study Group. *Journal of the American Medical Directors*, **14** (8), 542–559.

Bernstein, M.A. and Luggen, A.S. (2010) *Nutrition for Older Adults*. Jones & Bartlett Learning, Sudbury, MA.

Bernstein, M. and Munoz, N. (2012) Position of the Academy of Nutrition and Dietetics: food and nutrition for older adults: promoting health and wellness. *Journal of the Academy of Nutrition and Dietetics*, **112** (8), 1255–1277.

Breslow, R.A., Chen, C.M., Graubard, B.I. *et al.* (2013) Diets of drinkers on drinking and nondrinking days: NHANES 2003–2008. *The American Journal of Clinical Nutrition*, **97** (5), 1068–1075.

Cashman, K.D. and Kiely, M. (2014) Recommended dietary intakes for vitamin D: where do they come from, what do they achieve and how can we meet them? *Journal of Human Nutrition and Dietetics*, **27** (5), 434–442.

CDC (2015) *About Adult BMI*. http://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html (accessed 9 December 2016).

Dwyer, J.T. (2001) An assessment lexicon: assessment of dietary trends, physical activity patterns and nutritional status in the elderly. *The Journal of Nutrition, Health, & Aging*, **5** (2), 108–112.

Elia, M., Zellipour, L. and Stratton, R.J. (2005) To screen or not to screen for adult malnutrition. *Clinical Nutrition*, **24** (6), 867–884.

Flegal, K.M. and Kalantar-Zadeh, K. (2013) Overweight, mortality and survival. *Obesity*, **21** (9), 1744–1745.

Heron, M. (2012) Deaths: leading causes for 2009. *National Vital Statistics Reports*, **61** (7).

Institute of Medicine (US) Panel on Dietary Antioxidants and Related Compounds (2000) *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids*. National Academies Press, Washington, DC.

Institute of Medicine (US) Panel on Micronutrients (2001) Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. National Academies Press, Washington, DC.

Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes (1997) *Dietary Reference Intakes for Calcium, Phosphorous, Magnesium, Vitamin D, and Fluoride*. National Academies Press, Washington, DC.

Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and its Panel on Folate, Other B Vitamins, and Choline (1998) *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B_{12}, Pantothenic Acid, Biotin, and Choline*. National Academies Press, Washington, DC.

Mathus-Vliegen, E.M., Basdevant, A., Finer, N. *et al.* (2012) Prevalence, pathophysiology, health consequences and treatment options of obesity in the elderly: a guideline. *Obesity Facts*, **5** (3), 460–483.

Mentes, J.C. (2013) The complexities of hydration issues in the elderly. *Nutrition Today*, **48** (3S), S1–S3.

Mueller, C., Compher, C., Ellen, D.M. *et al.* (2011) A. S. P. E. N. Clinical Guidelines: nutrition screening, assessment, and intervention in adults. *Journal of Parenteral and Enteral Nutrition*, **35** (1), 16–24.

O'Dwyer, C., Corish, C.A. and Timonen, V. (2009) Nutritional status of Irish older people in receipt of meals-on-wheels and the nutritional content of meals provided. *Journal of Human Nutrition and Dietetics*, **22** (6), 521–527.

Otten, J.J., Hellwig, J.P. and Meyers, L.D. (eds) (2006) *Introduction to the dietary reference intakes. In Dietary Reference Intakes: The Essential Guide to Nutrient Requirements*. The National Academies Press, Washington, DC.

Phillips, M.B., Foley, A.L., Barnard, R. *et al.* (2010) Nutritional screening in community-dwelling older adults: a systematic literature review. *Asia Pacific Journal of Clinical Nutrition*, **19** (3), 440–449.

Ross, A.C., Taylor, C.L. Yaktine, A.L. and Del Valle, H.B. (eds) (2011) *Dietary Reference Intakes for Calcium and Vitamin D*. National Academies Press, Washington, DC.

Roubenoff, R. (2004) Sarcopenic obesity: the confluence of two epidemics. *Obesity Research*, **12** (6), 887–888.

Scientific Advisory Committee on Nutrition (2011) *Dietary Reference Values for Energy*. TSO, London. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/339317/SACN_Dietary_Reference_Values_for_Energy.pdf (accessed 8 December 2016).

Stratton, R.J., King, C.L., Stroud, M.A. *et al.* (2006) 'Malnutrition Universal Screening Tool' predicts mortality and length of hospital stay in acutely ill elderly. *British Journal of Nutrition*, **95** (2), 325–330.

The Institute of Medicine of the National Academies (2002/2005) Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. The National Academies Press, Washington, DC.

United Nations (2013) World Population Prospects, the 2012 Revision. http://www.un.org/en/development/desa/publications/world-population-prospects-the-2012-revision.html (accessed 8 December 2016).

Volpi, E., Campbell, W.W., Dwyer, J.T. *et al.* (2013) Is the optimal level of protein intake for older adults greater than the recommended dietary allowance? *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, **68** (6), 677–681.

White, J.V., Ham, R.J., Lipschitz, D.A. *et al.* (1991) Consensus of the Nutrition Screening Initiative: risk factors and indicators of poor nutritional status in older Americans. *Journal of the American Dietetic Association*, **91** (7), 783–787.

WHO (2003) Food Based Dietary Guidelines in the WHO European Region. WHO Regional Office for Europe, Copenhagen. http://www.euro.who.int/__data/assets/pdf_file/0017/150083/E79832.pdf (accessed 3 January 2017).

World Health Organization (2013) *Health 2020. A European Policy Framework and Strategy for the 21st Century*. WHO Regional Office for Europe, Copenhagen.