Review Article

Eating your way to a successful old age, with special reference to older women

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A comprehensive definition of successful ageing would combine the elements of survival (longevity), health (lack of disability), and life satisfaction (happiness). Predictors of longevity include being female, being physically active, not smoking, having good cognitive functioning, higher socio-economic status and greater life satisfaction. Predictors of life satisfaction include being healthy (which is in part influenced by nutrition and physical activity), being socially active, having work satisfaction, having a high happiness rating and enjoying sexual activity. To age successfully is therefore the ultimate challenge. This paper cannot address all variables in the equation to successful ageing, but will focus on the value of food and physical activity in later life.

Key words: successful ageing, older women, food variety, dietary recommendations, dietary supplements, physical activity.

What happens to our bodies as we age?

The elderly today are living almost 20 years more than their ancestors did at the turn of the century. They are achieving older age in better health and the majority will live independently. Life expectancy is increasing for both men and women; between 1981 and 2001 the number of older people will have increased by 50%, with an even greater increase in those aged over 70. In the year 2020, at birth men will be able to expect to live to 79, and women to 87.[1] Socio-economic progress and advances in medical care have apparently underpinned this increase in longevity,[2] but it is also likely that it has been facilitated, in part, through food availability and quality.[3]

If we live long enough, changes in body composition, physical function and performance will occur in all of us. Many of these changes, as well as health problems, which become more common in old age, have long been attributed to the 'normal ageing process' — whatever that may be! However, as can be observed when looking at those around us, people vary enormously in the degree to which changes occur with ageing. Indeed, the older people become, the more dissimilar they become from their contemporaries of the same chronological age. Some of this variability may reflect heterogeneity in true rates of ageing; however, other factors, which accompany ageing seem to be of major importance. These include lifestyle factors such as poor eating habits, a sedentary lifestyle and smoking, and the development of disease.[4] Each of these factors can contribute to deterioration in cardiovascular, lung or endocrine functions, thereby accelerating one's apparent 'rate of ageing'. For example, declining cardiovascular function has been observed in the Baltimore Longitudinal Study of Ageing. However, after careful exclusion of those with heart disease, no consistent declines in function with age remained. Thus the apparent declines in the study group members as they aged were due to the inclusion of people with defined disease rather than to the ageing process *per se*. The accumulated effects of years of poor eating habits can increase the risk of many health conditions as one grows older; yet, it is never too late to change!

As people grow older, a decline in muscle mass and increase in body fat tends to occur.[5] However, what is often not appreciated is that these also cannot be blamed on the ageing process *per se*. A major contributor to these changes is the increasingly sedentary nature of people's lifestyles as they grow older in Western countries. Reduced physical activity leads to loss of muscle (i.e. 'use it or lose it'!), and as a direct consequence basal metabolic rate falls. A lower metabolic rate means that we need to eat less in order to maintain the same body weight. If one does indeed eat less in order to avoid weight gain, rather than remaining (or becoming) active, the problem, particularly for women, is that it becomes increasingly difficult to meet our needs for essential nutrients. Without doubt, it is preferable to keep physically active, maintain muscle mass, and continue to enjoy eating.

In Western society, advancing age often brings an increase in blood pressure and a reduced ability to metabolise glucose from food. Diabetes also becomes more prevalent. Once again, these changes are linked to a lack of physical activity, increasing levels of obesity and an increased tendency for body fat to distribute around the abdomen.

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Thus, although ageing appears to be an inevitable, natural process programmed into our genes, many of the changes that occur in our bodies as we grow older are at least partly the result of lifestyle or environmental factors. Therefore, the good news is that they may be amenable to modification.[6] In other words, we can adopt lifestyle habits such as regular exercise and healthy eating that will slow functional declines and compositional changes within the limits set by genetics. Healthy eating habits can, by delaying or slowing disease processes, help us to reach our maximum life-span potential.

The special nutritional needs of older women

Let us now examine the ways in which the nutritional needs of post-menopausal women differ from those of younger women.[7] Reflecting the usual reduction in physical activity levels and the resultant loss of muscle, a lower level of energy (or kilojoule) intake is recommended for older women. Neither of these changes, however, are inevitable. Indeed, it can be argued that morbidity and mortality could be lowered if activity and muscles were maintained rather than diminished in old age. Certainly, the greater amount of food that can be eaten without putting on weight when older women are more active is more likely to ensure adequate intakes of essential nutrients.

The next most obvious change in nutritional needs among post-menopausal women is the lower need for iron. This is the result of the cessation of menstrual blood loss. Consequently, after menopause iron deficiency is unlikely to reflect a lack of iron in the diet. Other causes are more likely at this time. For example, chronic blood loss from ulcers or other disease conditions, poor iron absorption due to reduced stomach acid secretion, or medications such as aspirin that can cause blood loss.

One area that has attracted a great deal of attention is the higher calcium needs of post-menopausal women not on hormone replacement therapy. The importance of an abundant calcium intake in protecting against osteoporosis is discussed in more detail later, but here we will briefly mention the levels of calcium needed. Many women do not meet the current Australian recommended calcium intake for post-menopausal women (1000 mg/day). They are even further from meeting more recent consensus recommendations, which take into account the latest studies on the calcium intake–bone health link.[8] For example, the 1995 US National Institutes of Health Consensus Development Conference on Optimal Calcium Intake recommended 1000 mg per day for women aged 25–50 years and post-menopausal women on hormone replacement therapy;[8] 1500 mg per day for women over 50 years not on hormone replacement therapy and all women over 65 years; and 1200–1500 mg per day for pregnant or lactating women. In light of recent studies, there have been suggestions that the Australian recommended dietary intake for post-menopausal women be increased to 1500 mg calcium per day.[9]

Older women and men also appear to have greater needs for vitamin D, vitamin B12 and vitamin B6, and lower needs for vitamin A, than do younger people.[7] The main contributor to vitamin D deficiency in old age is reduced sun exposure, usually due to declining mobility levels. It appears that in the USA and Great Britain, some 30–40% of older patients with hip fractures are vitamin D deficient. However, even during old age, improving vitamin D status can have profound benefits for the health of one's bones. A number of carefully conducted studies in this area are worthy of specific mention. In a double-blind placebo-controlled trial, a 10 μg/day vitamin D supplement over a 1-year period significantly reduced winter-time bone loss and improved spinal bone density in healthy post-menopausal women.[10] In a Finnish study of out-patients over the age of 85 years and municipal home residents aged 75–84 years, those randomly assigned to receive an annual vitamin D injection had significantly fewer fractures over a 5-year follow-up period.[11] Probably the most striking and impressive study is the one undertaken by Chapuy *et al.* of a nursing home population of 3270 women with an average age of 84 years.[12] In a randomized controlled trial of vitamin D (20 μg/day) and calcium (1200 mg/day), those receiving the supplement experienced 43% fewer hip fractures and 32% fewer non-vertebral fractures over an 18-month period. Thus, clearly the message is that it is never too late to care for your bones.

We need to be aware not only of the high risk of vitamin D deficiency among older people living in institutions but also among those living in their own homes who have low mobility levels. The solution is straightforward: preferably 15–30 min of daily sun exposure on the hands and face (the amount of exposure required need not raise concerns about skin cancer), or alternatively a daily 10 μg vitamin D supplement (halibut or cod liver oil capsules are fine).[10] Greater attention needs to be drawn to this widespread nutritional problem given the serious health implications involved.

Two studies which have added greatly to our knowledge of the nutrition of older adults are the 'Survey in Europe on Nutrition and the Elderly, a Concerted Action' (SENECA) study[13] and the 'Boston Nutritional Status Survey'.[14] In the SENECA study, 23% of older people had biochemical levels suggesting subclinical vitamin B6 deficiency. Over half of the people over 60 years of age in the Boston survey had vitamin B6 intakes below two-thirds of the recommended level. This is of great concern for a number of reasons. Most importantly, vitamin B6 deficiency adversely affects immune function and also appears to be linked with an increased risk of vascular disease.

Probably the most important change in the digestive system as we grow older is the reduction in stomach acid production in a subgroup of older people who have 'atrophic gastritis'.[15] This atrophy of the stomach mucosa becomes more common with ageing and appears to affect approximately one third of those over 60 years of age. This can reduce the availability for absorption of vitamin B12, calcium, iron and folate.

So it can be seen that overall, older women need to reach at least the same levels (and in some cases, higher levels) of intake as young women for most vitamins and minerals. However, since this usually needs to be obtained in substantially lower overall food intakes, a nutrient-dense diet becomes a high priority in later life. In other words, given the tendency for activity levels to decline and total food intakes to fall with advancing years, there is less room for those high-kilojoule foods (particularly high-fat or high-sugar foods) which supply few of the essential nutrients which our bodies to continue to need.

Health conditions in old age that are influenced by diet

Many chronic conditions associated with ageing such as coronary heart disease, diabetes, osteoporosis and cancer are, in part, attributable to the cumulative effect of poor dietary habits and other less desirable lifestyle factors throughout life such as smoking and low levels of physical activity. Nutrition can play a useful role in reducing the risk of developing these diseases even at an older age and, if disease does occur, nutrition can play an important role in the management of these conditions. For example, as people age their bodies become less effective at utilizing their blood sugars (glucose). This condition is known as glucose intolerance and may develop into diabetes. Certain foods like legumes (baked beans, lentils), spaghetti and some fruits and vegetables appear to assist in normalizing blood sugars.

In women, coronary heart disease and stroke have become the major causes of death and disability with ageing. Cholesterol is one risk factor for coronary heart disease; however, not everyone with a high level of cholesterol will develop premature heart disease, and having a low level of cholesterol does not necessarily protect you from premature heart disease. Furthermore, the relationship between cholesterol and heart disease in older adults has not been investigated fully especially in adults over 70 years of age. There are a number of dietary factors that are likely to be protective and these include limiting saturated fat as well as including a variety of fats from different food sources. For instance, fish (a good source of omega-3 fats) appears to be protective against coronary heart disease and, in women, its regular consumption (more than once a week) has been associated with a reduced incidence of stoke.[16,17] Vitamin E, an antioxidant found predominantly in vegetable oils and nuts, may also play a protective role in coronary heart disease.[18]

Three vitamins that may be important in the prevention of coronary heart disease and stroke include folate, vitamin B6 and vitamin B12. Low intakes of these vitamins can lead to a build up of an amino acid, known as homocysteine, which is toxic to blood vessels. High blood levels of homocysteine appear to increase the risk of coronary heart disease[19] and have been associated with a narrowing of the carotid artery.[20] Good food sources of folate include soybeans, liver, leafy green vegetables and berries, while vitamin B6 is found predominantly in bananas, wholemeal breads, cereals and yeast. Vitamin B12 is found in foods of animal origin; the B12 found in mushrooms is not biologically active.

Factors that occur early in life may affect the risk of breast cancer in later life. For instance, rapid early growth, greater adult height[21] and the commencement of menstruation at a younger age are associated with an increased risk of breast cancer.[22] Although it is unlikely that appropriate interventions could be undertaken to avoid these factors, there are other nutritional and lifestyle factors that are amenable to change and may reduce the risk of breast cancer. These include consuming diets high in vegetables and fruits, avoiding alcohol, maintaining a healthy body weight and remaining physically active throughout life.[21] There is some evidence that phytoestrogens (compounds found in plants that possess mild oestrogenic properties) may reduce the risk of breast cancer.[23] Soy and linseed are two excellent sources of phytoestrogens and recently Australian food manufacturers have been adding soy and linseed to a variety of breads and cereals.

Women are more prone to osteoporosis than men for two reasons. First, bone loss is accelerated after menopause and women have a lower bone mineral density compared with men. A large study of elderly men and women conducted in Australia found that after the age of 60 years approximately 60% of women and 30% of men sustained an osteoporotic fracture.[24] In post-menopausal women, a high intake of calcium appears to prevent or reduce bone loss.[24] While adequate intakes of calcium appear to be protective against osteoporosis, other potentially protective factors include vitamin D,[12] vitamin K,[25] certain trace elements such as boron,[26] and possibly phytoestrogens.[27]

Carrying extra weight when we are older appears to be reasonably well-tolerated. In fact, several studies have shown that older adults with a higher body weight tend to survive longer than their thinner counterparts.[28] Having a higher body weight, however, increases the risk of developing non-insulin dependent (or Type II) diabetes, especially if there is a family history of diabetes. Interestingly, in some older adults there may be an inappropriate sense of need for weight change and this could lead to disordered eating behaviour.[29] This type of behaviour might include the prolongation of a minor eating disorder from earlier life, a preoccupation with the major morbidities and mortalities associated with later life, social isolation, physical handicaps, emotional difficulties and impaired cognitive function.[29]

Food habits of older adults

In early colonial times in Australia different food patterns were imposed on men and women. Female convicts were given smaller rations of meat and flour but unlike the males, they were also issued with vegetables and tea.[30] In fact, females became extravagant tea drinkers, consuming more tea per head than that consumed in the United Kingdom.[31] Traditionally, women have usually been responsible for planning, buying and preparing food for the family and as such the food habits of infants and children have been largely influenced by women rather than by men.[32] Women are perceived to be good mothers if their young children are well-nourished. In recent years, two random population surveys completed in South Australia and Victoria found that women, compared with men, were more concerned with nutrition and health, more fussy over their food, and more accepting of novel foods. Furthermore, those over 60 years of age were found to be the most health conscious and the least weight conscious.[33]

Contrary to the popular 'tea and toast' myth, it appears that many older adults outside institutions eat 'reasonably' well.[34–37] The dietary patterns of older adults have generally been found to be similar to or healthier than those of their younger counterparts (see Tables 1, 2).[38] Nevertheless, their intakes of cereals, fruit, vegetables and milk products are still below the recommended amounts. A news-poll conducted nationally in September 1998 reported that nine out of 10 Australians over the age of 60 years were not eating the recommended dietary intake of fruit and vegetables and that more than one in five (22%) women in this age group lacked the motivation to prepare a meal, especially if living alone.[38,39]

Table 1. Mean daily food (g/day) intake of older Australians compared with their middle-aged counterparts in 1995*

	65 years and over		25–44 years		Recommended intake g/day**
	M $n = 3337$	F $n = 2926$	M $n = 4189$	F $n = 3321$	
Cereals (e.g. rice, bread)	200	150	230	170	> 210 g
Fruit (not juice)	179	176	127	132	300 g
Vegetables (not juice)	282	244	275	220	300–375 g
Legumes (+ tofu)	9	3.6	11	8.4	> 30 g[a]
Nuts/seeds (e.g. peanut butter)	3	2	7	4	> 10 g[a]
Milk products	340	300	390	300	450 g
Meat/poultry	146	95	212	121	85 g[b]
Fish and seafood	26	20	28	20	40 g[a]
Egg products	14	10	16	12	30 g or 2–4 eggs/week
Snack foods (e.g. crisps)	0.8	0.4	4	4.4	
Sugar products (jam, sorbet)	28	17	22	14	
Confectionery (e.g. chocolate)	4	4	11	10	
Fats/oils	17	12	14	9	1–2 tablespoons (30 g)
Soup	77	69	40	53	
Savoury sauces	25	20	37	27	
Non-alcoholic beverages (e.g. tea, juice, water)	1644	1714	2162	2004	
Alcohol (pure)	15	5	20	8	Men 20 g; women 10 g

Source: *, Reference 53; **, References 54, 55. Foods were converted to equivalents in core food groups as follows: 30 g bread is equivalent to 90 g cooked rice/pasta or 20 g breakfast cereal; 150 g fruit is equivalent to one medium fruit (apple, orange, banana, two apricots, one cup diced pieces, edible portion); 75 g cooked vegetables is equivalent to ½ cup or one cup salad vegetables; 250 mL milk is equivalent to ½ cup evaporated milk or 40 g cheese or small tub (200 g) yoghurt. [a]Based on epidemiological studies of long-lived populations e.g. Greeks in Greece (Crete) in 1960s, Greek Australians, Japanese, vegetarians. [b]In core food groups 85 g/day of meat and meat equivalents is recommended. This includes red and white meat, eggs and legumes (note: 35 g cooked meat is equivalent to 40 g cooked fish fillet or ¼ cup cooked beans or ⅓ cup nuts).

Table 2. Mean daily nutrient intake of older Australians compared with their middle-aged counterparts in 1995*

	65 years and over		25–44 years		Recommended intake**	
	M	F	M	F	M, F	M, F
Nutrients	$n = 3337$	$n = 2926$	$n = 4189$	$n = 3321$	65+	19–64 years
Energy						
kJ	8510	6370	11 725	7875		
kcal	2000	1500	2800	1900		
Protein (%E)	17	17.6	17	17	10–15	10–15
Total fat (%E)	32	32	33	33	30–35	30–35
Saturated (%E)	12	12	13	13	< 10	< 10
Monounsaturated (%E)	11	11	12	12	> 15	> 15
Polyunsaturated (%E)[a]						
Omega 6 linoleic (%E)	5	5	5	5	3–5	3–5
Omega 3 linolenic (%E)	< 0.2	< 0.2	< 0.2	< 0.2	1–2	1–2
Omega 3 EPA/DHAg	< 0.2	< 0.2	< 0.2	< 0.2	0.4	0.4
Carbohydrate (%E)	46	47	45	47	> 55	> 55
Total sugars	21	22	19	20	< 15%	< 15%
Total starch	25	26	26	26	> 40%	> 40%
Dietary fibre g	24	20	26	20	> 30 g	> 30 g
Ethanol (%E)	5	2	5	3	< 3	< 3
Vitamin A RE (mcg)	1310	1064	1334	1038	750	750
Thiamin (mg)	1.6	1.2	2.1	1.4	0.9, 0.7	1.1, 0.8
Riboflavin (mg)	2.0	1.6	2.5	1.8	1.3, 1.0	1.7, 1.2
Niacin equivalent	39	29	54	35	16, 11	19, 13
Folate (mg)	280	225	311	227	200	200
Vitamin C (mg)	127	111	133	108	40, 30	40, 30
Calcium (mg)	796	686	990	762	800, 1000	800
Phosphorus (mg)	1420	1132	1867	1300	1000	1000
Magnesium (mg)	334	268	392	284	320	320
Iron (mg)	14	11	17	12	7, 5–7	7, 12–6
Zinc (mg)	11	9	15	10	12	12
Potassium (mg)	3232	2626	3818	2816	1950–5460	1950–5460

Source: *, Reference 53; **, References 85; [a], Reference 56; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid.

Energy intakes fall with advancing age (from 2800 kcal to 2000 kcal for men and from 1900 kcal to 1500 kcal for women) but average intakes of protein, total fat, polyunsaturated omega 6 linoleic acid, vitamin A, thiamin, riboflavin, niacin, vitamin C, iron, and phosphorus remain adequate in the 65-plus age group. Saturated fat and refined carbohydrates (high sugar content) continue to be consumed in excess of the recommended and monounsaturated fats; omega 3 fatty acids (from plants and fish), unrefined carbohydrates, fibre, folate, vitamin B6, calcium, magnesium and zinc tend to be below the recommended intakes. These intakes may not result in the appearance of any diagnostic features or symptoms of true deficiency but may result in 'subtle' or 'subclinical' nutrient deficiencies which may still significantly increase the risk of stroke, susceptibility to infections and neurological disorders.[40] There are some subgroups within older populations who appear more likely to be consuming inadequate diets (e.g. less regular consumption of cooked meals) such as older men living alone, low socioeconomic status groups, the socially isolated, the institutionalized, the recently bereaved, the physically and socially inactive and the lonely.[34,41–43] Participation in fewer activities outside the home has also been linked with higher mortality in old age.[44] Nutrients at greater risk of inadequate intakes in these subgroups include calcium, zinc, magnesium, vitamin B6 and folate.[35,42,45,46] Low intakes of these nutrients have important implications for bone health (calcium), wound healing (zinc), impaired immune response (zinc, vitamin B6) and vascular disease via elevated homocysteine levels (folate, vitamin B6).[40] Other negative influences on dietary intake include physical disability, problems with chewing (loss of teeth and poorly fitting dentures), shopping difficulties and depression.[41]

Is it too late to make dietary changes in later life?

Sometimes the assumption is made that after the age of 65 or 70 years is reached, lifestyle changes will perhaps no longer confer significant benefits. Are the remaining years sufficient to reap the benefits of modifications to food choice or exercise patterns? In fact, many recent intervention studies reveal that improvements in nutrition and regular exercise can benefit health even in advanced old age. For example, older muscles are just as responsive to strength-training exercises as are young muscles.[47] Nonagenarians have shown impressive increases in muscle mass, muscle strength, and walking speed with weight-training programs. As mentioned earlier, improvements in calcium or vitamin D nutrition can dramatically reduce fracture risk even in very old institutionalized people.[11,12] Chronological age is, in itself, clearly no justification for deciding whether it is worthwhile pursuing lifestyle change. Behavioural risk factors (e.g. not regularly eating breakfast, lack of regular physical activity, overweight, smoking) have been shown to remain predictors of 17-year mortality even at older ages (i.e. 70-plus).[48]

Furthermore, many older adults do make positive changes to their food patterns, often for health reasons, thus challenging the stereotyped view of this group as being resistant to change.[34] Studies which have described the food habits of elderly people in their 70s and then followed them up 5–6 years later to ascertain survival status, concluded that 'food patterns', even as late as 70 years and onwards, could reduce the risk of death by more than 50%.[49–52]

The 'food patterns' which were reported to confer longevity were defined as follows: (i) a high vegetable intake (approximately 300 g/day); (ii) a high legume intake (approximately 50 g/day); (iii) a high fruit intake (approximately 200 g/day); (iv) a high cereal intake (250 g/day); (v) a moderate dairy product intake (approximately 300 g of milk/day or equivalent in cheese/yoghurt); (vi) a moderate meat and meat products intake (approximately 100 g/day); (vii) a moderate alcohol intake (< 10 g/day); and (viii) a high monounsaturated : saturated fat ratio (> 1).

This food pattern was consistent with the traditional Greek food pattern of the 1960s and was basically high in plant foods (approximately 70% of total food intake) and low in animal foods (30% of total food intake). What was particularly interesting was that subjects achieved greater mortality advantage if they followed the entire food pattern as opposed to just achieving the required amount for one or two of the food groups. This suggests that there may be synergy between the food groups and that we need to follow dietary recommendations as a whole rather than focusing on just one food group or nutrient. Nevertheless, this 'food pattern' definition does have limitations. It does not differentiate between meat and fish, milk and yoghurt, fruit and nuts, different types of vegetables, the source of the monounsaturated fats (which can be derived from olive/rape seed oils, avocados, nuts and dairy products) or the mode of food preparation (e.g. olive oil, herbs and lemon juice added to Greek vegetable dishes *vs* melted margarine on Anglo-Celtic vegetable dishes). Therefore, these mortality studies, although interesting, leave us with some unanswered questions.

Studies have shown that consuming a wide variety of foods, especially plant foods,[57] and having a proportionately higher intake of plant foods relative to animal foods is associated with longevity.[49,51,58] The main concern for people eating meat-rich diets is that they tend to eat less plant foods and may not gain as many benefits of the protective substances found in plant foods. However, an omnivore diet that is low in saturated fat and contains plenty of fruits, vegetables, cereals and legumes may be just as effective as a vegetarian diet in terms of reducing cardiovascular disease risk (Diet & Heart Disease Advisory Committee, National Heart Foundation, 1997).[59] Also, the cooking technique used to prepare meat and fish is important. Charred and burnt meat/fish juices, grilling in direct flame, or cured and smoked meats have been linked with cancer due to the formation of carcinogenic compounds.[21]

A high intake of fish,[16] seeds and nuts,[18] soy products and other legumes,[60] olive oil and olives,[59,61] rape seed oil,[62] red wine, dark green vegetables, onions and garlic, apples and berries, green and black tea,[63] tomatoes, carrots,[64] citrus fruits, fermented milk products,[65] and herbs and spices (Kouris-Blazos *et al.* unpubl. data, 1998) have also been reported to protect against several chronic diseases associated with ageing and may result in lower overall mortality rates in later life. The protective components in these foods include the anti-oxidant vitamins (e.g. vitamins E, C, A) phytochemicals (e.g. polyphenols, flavonoids), phytoestrogens (e.g. isoflavones, lignans), omega 9 (monounsaturated) fatty acids, and omega 3 (polyunsaturated) fatty acids from plants