
VIEWPOINT

Dietary guidance for older Australians

A. Stewart TRUSWELL

Human Nutrition Unit, University of Sydney, Sydney, New South Wales, Australia

Abstract

Aim: This paper reviews the literature on dietary guidance for older Australians.

Methods: The components of the 1999 National Health and Medical Research Council Dietary Guidelines for Older Australians are reviewed in conjunction with the current literature.

Results: Advice on a healthy diet for older people from different professionals can sometimes seem to be looking in opposite directions in terms of amount and types of food to recommend. Appropriate nutritional guidance should be determined by the stage of ageing, not by chronological age. For those in the third age—older but still active—advice should be somewhat modified from the dietary guidelines for younger adults. For example, maintaining muscles and bones become more important than keeping a low body mass index.

Conclusions: The 1999 National Health and Medical Research Council Dietary Guidelines for Older Australians provide a sensible framework for considering recent evidence. In old people who are frail and losing weight, the 'fourth age', our main concern should be to prevent (further) malnutrition. The popular dietary rules of low calories, sugar, fat and salt no longer apply.

Key words: dietary guidelines, older Australians, third age, fourth age.

INTRODUCTION

Nutrition specialists' advice to older people and those caring for them can seem to be looking in opposite directions ('don't eat too much to stay healthier longer' vs 'we will help you get more to eat to keep going longer'). Carers, nurses, kitchen staff, volunteers and doctors can find this confusing—and so can the old persons themselves. Which direction—less or more—depends on what stage of ageing for the individual. It may be more useful to assess whether they are in the 'third age' or 'fourth age'.¹

The term, 'third age', is now in the *Concise Oxford English Dictionary*² as 'the period in life of active retirement, following middle age'. This is people older than 65 years who are apparently healthy and active in society. They are entitled to retire but may still be working part time or as volunteers, including grandparent duty. Their medical problems are minor and controllable. Modern medicine is keeping people in this stage for longer. They may well be taking medication for blood pressure, cholesterol, diabetes, arthritis, and so on. They may be walking quite well after a hip replacement,

have made a good recovery after a coronary thrombosis or be in remission from cancer.

In this third age people have more control of their time. For some it is even possible to increase their physical activity. This is one of the times in life when people can give more attention to a healthy lifestyle, including their diet. Muscular bulk and strength are, however, less than when they were 30 years. With less muscular activity their calorie expenditure and requirement are likely to be lower. This can be seen in the 1995 Australian National Nutrition Survey (NNS).³ In men 65 years and over mean energy intake (8.51 MJ) was equivalent to that between boys 4–7 years (7.85 MJ) and 8–11 years (9.66 MJ). In women 65 years and over mean energy intake was only 7% higher than the mean for girls 4–7 years. Protein and micronutrient requirements are the same as for younger adults—even more for vitamin D and possibly protein⁴—and more than for younger children, so the diet should contain more nutrients per calorie (or kilojoule), be more nutrient-dense. This review touches on these and other pertinent nutritional considerations in examining dietary guidance for older Australians.

METHOD

Fundamental material was referred to from the 1999 Dietary Guidelines for Older Australians⁵ (DGOAs), nutrition textbooks by authors, such as Shils,⁶ Geissler and Powers⁷ and Mann and Truswell,⁸ and the scientific literature. The chapters in the DGOAs provide structure for reporting this

A.S. Truswell, AO, MD, DSc, FRACP, FRCP, FFPH, FIUNS, Emeritus Professor of Human Nutrition

Correspondence: A.S. Truswell, Human Nutrition Unit, Building G.08, University of Sydney, Sydney, NSW 2006, Australia. Email: s.truswell@usyd.edu.au

Accepted September 2009

review. The National Health and Medical Research Council Dietary Guidelines for Older Australians reviewed in the paper have been rescinded.

RESULTS

1. Enjoy a wide variety of nutritious foods

Wahlqvist pioneered variety as a simple term that is valuable for nutrition education.⁹ Meat, poultry, fish, eggs, nuts and cheese are particularly rich in proteins and other different nutrients. They should be in the centre¹⁰ of old people's meals. The Australian/New Zealand recommended daily intake (ANZ RDI) for protein is higher for older people, at 81 (men) and 57 (women) g/day, although iron needs are lower for women after the menopause.⁴ Australia has an ethnically diverse population. Older people naturally prefer the food culture that they grew up with. At the same time, cuisines beyond traditional English, Italian, Chinese and others, have become shared across the whole country and add variety to tastes as well as nutrients.

2. Keep active to maintain muscle strength and a healthy bodyweight

The wording and the (higher) rank order of this guideline are different from that for younger adults. Maintaining muscle strength and function is very important in older people.^{11,12} Loss of muscle is a greater health hazard than being overweight. People with sarcopenia are liable to injurious falls, to lack of mobility and independence and less able to cope with bronchitis. Muscle wasting contributes to osteoporosis and insulin resistance. Fiatarone *et al.* demonstrated the value of strength training exercise in elderly people.¹³ There should be exercise trainers working in all our nursing homes.

Although older people have a higher fat/lean ratio for a given bodyweight and have had a decrease in their height, evidence has accumulated that the healthy range of BMI for older people is higher than in younger adults. Price *et al.* followed 6649 subjects in 53 British family practices for (median) 5.9 years.¹⁴ By quintiles of original BMI, the lowest mortality was with BMI 24.6–26.8 kg/m² in women and second lowest was with BMI 26.8–29.7 kg/m². In a national Canadian sample,¹⁵ relative risk of death was lowest in people over 60 years with a BMI 25–30 kg/m². Even those with BMI 30 to <35 kg/m² had lower mortality than people with BMI under 25 kg/m². It is not evidence-based to advise even a mildly obese older person to actively try to reduce their weight.

3. Eat at least three meals every day

The DGOAs stated that the 1999 NNS found that people over 65 years who ate two to four meals per day were more likely to meet recommended intakes than those who ate

fewer than two meals.⁵ The DGOAs suggest that older people eat at least three meals a day. With limited energy and nutrient intake, eating fewer than three meals a day may adversely affect nutritional status. Increased food intake may be achieved through encouraging breakfast, not skipping meals and eating in a social environment. This guideline states the obvious, but it is needed for older, not younger people, because they are more likely to be socially isolated, to have difficulty obtaining or preparing food and may have a poor appetite. Missing meals, they should be warned, is bad for their health.

4. Care for your food: prepare and store it carefully

Food safety has a higher ranking in DGOAs. Older people, who live on their own and have difficulty shopping, can keep food for too long. People with early dementia may neglect food hygiene and not be able to smell when food has deteriorated. Older people are more seriously affected by food poisoning bacteria, including *Listeria*.

5. Eat plenty of vegetables and fruit

Most of the plant foods are only small contributors to calories and protein intake—except legumes, nuts and starchy vegetables. However, from 1940 (or before) they have been classified for nutrition education as 'protective plant foods'¹⁶ The DGOAs put prevention of coronary heart disease and stroke first among the benefits. In the subsequent 10 years further support for both of these, especially stroke prevention, have come from cohort studies.^{17–20} In the Dietary Approaches to Stop Hypertension (DASH) trial increased fruit and vegetables, with corresponding rise in urinary potassium, lowered blood pressure.²¹

In the European Prospective Investigation of Cancer-Norfolk (EPIC-Norfolk) cohort plasma ascorbate was inversely related to mortality from all causes.²² The same was found in a follow up of older people in 51 British general practices.²³ There may be confounders and vitamin C supplements have not been beneficial in a large randomised controlled trial.²⁴ Plasma ascorbate is a biomarker for fruit and vegetable intake.

Evidence for protective effects against cancer, on the other hand, has weakened.^{19,25,26} The second (2007) World Cancer Research Fund review²⁷ changed its 1997 estimate²⁸ of fruit and vegetables protection against cancers of mouth, oesophagus and stomach from 'convincing' to 'probable'. For breast cancer the protective effect was changed from 'probable' (1997)²⁸ to 'limited—no conclusion'²⁷ in 2007.

Fruits and vegetables can contain very many potentially protective compounds: for example, nutrients, potassium, folate, retinol equivalents, vitamin K, dietary fibre and many non-nutrients, including lycopene, flavonoids, phytoestrogens, allicin and glucosinolates. Evidence has grown that lutein and zeaxanthin in green leafy vegetables, orange-red capsicums and sweet corn (and eggs) may protect against age-related macular degeneration.^{29–31} A prevention

trial with lutein and zeaxanthin is under way in the USA Age-Related Eye Disease Study (AREDS-2).

6. Eat plenty of cereals, breads and pastas

Cereal foods provide around 20% of dietary energy in the 1995 NNS,³ over a quarter of the protein, a third of the dietary fibre and 40% of the thiamin. With its expected folate and iodine fortification later this year, bread will make a larger contribution to folate intake.

In the 1995 NNS people over 65 years maintained bread consumption, breakfast cereals and biscuits. They ate more hot porridge than any other age group but less rice and pasta.³² Higher-fibre breads help prevent constipation, but people with poor teeth do not like wholegrain products. In the 10-year follow up of people starting 50+ years in the Blue Mountains Eye Study, wholemeal/grain bread consumption went down from 53 to 40 g/day while that of white breads increased slightly (Flood V., personal communication, 2009).

7. Eat a diet low in saturated fat

Keys in 1999 said that 'we find some risk factors for mortality are less important in old age, notably serum cholesterol and relative weight'.³³ But when people 70 to 82 years (admittedly with pre-existing vascular disease or with increased risk factors) took pravastatin,³⁴ their serum LDL cholesterol went down and they had significantly fewer heart attacks and transient ischaemic attacks over 4 years. This indicates that people in the third age should not be discouraged from changing their type of dietary fat to reduce their risk of coronary heart disease, or possibly ischaemic strokes.

For nutritionists there are two less desirable classes of fat: saturated and (industrial) *trans* (not mentioned in DGOAs (1999)) and two more desirable types of fatty acid: linoleic (i.e. ω -6) and eicosapentaenoic acid or docosahexaenoic acid (long-chain ω -3) polyunsaturates, with mono-unsaturates somewhere in between. It has been shown repeatedly that linoleic acid reduces LDL and total cholesterol—and coronary heart disease.³⁵⁻³⁷ Long-chain ω -3 polyunsaturates (in fatty fish) reduce coronary heart disease mortality too, mainly by reducing the risk of dangerous cardiac arrhythmia.³⁸ People who eat fatty fish also benefit from one of the few dietary sources of vitamin D3. They may also reduce the risk of macular degeneration.^{39,40} Cell membranes of the retinal photoreceptors have a high concentration of the ω -3 docosahexaenoic acid.

8. Drink adequate amounts of water and/or other fluids

This does not mean that people over 65 years have to drink more fluids than younger people. Water for the body comes from drinks (water, tea, milk, beer and wine) and from moisture in foods (e.g. about 70% of the weight of meat) and

water is a product of metabolism. In the 1995 NNS,^{3,32} fluid intakes were measured and healthy people over 65 years consumed somewhat smaller amounts of fluids than younger adults, partly because they drank less beer. Total water requirement is proportional to bodyweight and to energy expenditure.⁴ Weight and energy intake both go down over age 65 years.

Water intake, however, has a place in DGOAs because older people have a lower percentage of body water and less efficient renal function. Some old people have conditions that can make water intake inadequate, for example, dementia, dysphagia, limited mobility, and they may stop drinking in the second half of the day to limit urinary problems at night. If an acute illness causes vomiting or diarrhoea, or with heat stress, old people can develop dangerous dehydration. It is in these situations that the water guideline applies.

9. If you drink alcohol, limit your intake

Ethyl alcohol is a nutrient, with a caloric value, but it is also a drug affecting brain function and, above the socially beneficial dose, a toxin affecting most tissues of the body. The DGOAs lists 30 medical complications of excess alcohol consumption.⁵ Because total body water and liver size and function are all smaller than in younger adults, older people have higher blood alcohol levels and become more intoxicated after drinking the same amount.

There are three other reasons why alcohol is more dangerous in older people. One is falls. Old people are more likely to trip and fall because eyesight or balance and/or muscle strength are weaker, and falling on osteoporotic bones the result may be a fractured neck of femur. Alcohol causes confusion and affects memory. The older you are the more you need to keep your head straight. Third, older people are more likely to be taking multiple medicines. DGOAs have a list of 15 important interactions between alcohol and drugs. A drink with a meal should be a pleasure in older people, but the National Health and Medical Research Council's advice of not more than two alcoholic drinks a day needs to be followed more literally than by younger adults.

10. Choose foods low in salt and use salt sparingly

The guideline is well worded because about 85% of our salt intake comes from processed foods and only 15% is discretionary.⁴¹ Older people's tastes will have matured before the 'reduce salt' era and naturally they cannot be easily persuaded to give up a flavour they are used to, but reducing salt intake is more beneficial for older people. First, their blood pressure is more sensitive to reduction of salt (falls more) and a high salt intake (rises more).⁴²⁻⁴⁴ Second, sodium chloride increases urinary calcium and tends to make calcium balance negative. Urinary calcium and hydroxyproline (a marker of bone loss) were strongly

associated with sodium excretion in an Australian study.⁴⁵ Dietary salt is a more important determinant of urinary calcium than calcium intake (within the usual ranges of sodium and calcium intake).⁴⁶ In a West Australian study female bone density declined significantly more in post-menopausal women with higher urinary sodium.⁴⁷

It is difficult to find good low-salt bread, but some breakfast cereals are low in salt (e.g. puffed wheat) and so is oatmeal (for muesli) and porridge and some margarines. Fresh foods escape processing salt: vegetables, fruit (even canned) as well as meat—which does not raise blood pressure⁴⁸—and eggs.

11. Include foods high in calcium

In the 1995 NNS mean dietary calcium intakes were 796 mg/day in men and 686 mg/day in women over 65 years, against the 2006 ANZ unisex RDI for this age group of 1300 mg.⁴ Even the 75 percentiles of calcium intakes were only 979 mg/day in men and 863 mg/day in women.⁴⁹ As well 11% of women and only 2% of older men were taking calcium supplements. So the great majority did not achieve the ANZ RDI (which corresponds to 1.1 L of milk or 175 g of cheddar cheese). But our new RDIs are higher than the former ones (1000 mg/day for women and 800 mg/day for men),⁵⁰ and the North American AIs (1200 mg/day) and the British RDI of 700 mg/day.⁵¹

Since 1999 more trials of calcium supplements, with or without vitamin D, have been reported, with osteoporotic fractures as the main outcome. In the meta-analysis by Tang *et al.*⁵² 17 trials reported fractures as an outcome, with an overall significant 12% reduction of risk. Overall reduction of bone loss was only 0.54% at the hip and 1.2% in the spine. Benefits appeared to be greater when vitamin D was given as well. Since 1999 there has been an outpouring of reports of low-serum 25OH vitamin D in elderly and some other people in Australia⁵³ and elsewhere.⁵⁴ Vitamin D deficiency is also associated with muscle weakness (hence more serious falls),⁵⁵ and vitamin D supplementation appears to reduce all causes of mortality.⁵⁴ This guideline should be changed by adding vitamin D to calcium, but the vitamin D requirement of older people, which is four times that of younger people,⁴ is more reliably provided by vitamin D supplements than the diet, especially for those who cannot get out into the sun regularly.

12. Use added sugars in moderation

The inclusion of added sugars in the diet of older Australians should be moderate, to ensure that valuable nutrients are not diluted by food high in added sugar and limited in nutrient density. On the other hand, adding small amounts of sugar to foods that are nutrient-dense—for example, stewed fruit—can increase the palatability of these foods and promote their intake.⁵

One final point about nutrient advice for older people. There are diets that can prolong life by delaying or preventing disease, like cardiovascular disease or malnutrition, that

accompany old age. But no dietary change or prescription or supplement has been proven to delay the ageing process in humans.

Dietary Supplements

If an older person or their carers/advisers are not confident that the dietary intake covers all the vitamins, a multivitamin capsule is an inexpensive insurance policy. But there are 13 true vitamins and some multivitamins supplements do not contain them all. Look for a preparation with all the vitamins, each at dosage near the RDI.⁵⁶ Of the single nutrient supplements the two most valuable are calcium and vitamin D, or the two combined (see above). On the other hand, vitamin C does not prevent colds—there have by now been many randomised controlled trials^{57,58}—or prevent cardiovascular disease.²⁴ Vitamin E does not prevent cardiovascular disease⁵⁹ or cancer.⁶⁰

The Fourth Age

For old people who are declining in general health, nutritional status and dietary advice are different. Participants in the European multi-country SENECA Study who lost 5 kg of bodyweight had a significantly shorter survival.⁶¹ These are old people who are losing weight, including muscle, and becoming frail. They are the old people with impaired nutrition and low score by the Mini Nutritional Assessment described by Visvanathan *et al.*⁶² Some have serious disease or advanced ageing in a hospital or nursing home. Others may still be at home but socially isolated, with chronic disabilities, including dementia, or were nutritionally depleted by previous major illness in hospital.

The DGOAs have a 15-page appendix C with advice for Meal-Assisted Older Australians and Residents of Aged Care Accommodation. The prevailing dietetic principles for Australian adults—limit calories, low fat, sugar and salt—are not a priority here in frail old people losing weight. The first objective is to stop any further malnutrition from insufficient calories—and other nutrients, including protein, calcium, potassium, thiamin. The concern is for the person's weight and strength, and the main dietary principle here is frequent meals of enjoyable foods. The type and amount of fat are not a priority. In very old people plasma cholesterol correlates positively with general health, and low cholesterol indicates an increased risk of mortality.⁶³ Food hygiene and safety are a major challenge for field workers, and all involved have to watch that fluid intake is adequate.

CONCLUSION

The DGOAs provide a sensible framework for considering recent evidence. In old people who are frail and losing weight, the 'fourth age', our main concern should be to prevent (further) malnutrition. The popular dietary rules of low calories, sugar, fat and salt no longer apply. Research-based evidence for housebound frail elderly people is sparse indeed. Medical conditions and social and living conditions

vary greatly. The set of papers on Aged Care in this issue of the journal provide useful guidance from professionals with substantial practical experience.

REFERENCES

- 1 Truswell AS. *ABC of Nutrition* 4th ed. BMJ Books, London: 2003; 40.
- 2 Soanes C, Stevenson A. *Concise Oxford English Dictionary*, 11th edn. Oxford: Oxford University Press, 2008.
- 3 McLennan W, Podger A. *National Nutrition Survey Selected Highlights Australia 1995*. Canberra: Australian Bureau of Statistics/ Department of Health & Family Services, 1997.
- 4 Australian Government/Department of Health and Ageing/ National Health & Medical Research Council with New Zealand Ministry of Health. *Nutrient Reference Values for Australia and New Zealand*. Canberra: Australian Government/Department of Health and Ageing/National Health & Medical Research Council with New Zealand Ministry of Health, 2006.
- 5 Binns C, ed. *Dietary Guidelines for Older Australians*. Canberra: National Health & Medical Research Council, 1999.
- 6 Shils ME, Shike M, Ross AC, Caballero B, Cousins RJ. *Modern Nutrition in Health and Disease*, 10th edn. Philadelphia: Lippincott Williams & Wilkins, 2006.
- 7 Geissler C, Powers H. *Human Nutrition*, 11th edn. Edinburgh: Elsevier Churchill Livingstone, 2003.
- 8 Mann J, Truswell AS. *Essentials of Human Nutrition*, 3rd edn. Oxford: Oxford University Press, 2007.
- 9 Wahlqvist M, Lo C, Myers K. Food variety is associated with less macrovascular disease in those with type II diabetes and their healthy controls. *J Am Coll Nutr* 1989; **8**: 515–23.
- 10 Douglas M, Nicod M. Taking the biscuit: the structure of British meals. *New Society* 1974; **30**: 744–7.
- 11 Wolfe R. The underappreciated role of muscular health and disease. *Am J Clin Nutr* 2006; **84**: 475–82.
- 12 Lanza IR, Nair KS. Muscle mitochondrial changes with aging and exercise. *Am J Clin Nutr* 2009; **89**: 467S–71S.
- 13 Fiatarone MA, O'Neill EF, Rayon ND *et al*. Exercise training and nutritional supplementation for physical frailty in very elderly people. *N Engl J Med* 1994; **330**: 1769–75.
- 14 Price GM, Uauy R, Breeze E, Bulpitt CJ, Fletcher AC. Weight, shape and mortality risk in older persons: elevated waist-hip ratio, not high body mass index, is associated with a greater risk of death. *Am J Clin Nutr* 2006; **84**: 449–60.
- 15 Orpana HM, Berthelot J-M, Kaplan MS, Feeuy DH, McFarland B, Ross NA. BMI and mortality: results from a national longitudinal study of Canadian adults. *Obesity* 2009. doi: 10.1038/oby2009.191.
- 16 Truswell AS. Protective plant foods: new opportunities for health and nutrition. *Food Aust* 1997; **49**: 40–43.
- 17 Joshipura KJ, Ascherio A, Manson JAE *et al*. Fruit and vegetable intake in relation to risk of ischaemic stroke. *JAMA* 1999; **282**: 1233–9.
- 18 Liu S, Manson JAE, Lee IM *et al*. Fruit and vegetable intake and risk of cardiovascular disease: The Women's Health Study. *Am J Clin Nutr* 2000; **72**: 922–8.
- 19 Hung HC, Joshipura KJ, Jiang R *et al*. Fruit and vegetable intake and risk of major chronic disease. *J Natl Cancer Inst* 2004; **96**: 1577–84.
- 20 He FJ, Nowson CA, MacGregor G. Fruit and vegetable consumption and stroke: meta-analysis of cohort studies. *Lancet* 2006; **367**: 320–26.
- 21 Appel LJ, Moore TJ, Obarzanek E *et al*. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *N Engl J Med* 1997; **336**: 117–24.
- 22 Khaw KT, Bingham S, Welch A *et al*. Relation between plasma ascorbic acid and mortality in men and women in EPIC-Norfolk prospective study. *Lancet* 2001; **357**: 657–63.
- 23 Fletcher AE, Breeze E, Shetty PS. Antioxidant vitamins and mortality in older persons: findings from the nutrition add-on study to the Medical Research Council Trial of Assessment and Management of Older People in the Community. *Am J Clin Nutr* 2003; **78**: 999–1011.
- 24 Heart Protection Study Collaborative Group. MRC/BHF heart protection study of antioxidant vitamin supplementation in 20,536 high-risk individuals: a randomised placebo-controlled trial. *Lancet* 2002; **360**: 23–33.
- 25 Key TJ, Fraser GE, Thorogood M *et al*. Mortality in vegetarians and non-vegetarians: a collaborative analysis of 8300 deaths among 76,000 men and women in five prospective studies. *Public Health Nutr* 1998; **1**: 33–41.
- 26 Giles G. Do fruit and vegetables prevent cancer? *Perspectives (Unilever)* 2004; **November** (19): 1, 12.
- 27 World Cancer Research Fund. *Food, Nutrition, Physical Activity, and the Prevention of Cancer. A Global Perspective*. Washington DC: American Institute for Cancer Research, 2007.
- 28 World Cancer Research Fund. *Food, Nutrition and the Prevention of Cancer: A Global Perspective*. Washington DC: American Institute for Cancer Research, 2007; 997.
- 29 Krinsky NI, Landrum JT, Bone RA. Biologic mechanisms of the protective role of lutein and zeaxanthin in the eye. *Annu Rev Nutr* 2003; **23**: 171–201.
- 30 Bone RA, Landrum JT, Guerra LH, Ruiz CA. Lutein and zeaxanthin dietary supplements raise macular pigment density and serum concentration in humans. *J Nutr* 2003; **133**: 992–8.
- 31 DSM supports eye health study. *Food Aust* 2007; **59** (4): 164.
- 32 McLennan W, Podger A. *National Nutrition Survey. Foods Eaten, Australia 1995*. Canberra: Australian Bureau of Statistics, 1999.
- 33 Keys A. The elderly: problems caused by advances in technology and medical science. *Book of Abstracts, 1st European Congress on Nutrition and Health in the Elderly, Noordwijkerhout, the Netherlands*. Wageningen: Euronut-Seneca, 1999; 21.
- 34 Shepherd J, Blauw GJ, Murphy MB. Pravastatin in elderly individuals at risk of vascular disease (PROSPER): a randomised controlled trial. *Lancet* 2002; **360**: 1623–30.
- 35 Willett WC. The role of dietary n-6 fatty acids in the prevention of cardiovascular disease. *J Cardiovasc Med* 2007; **8** (Suppl. 1): S42–5.
- 36 Jakobsen MU, O'Reilly EJ, Heitmann BL *et al*. Major types of dietary fat and risk of coronary heart disease: a pooled analysis of 11 cohort studies. *Am J Clin Nutr* 2009; **89**: 1425–32.
- 37 Harris WS, Mozaffarian D, Rimm E *et al*. Omega-6 fatty acids and risk for cardiovascular disease. A science advisory from the American Heart Association Nutrition Subcommittee of the Council on Nutrition, Physical Activity, and Metabolism; Council on Cardiovascular Nursing, and Council on Epidemiology and Prevention. Circular published Online January 26, 2009. DOI 10.1161/Circulation.ANA.108.191627.
- 38 Mozaffarian D. Fish and n-3 fatty acids for the prevention of fatal coronary heart disease and sudden cardiac death. *Am J Clin Nutr* 2008; **87** (Suppl.): 1991S–6S.
- 39 Augood C, Chakravarthy U, Young I *et al*. Oily fish consumption, dietary docosahexaenoic acid and eicosapentaenoic acid

- intakes and associations with neovascular age-related macular degeneration. *Am J Clin Nutr* 2008; **88**: 398–406.
- 40 Smith W, Mitchell P, Leeder SR. Dietary fat and fish intake and age-related maculopathy. *Arch Ophthalmol* 2000; **118**: 401–4.
 - 41 James WPT, Ralph A, Sanchez-Castillo CP. The dominance of salt in manufactured food in the sodium intake of affluent societies. *Lancet* 1987; **1**: 426–9.
 - 42 Myers JB, Morgan TO. Effect of alteration in sodium chloride intake on blood pressure of normotensive subjects. *J Cardiovasc Pharmacol* 1984; **6**: S204–9.
 - 43 Miller JZ, Weinberger MH, Daugherty SA, Fineberg NS, Christian JC, Grimm CE. Heterogeneity of blood pressure response to dietary sodium restriction in normotensive adults. *J Chron Dis* 1987; **40**: 245–50.
 - 44 Cappuccio FP, Markandu ND, Carney C, Sagnella GA, MacGregor GA. Double blind randomised trial on modest salt restriction in older people. *Lancet* 1997; **350**: 850–53.
 - 45 Jones G, Beard T, Parameswaran V, Greenaway T, von Witt R. A population-based study of the relationship between salt intake bone resorption and bone mass. *Eur J Clin Nutr* 1997; **51**: 561–5.
 - 46 Antonios TFT, MacGregor GA. Salt—more adverse effects. *Lancet* 1996; **348**: 250–51.
 - 47 Devine A, Griddle AR, Dick IM, Kerr DA, Prince RL. A longitudinal study of the effect of sodium and calcium intakes on regional bone density in postmenopausal women. *Am J Clin Nutr* 1995; **62**: 740–45.
 - 48 Hodgson JM, Burke V, Beilin LJ, Puddy IB. Partial substitution of carbohydrate intake with protein intake from red meat lowers blood pressure in hypertensive persons. *Am J Clin Nutr* 2006; **83**: 780–83.
 - 49 *Analysis of the 1995 National Nutrition Survey*. School of Public Health, Curtin University, 1999.
 - 50 National Health & Medical Research Council. *Recommended Dietary Intakes for Use in Australia*. Canberra: Australian Government Publishing Service, 1991.
 - 51 Subgroup on Bone Health, Working Group on the Nutritional Status of the Population of the Committee on Medical Aspects of Food and Nutrition Policy. *Nutrition and Bone Health with Particular Reference to Calcium and Vitamin D*. Department of Health Report on Health and Social Subjects 49. London: The Stationery Office, 1998.
 - 52 Tang BMP, Eslick GP, Nowson C, Smith C, Bensonsan A. Use of calcium or calcium in combination with vitamin D supplementation to prevent fractures and bone loss in people aged 50 years and older: a meta-analysis. *Lancet* 2007; **370**: 657–66.
 - 53 Shrapnel W, Truswell AS. Vitamin D deficiency in Australia and New Zealand: what are the dietary options? *Nutr Diet* 2006; **63**: 206–12.
 - 54 Autier P, Gandini S. Vitamin supplementation and total mortality. *Arch Intern Med* 2007; **167**: 1730–37.
 - 55 Venning G. Recent developments in vitamin D deficiency and muscle weakness among elderly people. *BMJ* 2005; **330**: 524–6.
 - 56 Furlong V, Truswell AS. The search for the most complete multivitamin. *Asia Pac J Clin Nutr* 2004; **13**: 222–5.
 - 57 Truswell AS. Ascorbic acid and colds. *N Engl J Med* 1986; **315**: 709.
 - 58 Knipschild P. Systematic reviews. Some examples. *Lancet* 1994; **361**: 51–9.
 - 59 GISSI-Prevenzione Investigators. Dietary supplementation with n-3 polyunsaturated fatty acids and vitamin E after myocardial infarction: results of the GISSI-Prevenzione trial. *Lancet* 1999; **354**: 447–55.
 - 60 The Alpha-Tocopherol, Beta Carotene Cancer Prevention Group. The affect of vitamin E and beta carotene on the incidence of lung cancer and other cancers in male smokers. *N Engl J Med* 1994; **330**: 1029–35.
 - 61 De Groot CPGM, van Staveren WA. Undernutrition in the European SENECA studies. *Clin Geriatr Med* 2002; **18**: 699–708.
 - 62 Visvanathan R, Macintosh C, Callary M, Penhall R, Horowitz M, Chapman I. The nutritional status of 250 older Australian recipients of domiciliary care services and its association with outcomes at 12 months. *J Am Geriatric Soc* 2003; **51**: 1007–13.
 - 63 Strandberg TE, Valvanne J, Erkinjuntti T, Sorva A, Tilvis RS. Serum lipids, health and one-year mortality in randomised age cohorts of 75, 80 and 85 years: the Helsinki Ageing Study. *Nutr Metab Cardiovasc Dis* 1992; **2**: 101–5.