Food and Nutrition Guidelines for Healthy Adults

A Background Paper

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Foreword

Good nutrition, physical activity and maintaining a healthy body weight are fundamental to health and to the prevention of disease and disability.

Food not only is a means of maintaining and improving physical health but has a valued place in our society. It is a catalyst for social interaction and has a significant part in most celebrations. The cultural and psychological functions of food cannot be overemphasised.

Over recent years there has been a rapid rise in health conditions for which poor nutrition and inadequate physical activity are key risk factors. This trend is particularly evident in the current obesity epidemic. The Ministry of Health recognises the need for sound, up-to-date technical information to support health professionals, health educators and teachers in the practice of healthy nutrition.

This background paper supports three of the key priorities of the New Zealand Health Strategy. It brings together the latest evidence and advice on food and nutrition, physical activity and obesity relevant to the health of adult New Zealanders. In addition, it provides information on important nutrition-related health disorders, food safety and quality issues. It will assist health professionals and educators with the implementation of the *Healthy Eating – Healthy Action Strategy,* which was launched in March 2003.

Key population groups in New Zealand, including Māori and Pacific peoples, are at particular risk of compromised health due to poor nutritional status. For this reason, one part of this paper is devoted to nutrition issues relating to the health of these groups.

These guidelines are an important part of the Ministry's Food and Nutrition Guideline series for New Zealanders. This paper provides background material for health education resources for the general public. It is envisaged that *Food and Nutrition Guidelines for Healthy Adults: A background paper* will provide sound and practical advice on food and nutrition for health professionals and educators to use in their daily work.

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The many individuals and groups who gave feedback as part of the public consultation process and the specialists who commented on the final draft have shaped this final document significantly. The Ministry of Health appreciates the assistance of the many people who have had input during the process.

This document has been produced by the Public Health Policy Group.

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Introduction

Food and Nutrition Guidelines for Healthy Adults: A background paper is the technical background paper that supports the Food and Nutrition Guideline statements. There are seven background papers in the series. This adult background paper is the most comprehensive of the series and follows the format of all the other papers. In addition to underpinning the Food and Nutrition Guideline statements, it has been written to support health professionals including dietitians and nutritionists, teachers and health educators in the practice of healthy nutrition.

This document has been divided into six parts.

Part I: The New Zealand Food and Nutrition Guidelines presents the Food and Nutrition Guideline statements and the background as to why they were adopted.

Part II: Nutrients, food and drinks considers the role that energy and each of the major nutrients play in health. It discusses current and recommended dietary intakes in New Zealand, identifies sources of the nutrient in the New Zealand diet and summarises the evidence available on the topics covered. Where appropriate, it makes suggestions that can form the basis for nutrition advice to healthy adult New Zealanders. These suggestions are intended as a guide only, as the nutritional needs of individuals are dependent on many factors.

Part III: Nutrition and health outcomes discusses the most important non-communicable diseases where food and nutrition are significant risk factors. These include obesity, type 2 diabetes, coronary heart disease, hypertension, cancer and osteoporosis. These guidelines are not intended as treatment guidelines but rather emphasise reducing the risk of developing these diseases.

The document goes on to consider other factors that sit alongside nutrition in contributing to good health.

Part IV: Physical activity – a partner to nutrition considers the complementary role of physical activity in reducing the risk of the diseases considered in Part III.

Part V: Nutrition and health in Māori and Pacific peoples considers the cultural approaches to nutrition by Māori and Pacific peoples. It discusses the differential burden of disease these populations carry that can be influenced by nutrition.

Part VI: Other issues examines factors that can influence people's ability to access good nutrition in terms of food security, fortification, supplementation and food safety.

This document weaves the relevance of nutritional issues for Māori throughout the document. Specific issues for Māori as a population group are described separately in Part V. However, Māori health must be understood in the wider context of their social, economic, cultural and political position. Integral to working with Māori is a need to understand the special relationship between iwi and the Crown, and the Treaty of Waitangi. The Crown recognises the three guiding principles of the Treaty of Waitangi as the basis of any health strategies for Māori. The three principles are:

- partnership – working together with iwi, hapū, whānau and Māori communities to develop strategies for Māori health gain and appropriate health and disability services
- participation – involving Māori at all levels of the sector, in decision-making, planning, development and delivery of health and disability services

- protection and improvement of Māori wellbeing – working to ensure Māori have at least the same level of health as non-Māori and safeguarding Māori cultural concepts, values and practices (Minister of Health and Associate Minister of Health 2002).

This background paper draws on an enormous body of national and international literature.

For the major nutrients this information is translated into food-based suggestions at the end of each chapter. Food serving sizes and samples of two sets of three-day meal plans have been provided in Appendix 1.

In 1999 the Ministry of Health released *NZ Food, NZ People: Key results of the 1997 National Nutrition Survey* (Ministry of Health 1999c) and this survey is described in Appendix 2. The results of this survey are used throughout to document current intakes, eating patterns and nutrition-related risk factors of New Zealand adults.

In 1991 New Zealand adopted, where practical, the Australian Recommended Dietary Intakes pending a comprehensive review of all the recommended levels by Australia or jointly with New Zealand. Throughout this text, where RDIs are detailed, they refer to the Australian value unless otherwise stated.

Part I: The New Zealand Food and Nutrition Guidelines

1 Background

The background papers and guideline statements of the Food and Nutrition Guidelines

In 1991 the New Zealand Nutrition Taskforce recommended the development of population-based food and nutrition guidelines for the New Zealand public. The first guidelines developed were the *Food and Nutrition Guidelines for Healthy Adults*. These were included in *Food for Health: Report of the Nutrition Taskforce* (Department of Health 1991). This report included a set of guideline statements. These statements were designed to be positive, food-oriented statements that gave health professionals and teachers simple, understandable guidance on healthy eating for the adult population of New Zealand.

Over the next four years, a series of six population-specific background papers were developed in addition to the *Guidelines for Healthy Adults*. They offered additional guideline statements for specific population groups. These population groups include:

- healthy infants and toddlers (1992) reprinted in 2000*
- healthy children (1993) reprinted in 1997*
- healthy adolescents (1993) reprinted in 1998*
- healthy older people (1993) reprinted in 1996*
- healthy pregnant women (1995) reprinted in 1997
- healthy breastfeeding women (1995) reprinted in 1997 (Ministry of Health 1996, 1997a, 1997b, 1997c, 1998a, 2000b).

For each set of population-specific guidelines, a technical background paper to support professionals in the use of the guidelines was developed, as were simplified health education pamphlets for the general public.

In December 2000 the Ministry of Health recommended to the Food and Nutrition Advisory Committee that the Food and Nutrition Guideline statements should be modified. The Committee agreed to the proposed changes. During a public consultation process for the *Food and Nutrition Guidelines for Healthy Adults: A background paper*, comment was sought on the guideline statements. Feedback was, for the most part, positive. The guideline statements have been modified to take account of suggestions raised in the consultation and are as follows.

New Zealand Food and Nutrition Guideline statements

1. Maintain a healthy body weight by eating well and by daily physical activity.*
2. Eat well by including a variety of nutritious foods from each of the four major food groups each day.
   - Eat plenty of vegetables and fruits.
   - Eat plenty of breads and cereals, preferably wholegrain.
   - Have milk and milk products in your diet, preferably reduced or low-fat options.
   - Include lean meat, poultry, seafood, eggs or alternatives.
3. Prepare foods or choose pre-prepared foods, drinks and snacks:
   - with minimal added fat, especially saturated fat
   - that are low in salt; if using salt, choose iodised salt
   - with little added sugar; limit your intake of high-sugar foods.
4. Drink plenty of liquids each day, especially water.
5. If choosing to drink alcohol, limit your intake.
6. Purchase, prepare, cook and store food to ensure food safety.

* At least 30 minutes of moderate intensity physical activity on most if not all days of the week and if possible add some vigorous exercise for extra health and fitness.

Food groups and the nutrients they provide

The Food and Nutrition Guideline statements refer to the four food groups. Table 1 gives a broad indication of the main nutrients supplied by each food group. Not all the foods within each group will contain all these nutrients. See Appendix 1 for serving sizes of foods within the food groups and for examples of three-day meal plans to achieve these guidelines.

* Reprinted and reviewed.

Table 1: The four food groups, advice on number of servings and the nutrients they provide for New Zealand adults

Advice	Food group	Nutrients provided
Eat at least five servings per day; at least three servings of vegetables and at least two servings of fruits	**Vegetables and fruits*** (includes fresh, frozen, canned and dried) (only one serving of vegetable or fruit juice or dried fruit counts) If trying to control energy intake, do not eat too much dried fruit and drain syrup from canned fruit	Carbohydrates Dietary fibre Vitamins: especially A (yellow and green vegetables), C (dark green vegetables and most fruits, potatoes) and folate Minerals: magnesium, potassium
Eat at least six servings per day (try to choose wholegrain)	**Breads and cereals** (includes all breads, grains, rice, and pasta)	Protein Carbohydrates Dietary fibre Vitamins: all B group (except B_{12}), E (rich in wheat germ) Minerals: magnesium, calcium, iron, zinc and selenium (wholegrain products)
Eat at least two servings per day (choose low or reduced fat options)	**Milk and milk products** (includes cheese, yoghurt and ice cream)	Protein Fats: higher proportion of saturated than poly- or mono-unsaturated fats especially in full fat products Vitamins: riboflavin, B_{12}, A Minerals: especially calcium, phosphorous, zinc and iodine
Eat at least one serving per day	**Lean meat, poultry, chicken, seafood, eggs, nuts and seeds and legumes**	Protein Fats: both visible and marbled in meat (mostly saturated fat, cholesterol); mostly unsaturated fats in seafood, nuts and seeds Carbohydrates: mainly legumes (dried peas and beans) Vitamins: B_{12}, niacin, thiamin Minerals: iron, zinc, magnesium, copper, potassium, phosphorous and selenium

* See the Glossary for definitions of 'vegetable' and 'fruit'.

Source: Modified from Department of Health 1991

New Zealand Recommended Dietary Intakes

One of the requirements of the Nutrition Taskforce was to update the recommendations for selected nutrient levels for New Zealanders, which were first set in 1983 (Nutrition Advisory Committee 1983). The Taskforce recommended that, as an interim measure, the 1990 Australian Recommended Dietary Intakes (RDIs) be adopted where practical. This recommendation was accepted and New Zealand has used these RDIs since then. Reference to RDIs in the text is specific to these RDIs, unless otherwise stated (Truswell et al 1990).

In November 2002 a joint Australia-New Zealand review of Nutrient Reference Values (NRVs) commenced. New Zealand has recently completed the technical reports on selenium and iodine NRVs which will contribute to this process. The review is being overseen by the National Health and Medical Research Council of Australia (NHMRC) and is expected to be completed in 2005.

The Australian RDIs are included in Appendix 3.

Recommended energy intakes

Recommended energy intakes are based on estimates of the average requirement of a group of comparable individuals. This focus differs from that of other recommended nutrient intakes that are set to exceed the needs of all but 2 to 3 percent of the population (FAO et al 1985).

Part II: Nutrients, Food and Drinks

2 Energy

Background

Energy intake

Fat, protein, carbohydrate (macronutrients) and alcohol from food and drinks are the only sources of energy for humans. They are broken down in the body to provide energy, measured in kilojoules, in the amounts shown in Table 2.

Table 2: Energy factors used in the National Nutrition Survey 1997 to determine energy provided by different food sources

Food source	Energy (kJ) provided by 1 g
Carbohydrate	16.7
Fat	37
Protein	16.7
Alcohol	29

Food energy is used by the body for metabolic processes, physiological functions, heat production, growth, and synthesis of new tissues. It is also the source of energy for physical activity. Excess energy intake is stored as fat, which can lead to overweight and obesity. In extreme cases, insufficient energy intake results in the body using its sources of stored energy (fat) and leads to muscle wasting and a slowing of all body functions.

Energy expenditure

There are three components to energy expenditure:

- the **basal metabolic rate** (BMR), which is the energy required to sustain metabolism
- the **thermic effect of food** (TEF), which is the energy expended in converting food to nutrients
- the energy required for physical activity.

The BMR accounts for 50 to 70 percent of daily energy expenditure. The TEF accounts for a further (fairly constant) 10 percent. Energy expenditure for physical activity is defined as the increase in metabolic rate above BMR and TEF. It is the most variable component of energy expenditure. In affluent countries, it accounts for 20 to 40 percent of total energy expenditure (van Raaij 2002). The energy expenditure from physical activity is dependent on the frequency, intensity, duration and type of activities undertaken throughout the day. Physical activity is therefore a key component of energy balance. See also: Chapter 18, Physical activity.

Energy balance

Energy balance is achieved when the energy from the intake of food and drinks equals the energy expended for metabolic processes and during physical activity. A change in energy intake or output leads to positive or negative energy balance. Positive energy balance results in body tissue being deposited as fat and an increase in body weight. A negative energy balance results

in body tissue being mobilised and a loss of body weight. The amount of food eaten and the amount of physical activity undertaken determine the state of energy balance (van Raaij 2002).

The mean body weight of New Zealand adults increased from 71.3 kg in 1989 to 74.5 kg in 1997 Ministry of Health 1999c). The increase for males and females was 2.6 kg and 3.6 kg respectively. As no data were collected on energy expenditure in the NNS97, it is not known whether the increase in body weight was the result of increases in energy intake or decreases in energy expenditure, or a combination of both (see: 'Energy intakes in New Zealand' below).

An increase in body weight, particularly in body fatness, may have important implications for the health status of New Zealand adults. Specifically, it may increase the risk of diseases such as obesity, cardiovascular diseases, type 2 diabetes and some cancers. See also: Chapter 12, Obesity.

Effects of energy balance on body mass and composition

The state of energy balance can be assessed by changes in body weight and body composition. Body mass index (BMI) is one measure used to quantify changes in energy balance. BMI is calculated using the following equation:

$$\text{BMI} = \text{weight (kg)}/\text{height (m}^2\text{)}$$

The World Health Organization (WHO) defines a healthy range of BMI as 18.50 to 24.99 kg/m^2. Pre-obesity (overweight) is defined as a BMI range of 25.00 to 29.99 kg/m^2 and obesity as 30.00 kg/m^2 or above (WHO 2000). These BMI ranges were used for New Zealand European and Others in the NNS97. A healthy BMI range for Māori and Pacific peoples was defined as 18.50 to 25.99 kg/m^2. Overweight was defined as BMI 26.00 to 31.99 kg/m^2 and obesity as 32.00 kg/m^2 or above (Ministry of Health 1999c). See also: Chapter 12, Obesity.

Recommended energy intakes for adults

Recommendations for energy intakes for adults are more difficult to determine than the equivalent recommendations for most nutrients. The difficulty lies in the wide range of requirements, even among individuals of the same age, sex, weight, height and general pattern of activity (Truswell et al 1990). Recommended energy intakes for healthy individuals are based on estimates of the average requirement of a group of comparable individuals. In contrast, other recommended nutrient intakes are set to exceed the needs of all but 2 to 3 percent of the population (FAO et al 1985).

The Australian recommended energy intakes for adults are given in Table A3.2 in Appendix 3. The recommendations vary by age and gender for a given height and weight. The United States Dietary Reference Intakes (DRIs) and a reference for recommendations for energy in 30-year-old adults are given in Appendix 4 and the United Kingdom (Department of Health (UK) 1991) values are shown in Appendix 5.

Energy intakes in New Zealand

Males generally have a greater average proportion of lean body mass than females. This, combined with a larger average body size, means males require a higher energy intake than females to maintain energy balance. Therefore the daily median intake of energy for males is higher than for females. The usual daily median energy intakes of New Zealand males and females as measured by the NNS97 are shown in Table 3.

Table 3: Energy intakes in New Zealand

	Usual daily median energy intake kJ/day (kcal/day)
Males	11,631 (2769)
Females	7701 (1834)

Source: Ministry of Health 1999c

Males and females aged 19 to 24 years had the highest median energy intake (males 13,037 kJ, females 8783 kJ). Energy intake decreased gradually with advancing age. There were no clear differences in energy intake between different socioeconomic groups (Ministry of Health 1999c).

Comparing the energy intakes measured by NNS97 with those of the 1989 Life in New Zealand (LINZ) survey, it appears that mean daily energy intakes have increased. Whether this is a 'true' increase in energy intake cannot be determined because the differences in sampling and methodology would be expected to increase reported energy intakes. What can be concluded is that the proportion of high-energy consumers has increased (Ministry of Health 1999c).

Sources of energy in the diet

The principal sources of energy in the New Zealand diet are: bread (11 percent); potatoes and kümara, including fat added when cooking (7 percent); butter and margarine (6 percent); and milk, alcoholic beverages, cakes and muffins, non-alcoholic beverages, and sugar/sweets (all 5 percent) (LINZ Research Unit 1999).

The ratio of energy supplied by fat, carbohydrate and protein has continued to change (Ministry of Health 1999c). The proportion of energy from fat has decreased as shown in Table 4.

Table 4: Percentage contribution to energy from macronutrients

	Percentage contribution to energy		
Nutrient	1977[1]	1989[2]	1997[3]
Fat	43	37	35
Carbohydrate	40	44	46
Protein	14	15	16

Sources: [1] Birkbeck 1983; [2] Russell and Wilson 1991; [3] Ministry of Health 1999c

Practical advice

- Adjust food intake and energy output to maintain energy balance.
- To reduce dietary energy intake it is important *not* to remove the foods that contribute important nutrients (vegetables and fruits, wholegrain breads and cereals, milk and milk products, meat, eggs and legumes) but to choose low-fat alternatives.
- Do not add sugar or fat to foods where possible. Spreads for breads should be the lower fat and sugar options.
- Reduce or limit the intake of foods that are high in energy (kilojoules) but low in essential nutrients, such as snack foods and convenience food and drinks including cakes, chips,

biscuits, confectionery (sweets and lollies), soft drinks (including carbonated beverages) and drinks containing alcohol.

- Do at least 30 minutes of moderate intensity physical activity on most if not all days of the week. If possible add some vigorous exercise for extra health benefit and fitness.

See also: Chapter 4, Carbohydrate; Chapter 5, Fat; Chapter 11, Alcohol; Chapter 12, Obesity; and Chapter 18, Physical activity.

3 Protein

Background

Proteins are composed of amino acids. There are 20 common amino acids, which make up most proteins. The body can synthesise some amino acids, whereas the 'essential' amino acids must be obtained from food. Proteins are necessary to build and repair tissue; in hormone, enzyme and antibody synthesis; and for many other body functions. Proteins are found in both animal foods (meat, seafood, chicken, eggs, milk and milk products) and plant foods (legumes, cereals and nuts).

Recommended protein intakes for adults

The 1985 FAO-WHO Consultation in Human Nutrition (FAO et al 1985) estimated the daily protein requirement for healthy adults to be 0.6 g/kg per day. The safe level of intake was set at 0.75 g/kg per day in order to cover the protein needs of 97.5 percent of the population (FAO et al 1985). The RDIs for protein for adult New Zealanders are 45 g for women and 55 g for men, based on the value of 0.75 g/kg per day. These amounts equate to approximately 11 to 15 percent of energy being derived from protein (Jackson 2002).

Vegetarian diets are generally adequate in protein because the proteins of dairy products, eggs, legumes, nuts, breads and cereals are rich in essential amino acids. Plant-based diets generally include legumes, nuts and seeds, low-fat milk and/or soy products and eggs. A combination of different plant foods each day should ensure sufficient protein in a vegetarian diet (Read 1997).

Protein intakes in New Zealand

The protein intake of New Zealand adults is 15 to 16 percent of total energy, as shown in Table 5. According to the NNS97 the dietary protein intake of most New Zealand adults is high at almost double that of the United Kingdom Reference Nutrient Intake (RNI; see Appendix 5), but very similar to the intake of adult Australians (Department of Health (UK) 1991; Australian Bureau of Statistics 1998). Protein intake provides a fairly constant proportion of energy across age, sex and ethnic groups.

Table 5: Protein intakes in New Zealand

	Usual daily median intake (g)	Percentage contribution to energy
Males	105	15
Females	71	16

Source: Ministry of Health 1999c

High-protein low-carbohydrate diets

High-protein low-carbohydrate diets, while not new, have recently regained popularity. These diets advocate the restriction of carbohydrate foods such as breads and cereals and sometimes vegetables and fruits, while increasing intakes of foods such as meat, milk and sometimes fats. The proposed beneficial effects claimed of these diets include lower rates of obesity, cardiovascular disease and diabetes, and lower blood cholesterol levels.

Much of the evidence in favour of such diets is circumstantial. Further research is required before concluding that there are any advantages of higher protein diets (Dietitians Association of Australia 2000). In a recent review article (Bravata et al 2003) it was found that there was insufficient evidence to make recommendations for or against the use of low carbohydrate diets. Among the published studies, decreased energy intake rather than low carbohydrate diets themselves was the factor associated with weight loss.

Sources of protein in the diet

The principal sources of protein in the New Zealand diet are beef and veal (14 percent); bread (11 percent); milk (10 percent); poultry and fish/seafood (both 7 percent); and bread-based dishes and pork (both 5 percent) (LINZ Research Unit 1999). Lean meat, chicken, seafood, eggs, low-fat milk, reduced-fat cheese, and dried peas, beans and lentils are all good sources of protein. These foods may be used as part of a balanced diet to ensure adequate protein intakes.

Practical advice

- Protein in the diet is provided by a wide range of available foods, including lean meat, chicken and seafood, eggs and milk. Bread is also an important source.
- Choose low and reduced-fat options from the meat and milk food groups where possible.
- If vegetarian, include protein from diverse plant sources (legumes, nuts, breads and cereals). If lacto-ovo vegetarian, also include eggs and milk products.

4 Carbohydrate

Background

Carbohydrates provide the largest single source of energy in the diet. Carbohydrates (in the form of glucose) are an easily available form of energy. They maintain blood glucose levels and have a role in gastrointestinal health and functioning. Excess energy intake from carbohydrate in the form of added sugars (especially high-sugar beverages) may contribute to overweight or obesity.

Too little carbohydrate in the diet can result in an imbalance in the blood known as ketosis or keto-acidosis. As the amount of carbohydrate required to avoid ketosis is very small (about 50 g per day), only the most restricted diets risk this condition. Carbohydrate usually provides most of the energy in any diet.

Classification of carbohydrates

Several classifications of carbohydrates are currently in use. The FAO-WHO Expert Consultation has recommended that terminology be standardised and classification be based primarily on molecular size. Specifically, all carbohydrates should be classified as sugars (called monosaccharides, disaccharides and polyols), oligosaccharides and polysaccharides (FAO and WHO 1998). Table 6 shows a classification of dietary carbohydrates.

Table 6: Classification of major dietary carbohydrates in the diet

Class (number of carbons in the molecule)	Sub-group	Examples
Sugars (1–2)	Monosaccharides	Glucose, galactose, fructose
	Disaccharides	Sucrose, lactose, trehalose
	Polyols	Sorbitol, mannitol
Oligosaccharides (3–9)	Malto-oligosaccharides	Maltodextrins
	Other oligosaccharides	Raffinose, stachyose, fructo-oligosaccharides
Polysaccharides (≥ 9)	Starch	Amylose, amylopectin, modified starches
	Non-starch polysaccharides	Cellulose, hemicellulose, pectins, hydrocolloids

Source: Adapted from FAO and WHO 1998

Sucrose and other sugars

The term **sugars** is used to describe the mono-, di- and oligosaccharides. **Sugar**, by contrast, is used to describe the most common disaccharide, purified sucrose. Other terms used are **refined sugar** and **added sugar** (FAO and WHO 1998). Sucrose is extracted from sugar cane and sugar beet and is naturally present in variable amounts in vegetables and fruits. Two other sugars that are added to many foods, often in a syrup form, are fructose and glucose. Fructose is a very sweet sugar.

Almost universally, humans appear to find sweetness a pleasant sensation. Although there is no direct evidence to support the hypothesis that a high sucrose intake causes obesity, the FAO-WHO Expert Consultation has reiterated that excess energy in any form could contribute to the accumulation of body fat (FAO and WHO 1998; WHO and FAO 2003).

There is a strong link between dental health and sucrose (sugar) intake. Foods containing sugars or starch may be easily broken down to produce acid, which increases the risk of dental caries. However, the impact of sugars and starch on dental caries is dependent on many factors. Rather than only addressing the consumption of sucrose to eliminate dental caries, health promotion initiatives should also emphasise fluoridation, adequate oral hygiene and reduction of the frequency of sucrose intake (see: 'Fluoride' in Chapter 9, Other nutrients) (FAO and WHO 1998).

Polysaccharides

The term **complex carbohydrates** was traditionally used to describe either starch alone or the combination of all polysaccharides. It was coined to encourage the consumption of what were considered to be the 'healthy' carbohydrates, such as wholegrain cereals and legumes. However, it becomes meaningless when used to describe vegetables and fruits, which may be low in starch. It is now clear that starch (by definition a complex carbohydrate) is variable metabolically (see: 'Non-starch polysaccharides and resistant starch' below). Some forms of starch are rapidly absorbed and have a high glycaemic index, while others are resistant to digestion.

Non-starch polysaccharides and resistant starch

The carbohydrate polymers that originate from plant-cell walls are collectively called non-starch polysaccharides (NSPs). They provide structure to plant tissues, and are chiefly responsible for the texture of vegetable foods. NSPs are found in legumes (peas, dried beans, and lentils), wholegrain cereals (barley, wheat, rye, oats, brown rice), and vegetables and fruits. The concentration of cell-wall components is highest in the outer layers of plant foods. Presumably they perform a protective function for the endosperm, which is rich in starch and protein. Peeling vegetables and fruits or milling cereals lowers their NSP content significantly.

Water-insoluble NSPs are the most important contributors to faecal weight. Increasing consumption of foods rich in these kinds of NSPs (such as wheat bran, cereals and vegetables) is an effective means of preventing and treating constipation, haemorrhoids, diverticular disease, irritable bowel syndrome and anal fissures. High intakes of NSPs may also protect against gallstones (FAO and WHO 1998).

Water-soluble NSPs are found in peas, oats, dried beans, lentils, barley, pasta and fruits. They reduce the glycaemic index of carbohydrate foods, increase bile acid excretion and may reduce low density lipoprotein (LDL) cholesterol levels (Baghurst et al 1996). Soluble and viscous NSP components in diets may delay the absorption of sugars from food and improve metabolic control of glucose. NSP and resistant starch are fermented in the colon, where they stimulate the proliferation of bacteria, resulting in bulky stools. They also have a laxative-promoting effect.

Resistant starch occurs naturally. It can also be produced by the modification of starch during the processing of foods (Institute of Medicine 2002b). Resistant starch is defined as 'starch and starch degradation products not absorbed in the small intestine in healthy humans' (Englyst et al 1992). Most of the health benefits of resistant starch relate to its impact on the colon. Resistant starch increases bowel action due to its mild laxative effect. It also increases the beneficial microflora of the bowel; reduces secondary bile acids in the faeces; beneficially lowers faecal pH; and increases the level of short-chain fatty acids (especially butyrate and propionate) in the faeces (Baghurst et al 1996). A proportional, high butyrate supply is thought to be important for the health of the large bowel epithelium (Brand-Miller 2002). The role of resistant starch and NSP in protecting against colorectal cancer remains to be confirmed in clinical trials.

Foods that are high in resistant starch are cereals, potatoes, green bananas and legumes.

Dietary fibre

Dietary fibre is a term that is still in common usage even though some nutritionists have replaced it with other terms. A precise definition of dietary fibre remains to be established. The new North American definition of dietary fibre refers not only to the NSP component of dietary fibre but to non-carbohydrates such as lignin and psyllium (Institute of Medicine 2002b). For New Zealand dietary fibre intakes in the NNS97 refer to NSP intakes only.

Cereals, legumes, vegetables and fruits are the main sources of dietary fibre.

Glycaemic index

The glycaemic index (GI) can be used to classify foods based on their potential to raise blood-glucose levels. Some foods, classified as high GI foods, break down quickly during digestion and their blood glucose response is fast. Low GI foods break down slowly, releasing glucose gradually into the blood stream (Brand-Miller et al 1996; Brand-Miller 2002).

Individuals vary in their capacity to metabolise glucose after eating. People with diabetes, for example, have an impaired capacity to clear glucose from the blood – a process that is under the control of the hormone insulin. The GI is valuable in planning diets for people with diabetes where it is important to maintain blood glucose levels within the normal range.

Studies conducted in people with hyperlipidaemia, and people with and without diabetes, have found that low GI meals and snacks can improve biochemical indices, particularly blood glucose concentrations and insulin secretion (Wolever et al 1991, 1992; Frost et al 1996; Wolever 1997). The carbohydrate in low GI foods is generally less digestible than that in high GI foods because low GI foods increase the amount of carbohydrate progressing to the colon. This increase, in turn, increases colonic fermentation and short-chain fatty acid production (Brand-Miller et al 1996). The GI of foods needs to be evaluated in conjunction with other dietary constituents and recommendations. The GI has its limitations as high-fat foods have a low GI and may not confer nutritional benefits when consumed.

Recommended carbohydrate intakes for adults

The WHO–FAO Expert Consultation (2003) recommends that an optimum diet derives at least 55 percent of total energy from a variety of carbohydrate sources. It also recommends that free sugars that are added to foods by the manufacturer, cook or consumer plus the sugars naturally present in honey, syrups and fruit juices should be restricted to less than 10 percent of total energy. The New Zealand Nutrition Taskforce recommends that New Zealand adults obtain 50 to 55 percent of total energy from carbohydrate. Sucrose and other free sugars should be restricted to no more than 15 percent of total energy because of the potential problems associated with excess energy and dental caries.

The recommended guideline for dietary fibre in New Zealand is 25 to 30 g per day (Department of Health 1991). This recommended dietary fibre intake was based on a definition of fibre that included resistant starch and other components in addition to NSP. Because the NNS97 dietary fibre intake data are NSP only, direct comparison is inappropriate.

Carbohydrate intakes in New Zealand

Only 36 percent of the adult population met the recommended intake of 50 to 55 percent of carbohydrate as a proportion of total energy. The average New Zealander consumes 45 to 47 percent of energy as carbohydrate, as shown in Table 7 for carbohydrate intake and Table 8 for

total sugar intake (Ministry of Health 1999c). Table 9 shows intakes of sucrose in New Zealand. Carbohydrate intakes show no consistent pattern across age groups.

Table 7: Carbohydrate intakes in New Zealand

	Usual daily median intake (g)	Percentage contribution to energy
Males	305	45
Females	214	47

Source: Ministry of Health 1999c

Table 8: Total sugar intakes in New Zealand

	Usual daily median intake (g)
Males	131
Females	99

Source: Ministry of Health 1999c

Table 9: Sucrose intakes in New Zealand

	Usual daily median intake (g)
Males	62
Females	45

Source: Ministry of Health 1999c

Principal sources of carbohydrate in the New Zealand diet are bread (20 percent); non-alcoholic beverages (10 percent); potatoes and kūmara (10 percent); sugar/sweets (9 percent); and fruits (8 percent) (LINZ Research Unit 1999).

Only about one in five of the population is reaching the New Zealand Nutrition Taskforce recommendation of at least six servings of breads and cereals per day (Ministry of Health 1999c). For females, the main sources of carbohydrate are vegetables and fruits. Males consume more carbohydrate as breads and cereals. Median dietary fibre intake as NSP is 20 g, with the specific figures for males and females shown in Table 10. Approximately half the NSP intake is as insoluble NSPs and half as soluble NSPs. A low intake of breads and cereals among women may be related to misunderstandings about the energy density of carbohydrate foods.

Table 10: Dietary fibre intakes in New Zealand

	Usual daily median intake (g)
Males	23
Females	18

Source: Ministry of Health 1999c

Although only about one-third of New Zealanders are meeting the New Zealand Nutrition Taskforce target for carbohydrate intake (50 to 55 percent of total energy), there is a general trend towards increasing carbohydrate intake. Increases in carbohydrate came from increased consumption of pasta, rice, soft drinks, chocolate and other confectionery. There was also increased consumption of some vegetables and fruits (pears, feijoas, melon, bananas, grapes, broccoli and capsicum). However, this growth was offset by a decrease in other vegetables and fruits (green beans, pumpkin, peas, cabbage, beetroot, avocado, bean sprouts, grapefruit, pineapple, canned fruit in syrup, raisins and stewed fruit) (Ministry of Health 1999c).

Sources of carbohydrates in the diet

Foods rich in carbohydrates include cereal grains, starchy vegetables, leguminous seeds and wholegrain cereals, all of which contain reasonable proportions (3 to 15 percent) of non-starch polysaccharides. Most other vegetables, as well as most fruits, contain small amounts of both starch and NSP, together with variable amounts of sugars. Only a few foods that are not highly processed, such as honey and dried fruits, contain a significant amount of sugars. Many processed foods contain added sugars, usually sucrose. The principal sources of sugar in the NNS97 were non-alcoholic beverages, sugar and sweets, and fruits.

New Zealand adults should be encouraged to achieve a desirable carbohydrate intake by increasing consumption of vegetables, fruits, legumes, and breads and cereals. The adult guideline is at least six servings of breads and cereals, at least three of vegetables and two of fruits.

Practical advice

- Eat a variety of foods that provide carbohydrate, including breads, cereals and legumes.
- Include wholemeal/wholegrain breads and cereals in the diet.
- Eat plenty of vegetables and fruits.
- Remember that plant foods such as cereals, breads, vegetables, fruits and legumes are good sources of dietary fibre.
- Choose food and drinks that are low in sugar to avoid excess energy intake. Remember that non-alcoholic beverages such as soft drinks and fruit juices are a dietary source of sugar.
- Sweets, honey, sweet spreads and dried fruits are concentrated sources of sugar.
- Keep high-sugar foods such as cakes and sweets for treat foods.
- To reduce dental decay, restrict the frequency of eating foods and drinking beverages with a high sugar content. If eating sugary foods, take them at mealtimes instead of as snacks between meals.

See also: Chapter 10, Fluids.

5 Fat

Background

Fats make an important contribution to adequate nutrition and are a source of essential fatty acids. They also provide the mechanism for the absorption of the fat-soluble vitamins (Mann and Skeaff 2002). Associated nutrients are the fat-soluble vitamins A, D, E and K. Dietary fat carries these vitamins and facilitates their absorption. Any conditions that interfere with fat absorption will also limit the absorption of fat-soluble vitamins. Dietary fat is a concentrated energy source compared to carbohydrate and protein. Fat carries food's flavour components, assists with satiety and enhances palatability.

One major health concern for adults in western countries is excessive dietary fat intake. This concern applies particularly to saturated fat, which increases the risk of obesity, cardiovascular diseases, type 2 diabetes and hypertension (NHF 1999). A high-fat intake has also been associated with colorectal cancer (Baghurst et al 1997).

Classification of fats

All fats are a mixture of saturated and unsaturated fatty acids. Triglycerides are the predominant component of fats and oils. Triglycerides are made up of one unit of glycerol combined with three fatty acids, which may be different or the same. Most fatty acids are synthesised in the body. The exceptions are the essential fatty acids (EFA), linoleic and alpha-linolenic acids, which must be obtained from food in the diet. The differences in physical properties between one fat and another are due to the fatty acids they contain. The structure of the fat molecule determines whether a fat is classed as **saturated** or **unsaturated**. **Unsaturated fats** (fatty acids) can be further divided into **mono-unsaturated** and **poly-unsaturated** fatty acids.

Saturated fatty acids

Certain saturated fats increase total blood cholesterol and low-density lipoprotein (LDL) cholesterol, promote postprandial lipaemia (blood fat levels after eating) and, through their action on platelet adhesion, encourage thrombosis (NHF 1999). Saturated fatty acids are found largely in animal products. Dairy products such as butter, full-fat milk and cheese contain a large proportion of saturated fats. Meat fats are a mixture of all types of fatty acids but are predominantly saturated and mono-unsaturated. Most plant sources of fats are largely mono-unsaturated and/or poly-unsaturated fats. The exceptions are coconut and palm oil which contain largely saturated fats. A reduction in consumption of products containing largely saturated fats, such as high-fat dairy products, is an important means of reducing the risk of coronary heart disease (Mann 2002).

Of the ways in which diet can be used to influence the risk factors for coronary heart disease, controlling the level of plasma LDL cholesterol remains the best established. This risk factor has been found to be significant in at least 50 prospective studies involving more than 600,000 subjects in 18 countries (NHMRC 2003).

Mono- and poly-unsaturated fatty acids

Unsaturated fatty acids include mono-unsaturated and poly-unsaturated fatty acids. Plant foods and seafood are usually a mixture of these two types of fatty acids.

Mono-unsaturated fats decrease blood total cholesterol and LDL cholesterol, with little effect on high-density lipoprotein (HDL) cholesterol. HDL has been of interest as a protective factor in coronary heart disease (Mann 2002). Mono-unsaturated fats appear to be more resistant to

oxidation than poly-unsaturated fats (NHF 1999). Examples of foods rich in mono-unsaturated fatty acids are olive oil, canola oil, macadamia nuts, pistachios, hazelnuts, almonds and avocado oil.

Poly-unsaturated fats can be divided into omega-6 and omega-3 fatty acids. As mentioned above, there are two essential fatty acids – linoleic acid (an omega-6 fatty acid) and alpha linoleic acid (an omega-3 fatty acid) – that humans cannot synthesise. There are also several other biologically important long chain fatty acids (arachadonic, eicosapentaenoic and docosahexanoic) that can, under certain conditions, be synthesised by humans from these essential fatty acids. Omega-6 fatty acids are found predominantly in sunflower seed, soyabean and corn oils. They can lower total and LDL-cholesterol. The omega-3 fatty acids are derived from oily fish or plant products such as soybean, mustard, walnut, canola and linseed (flax) oils. Fish and fish oils may reduce blood pressure. They have also been associated with a reduction in thrombosis, although results are inconsistent (NHF 1999).

Trans fatty acids

Trans fatty acids sometimes form during hydrogenation of vegetable oils in the production of some margarines. They are also formed in small quantities during deep frying, and can occur naturally in small amounts in some foods such as butter. Trans fats, although unsaturated, may have metabolic effects similar to those of saturated fatty acids. The adverse metabolic effects include increasing total and LDL-cholesterol, increasing lipoprotein, and decreasing HDL-cholesterol (ASCN-AIN 1996). They are found in some margarines and in manufactured foods that contain fat as an ingredient, such as biscuits, cakes, chocolates and convenience foods. However, most table spreads now available in New Zealand and Australia only contain a small proportion of trans fatty acids (Table spreads 2002).

Recommended fat intakes for adults

In considering the lower limits of acceptable fat intake, four criteria must be met:

- sufficient fat intake to meet energy needs
- an adequate supply of essential fatty acids
- an adequate absorption of fat-soluble vitamins (Jéquier 1999)
- a suitable balance of the different types of fatty acids (Eyres 2000).

For most adults, oils and fats should supply at least 15 percent of their energy intake (Jéquier 1999). Women of reproductive age should consume at least 20 percent of their energy from fat (FAO and WHO 1993).

The New Zealand Nutrition Taskforce recommended that the proportions of total energy supplied by different sources of fats should be:

- total fat: 30 to 33 percent
- saturated fatty acids plus trans fatty acids: no more than 12 percent
- poly-unsaturated fatty acids: approximately 6 to 10 percent
- mono-unsaturated fatty acid: from 10 to 20 percent (Department of Health 1991).

Vegetarian diets can be low in omega-3 fatty acids. It is recommended that vegetarians include some good sources of these fatty acids in their diets (American Dietetic Association 2003).

Fat intakes in New Zealand

The NNS97 results for males and females are shown in Table 11. The contribution to energy intake from fat has fallen from 37 percent in 1989/90 to 35 percent in 1997. However, the fat intakes of New Zealand adults are still above the upper limit of the levels recommended (Ministry of Health 1999c). Consumption of food containing saturated fatty acids still predominates (at 15 percent of total energy) and is above the recommended level. Consumption of food containing poly-unsaturated (at 5 percent of total energy) and mono-unsaturated fatty acids (at 11 to 12 percent total energy) needs to be increased to meet the recommendations.

More females (43 percent) than males (37 percent) met the 1991 New Zealand Nutrition Taskforce target for the contribution of total fat from energy (≤ 33 percent). However, the percentage meeting this target may have been overestimated as the figures were not adjusted for intra-individual variation (Ministry of Health 1999c).

Table 11: Fat intakes in New Zealand

	Usual daily median intake (g)	Percentage contribution to energy
Males	110	35
Females	72	35

Source: Ministry of Health 1999c

The principal dietary sources of total fat in the New Zealand diet are butter and margarine (16 percent); potatoes and kūmara cooked in fat or oil, beef and veal, milk, cakes and muffins (all 6 percent); pies and pastries, bread-based dishes (including sandwiches) and sausages and processed meat (all 5 percent) (LINZ Research Unit 1999).

Discretionary additions of butter and margarine to food immediately prior to consumption have been analysed by Simpson et al (2002) using the NNS97 24-hour recall dataset. Results showed that discretionary addition of fat to food contributed 22.5 percent of the total fat intake of New Zealanders and that butter/margarine made up the largest contribution to this proportion (44 percent).

Reducing fat intakes

Difficulties cited by those trying to reduce the amount of high-fat food eaten were that 'they taste good' (32 percent), that 'low-fat food is not as enjoyable' (16 percent), 'convenience' (14 percent) and 'lack of willpower' (11 percent) (Ministry of Health 1999c).

As convenience becomes an increasingly important influence on dietary patterns, processed and pre-prepared foods appear to contribute more to fat and energy intakes. In NNS97, dairy products, meat, fish and poultry contributed 34 to 35 percent of total fat, while spreads, fats and oils contributed 20 to 21 percent. Excluding bread, at least 42 percent of fats came from processed foods (Ministry of Health 1999c). In contrast, in the 1977 survey, dairy products, meat, fish and poultry contributed 47 to 55 percent of total fat intakes, and spreads and fats over 22 percent. These earlier findings indicate that less than 30 percent of fats were derived from processed and prepared foods (Birkbeck 1983).

Simpson et al (2002) note that most of the discretionary additions of butter/margarine are made to bread. They also note that a reduction of fat intake for the New Zealand population may be possible by focusing on this food group.

Practical advice

While New Zealanders should be encouraged to continue to reduce the percentage of energy from fat, changing the type of fat consumed is also important for health. To reduce fat intake and change the types of fat eaten, New Zealanders can act as follows.

- Follow the recommended servings of the Food and Nutrition Guidelines in regard to breads and cereals (at least six servings per day), vegetables and fruits (at least five servings per day, of which at least three are vegetables and at least two are fruits), low-fat milk and milk products, yoghurt, cheese or ice cream (at least two servings per day) and lean meat, seafood, chicken, eggs or legumes (at least one serving per day).
- Choose snacks based on vegetables and fruits, breads and cereal and low-fat milk and milk products rather than potato crisps, biscuits or pastries.
- Trim all visible fat from meat, choose lean meat and remove the skin from chicken.
- Use less fat in cooking – grill, boil, steam or microwave as an alternative.
- When using fat, choose a vegetable oil or an oil high in mono-unsaturated fat such as olive, canola or avocado oil.
- Use less spread on bread and rolls. When using a spread, choose a poly-unsaturated or mono-unsaturated margarine instead of butter.
- Select lower-fat milk products such as reduced- or low-fat milk and yoghurt, cottage cheese or lower fat cheeses such as Edam and mozzarella.
- Prepare or purchase low-fat sauces and dressings for vegetables, salads and meat.
- Eat sausages, processed meat and luncheon meat less frequently, as they are high in fat, particularly saturated fats. If eating these meats, grill rather than fry them.
- Eat fried foods such as fried fish, fried chicken and chips only occasionally.
- When reducing fat in the diet, take care not to compensate by increasing sugar intake.

6 Iron

Background

Iron is present in haemoglobin and as a carrier of oxygen in the blood, in myoglobin in the muscle cells and also in many cell enzymes. The total body iron content is about 50mg/kg. Over 60 percent is in the haemoglobin of red blood cells and about 25 percent is in the form of stores, mainly in the liver (MacPhail 2002). In the adult population, iron needs are greatest among women of childbearing age, as iron lost through menstruation must be replaced (Bothwell and Charlton 1981).

Dietary iron and absorption

The quantity of iron absorbed in the body is controlled by gut absorption. The level of absorption is determined by:

- the iron requirements of the individual
- the amount of iron in the diet
- the presence of dietary factors that enhance or inhibit the absorption of iron.

The percentage of iron absorbed and utilised by the body (iron bioavailability) can vary from less than 1 percent to more than 30 percent (Hallberg 1981). The main factor controlling iron absorption is the amount of iron stores in the body. Iron absorption from the gastrointestinal tract increases when the body's iron stores are low, and decreases when stores are sufficient. A higher rate of red blood cell production can also stimulate iron uptake several-fold (Skikne and Baynes 1994; Bothwell 1995).

Iron absorption also depends on the food source. Haem iron from meat, poultry and fish is typically 20 to 30 percent absorbed. Non-haem iron, found primarily in non-animal sources (such as plant-based foods, iron supplements and iron fortificants in foods), is usually absorbed at 5 percent or less (Hallberg 1981; Skikne and Baynes 1994). Bioavailability of non-haem iron is affected by the presence of enhancers and inhibitors when they are consumed in the same meal, and by the iron status of the individual. Iron absorption enhancers include muscle proteins in meat, chicken, fish and seafood (which can enhance absorption of non-haem iron threefold), vitamin C (ascorbic acid), cysteine, alcohol and possibly certain organic acids such as lactic, tartaric and citric acid. Ascorbic acid can increase non-haem iron absorption by two to three times, depending on both the dose and the meal matrix (Hallberg and Hulthen 2000). When a variety of foods is consumed, ascorbic acid has a lower absorption-enhancing effect, particularly if meat is present.

Inhibitors of non-haem iron absorption include polyphenols in tea, coffee, and certain vegetables; phytates in unrefined cereals, nuts and legumes; and factors in soy protein. Single-meal studies have shown that calcium in milk, milk products and supplements inhibits non-haem and haem iron absorption (Hallberg et al 1991). However, the results of whole-diet studies have been conflicting, indicating that absorption is dependent on the iron status of the individuals studied (Gleerup et al 1995; Ilich-Ernst et al 1998). Vegetarian diets are low in readily available haem iron. However, by including enhancers of non-haem iron absorption, such as ascorbic acid, in the same meal, iron bioavailability in a vegetarian diet can be enhanced.

Iron deficiency

Table 12 shows the three stages that characterise the development of iron-deficiency anaemia: iron depletion, iron-deficient erythropoiesis and iron-deficiency anaemia. Each stage can be detected by using a combination of biochemical iron indices, preferably in conjunction with an index of infection/inflammation, such as serum C-reactive protein. Dehydration, strenuous

exercise, the presence of pathological conditions such as infection, inflammation or malignancy, and iron storage disorders may elevate serum ferritin and confound the interpretation of these indices.

Table 12: Spectrum of iron deficiency

Stage 1	Iron depletion	Low iron stores based on serum ferritin from 20–12 μg/L; normal haemoglobin
Stage 2	Iron-deficient erythropoiesis	Depleted iron stores based on serum ferritin < 12 μg/L; transferrin saturation < 16%; normal haemoglobin
Stage 3	Iron-deficiency anaemia	Anaemia (based on low haemoglobin) in the presence of iron deficiency (based on serum ferritin < 12 μg/L)

Source: Cook and Finch 1979

Iron status of New Zealand adults

The Dunedin longitudinal survey (Fawcett et al 1998) studied iron status in New Zealand. It found that for age groups on either side of adolescence, the prevalence of anaemia in predominantly European females (haemoglobin < 120g/L) increased from 3.1 percent at age 11 years to 5.8 percent at age 21 years. The prevalence of iron deficiency (ferritin < 12 μg/L) at age 21 years was 0.2 percent for men and 6.7 percent for women, while the prevalence of iron deficiency with anaemia was 0 percent and 2.2 percent respectively.

In another study of Dunedin women of childbearing age, important risk factors for mild iron deficiency (levels equivalent to Stage 1, iron depletion in Table 12) were:

- recent blood donation
- menstrual blood loss (both extent and duration of menstrual bleeding)
- nose bleeds
- low intake of meat, fish and poultry (Heath et al 1999).

Other risk factors for iron deficiency include:

- high parity
- previous diagnosis of iron-deficiency anaemia
- low iron intakes (vegan or vegetarian diets, etc)
- use of intra-uterine contraceptive devices (Galan et al 1998).

Intrauterine contraceptive devices (IUDs) induce high blood loss (Yip and Dallman 1996; Looker et al 1997). By contrast, oral contraceptive agents reduce menstrual blood loss, and have thus been associated with a lower risk of iron deficiency (Bothwell and Charlton 1981; Mooij et al 1992; Hallberg et al 1995).

The NNS97 indicated that low iron stores, iron deficiency and iron-deficiency anaemia mainly affected females in the 15 to 44 years age group. Males overall are not affected (Ministry of Health 1999c). The iron status of New Zealand women appears to be slightly superior to that of women from other western nations despite lower or similar iron intakes. Amongst those who are affected by sub-optimal iron status there is a potential for negative functional consequences (Ferguson et al 2001). Low iron stores, iron deficiency and iron-deficiency anaemia primarily affected females (6 percent, 3 percent and 2 percent respectively). Prevalence was highest among New Zealand Māori females (11 percent, 9 percent and 6 percent). Of males, only

4 percent of the 15 to 18 years group and 2 percent of the 75+ years group were considered to have low iron stores, iron deficiency and iron-deficiency anaemia (Ministry of Health 1999c).

Recommended iron intakes for adults

The RDIs for iron shown in Table 13 are based on the estimate that on average 15 to 20 percent of dietary iron is absorbed (Truswell et al 1990). Australian, United Kingdom and United States recommendations are given in Appendices 3 to 5. Inconsistencies among recommendations are due in part to the consideration of the dietary habits specific to a country or region, which influence the bioavailability of iron.

Table 13: Australian RDIs for iron (mg/day)

	19–54 years	54+ years
Female RDI (g)	12–16	5–7
Male RDI (g)	7	7

Iron intakes in New Zealand

Among males and non-menstruating females, estimates of the prevalence of inadequate intake are similar to those with low iron stores assessed with biochemical indicators (0 percent males, 6 percent females). However, for menstruating females, low iron stores range from 4 to 7 percent, considerably below the estimated prevalence of inadequate intake. Reasons for this finding may include overestimation of menstrual blood loss, underreporting of food intake and better than estimated absorption of dietary iron (Ministry of Health 1999c).

Vegetarianism

Based on the NNS97, 94 percent of all New Zealanders eat a diet that regularly includes animal products. Two percent of New Zealanders fall into the category of 'avoids meats except for chicken' (Ministry of Health 1999c).

The haemoglobin and serum ferritin levels of New Zealand vegetarians have been shown to be similar to those of non-vegetarians (Harman and Parnell 1998). Harman and Parnell (1998) reported that the dietary iron intake of the female vegetarians was slightly higher than that of non-vegetarians. Not surprisingly, the vegetarians gained a greater proportion of iron from vegetables and fruits than non-vegetarians.

Individuals choosing a vegetarian-eating pattern should choose foods rich in vitamin C at each meal to improve iron absorption. Eggs and cheese, although good sources of protein, do not have the same enhancing effect on non-haem iron absorption as muscle proteins in meat.

Iron supplements

Generally, iron supplements are only necessary when there is evidence of iron-deficiency anaemia or low iron stores. When iron supplements are required, they should be used under medical supervision. General practitioners and other health professionals should monitor iron deficiency status in at-risk women. In New Zealand this monitoring should include young Māori women.

Women of childbearing age and those at risk of iron deficiency should be encouraged to consume adequate amounts of iron-rich foods, including lean meat, poultry and seafood. It is also important that iron-rich foods are consumed with a dietary source of vitamin C, especially when

the iron is in the non-haem form (Department of Health 1991). In some cases, where recommended by a health professional, it may be appropriate for those at risk of iron deficiency to consume foods that have been fortified with iron, such as iron-fortified breads and cereals.

Sources of iron in the diet

The principal sources of iron in the New Zealand diet are bread (13 percent); beef and veal (12 percent); breakfast cereals (9 percent); vegetables (8 percent); and potatoes and kūmara (7 percent) (LINZ Research Unit 1999). The dietary intake of haem iron has been estimated to be just under one-third of the total intake and non-haem iron to be about two-thirds (Ministry of Health 1999c).

Practical advice

- Eat plenty of iron-rich foods. These may include lean red meat, liver, fish and chicken.
- If vegetarian, eat iron-containing foods from plant sources, such as beans and lentils.
- Breakfast cereals and vegetables are an important source of iron in New Zealand.
- To optimise iron absorption, include foods rich in vitamin C at mealtimes such as citrus fruits, kiwifruit, broccoli and potatoes.
- When trying to increase iron intake, minimise the consumption at mealtimes of food and drinks that inhibit the uptake of iron, such as phytates (bran) and polyphenols (tea, coffee). These foods should be eaten between meals.

7 Calcium

Background

Calcium is required to support the bone formation phase of bone remodelling, a process that continues throughout life. It also has a wide range of metabolic functions for muscle and nerve activity. Calcium is lost from the gut, in urine and through the skin.

Calcium absorption and excretion

The absorption of calcium from food in the gut is normally at a rate of less than 70 percent. The rate of absorption is affected by biological status; a higher need for calcium is likely to increase absorption. Calcium is also reabsorbed into the gut after excretion. One factor that is important for absorption is vitamin D status as this vitamin is required for the absorption of calcium. Other dietary factors such as oxalate, fibre and phytates may interfere with absorption.

Dietary sodium, protein, caffeine and acidifying agents raise calcium losses; and phosphorus, alkaline agents and some diuretics lower excretion (Goulding 2002). Physical activity also has an effect on bone retention of calcium. Regular moderate physical activity is good for calcium retention in bones whereas excessive physical activity with an inadequate diet is detrimental to bones.

Recommended calcium intakes for adults

Table 14 shows the RDIs for calcium. There is considerable controversy over the optimal daily dietary intake of calcium required to achieve peak bone mass, maintain adult bone mass and prevent loss of bone in later life. Based on United States balance data, the National Academy of Sciences recommends a daily intake of 1200 mg per day for men and women over age 50 (Institute of Medicine 1997). However, many people find it difficult to consume more than 1000 mg of calcium daily from foods.

Table 14: Australian RDIs for calcium (mg/day)

	19–54 years	54+ years
Female RDI (mg/day)	800	1000
Male RDI (mg/day)	800	800

Calcium intakes in New Zealand

The NNS97 indicates that the usual daily median intake of calcium is 766 mg (females 691 mg, males 857 mg). There are significant differences in calcium intake among individuals from different NZDep96 quartiles. Individuals from NZDep96 quartile IV (most deprived) areas have lower intakes, compared with those from quartile I (least deprived) and quartile II areas. Māori males were also found to have lower intakes than New Zealand European and Other males.

The estimated prevalence of inadequate calcium intake is 20 percent. A higher prevalence is observed among females (25 percent) than among males (14 percent), and higher among Māori (females 34 percent, males 24 percent) than among New Zealand European and Others (females 22 percent, males 11 percent) (Ministry of Health 1999c).

Sources of calcium in the diet

The principal dietary sources of calcium are milk (37 percent); cheese (11 percent); bread (6 percent); and vegetables, non-alcoholic beverages and dairy products (all 5 percent) (LINZ Research Unit 1999). Since 1996 permission to fortify some foods with calcium may have increased the calcium intake of New Zealanders.

Foods vary greatly in their calcium content. Milk has a particularly high calcium content. Other excellent sources include cheeses, yoghurt and fortified soy beverages. Good sources include milky dairy foods, nuts, canned fish with bones, leafy vegetables and dried fruits (Goulding 2002).

In some circumstances, if insufficient calcium is consumed because of dietary restrictions, supplementation of calcium may be used. This option is relevant for those who consume little or no milk or milk products (eg, those with lactose intolerance or allergies to milk and milk products) (American Dietetic Association 1996).

Practical advice

- Eat foods high in calcium such as low-fat milk and milk products, and lower fat cheese options.
- Non-milk sources of calcium in foods include wholemeal bread, peanuts, broccoli, fortified soy beverages, canned salmon, sardines, spinach, baked beans and tofu.
- Do at least 30 minutes of moderate intensity physical activity on most if not all days of the week. If possible, add some vigorous exercise for extra health and fitness.
- Prevent calcium losses by being smokefree, cutting down on salt, keeping alcohol consumption to a minimum and being physically active.

See also: Chapter 14, Hypertension; and Chapter 17, Osteoporosis.

8 Sodium

Background

Salt has long been a valuable commodity and an integral part of human life and culture.

Common salt is sodium chloride, each gram of which contains 17.1 mmol of sodium (Robinson 2002). Sodium is an important component of extracellular fluid. The physiological roles of sodium include maintenance of acid base balance, energy transfer mechanisms, the uptake of nutrients, and fluid balance within and outside cells (Department of Health (UK) 1991).

Sodium and health

High sodium intake (principally from salt) is associated with high blood pressure, an important risk factor for cardiovascular disease, particularly stroke (Prospective Studies Collaboration 2002). There is strong evidence indicating a dose-response relationship between sodium intake and blood pressure. The sources of this evidence include large observational studies (Elliott et al 1996), meta-analyses of observational studies and randomised controlled blood pressure lowering trials (Law et al 1991a, 1991b, 1991c), and the recent well-designed Dietary Approaches to Stop Hypertension trial (Sacks et al 2001). The effect of dietary sodium on blood pressure varies according to age and baseline blood pressure, with the strongest effect found among older adults with hypertension. As a result, there continues to be some debate about the importance of reducing sodium intake in the general population (Alderman 2002). However, even small decreases in blood pressure translate into important variations in cardiovascular disease at the population level. For this reason, most countries and organisations recommend a reduction in dietary sodium.

Recommended sodium intakes for adults

The RDI for sodium for adult New Zealanders is 920 to 2300 mg of sodium per day (Truswell et al 1990). The United Kingdom recommended intake is 1600 mg per day (Department of Health (UK) 1991).

Sodium intakes in New Zealand

Assessment of sodium intake by dietary assessment methods is difficult because people add discretionary salt to food, and cooked meals may have an unknown salt content. For this reason, dietary sodium intake was not included in the NNS97.

Sodium excretion in the urine is the best indicator of sodium intake (Caggiula et al 1985; Shortt et al 1988). A regional study in New Zealand found a mean sodium excretion of 3105 mg per day. This amount corresponds to a mean sodium intake of 3473 mg per day (Thomson and Colls 1998). The results show an estimated intake well above both the Ministry of Health target of 2760 mg per day (Ministry of Health 1998c) and the RDI (920 to 2300 mg). This target was proposed by the Nutrition Taskforce in 1991 as a realistic target to meet by 2005.

Given the evidence is strong (but not conclusive) for the benefits of salt reduction, the latest reviews recommend continuing to promote salt reduction (Thomson and Colls 1998; NHF 1999; Scientific Advisory Committee on Nutrition 2003).

Sources of sodium in the diet

Sodium is often added during food processing, with up to 85 percent of the average daily sodium intake coming from processed and manufactured foods (Godlee 1996; Engstrom et al 1997; Young and Swinburn 2002). Sodium chloride (common salt) is the most common source of sodium in the diet, while food additives are significant but smaller contributors.

The National Heart Foundation (1999) states that sodium intake could be reduced by about 1150 mg, or approximately 3 g of salt, by avoiding salty foods and not adding salt during cooking or at the table.

Practical advice

- Reduce overall sodium consumption by preparing meals with minimal added salt.
- When purchasing food and drinks that have been prepared away from home, choose those that are low in salt.
- When using salt, iodised table salt is recommended.

See also: 'Iodine' in Chapter 9, Other nutrients; and Chapter 14, Hypertension.

9 Other nutrients

Zinc

Background

Zinc is essential for many functions, including growth and neurobehavioural development, immune and sensory function, reproduction, antioxidant protection and membrane stabilisation (Cousins 1986).

Zinc absorption and deficiency. The presence of amino acids (particularly methionine and histidine) and certain organic acids (lactic, citric, malic and tartaric acid) enhances zinc absorption. A study of 330 premenopausal Dunedin women found that women who included red meat in their diet had a superior biochemical zinc status compared to those who did not eat red meat (Gibson et al 2001).

High intakes of phytate, found in unrefined cereals, legumes and nuts, reduce zinc absorption (Oberleas and Harland 1981). In the Dunedin study, there was a significant negative correlation between serum zinc and a diet high in phytate-containing foods (Gibson et al 2001). High calcium intake when combined with a high phytate intake further inhibits zinc absorption (Gibson 1990) such that lacto-vegetarians may be at particular risk of zinc deficiency.

Consumption of high doses of iron supplements is also known to limit zinc absorption (Gibson et al 2002).

Although zinc deficiency can be identified, marginal zinc status is difficult to assess. The only sure way to confirm diagnosis is to see a clear improvement in functional disturbances (eg, impaired appetite, taste acuity, immune function and linear growth) in response to zinc supplementation (Gibson 1990). Serum zinc concentration is frequently used to assess zinc status. However, in marginal deficiency, this test may give a false negative result. Urine zinc concentrations are useful only in disease-free people. Hair zinc concentration measured during childhood reflects zinc status, but the validity of this test is less certain in adults. Impaired taste acuity has been used to detect marginal zinc deficiency. This measure should, however, be interpreted in conjunction with biochemical indices (Gibson 1990).

Recommended zinc intakes for adults

The RDIs for zinc for New Zealand adults are presented in Table 15.

Table 15: Australian RDIs for zinc (mg/day)

	19–54 years	54+ years
Female RDI (mg/day)	12	12
Male RDI (mg/day)	12	12

Zinc intakes in New Zealand

The NNS97 found the usual daily median intake of zinc to be 14.5 mg for males and 9.8 mg for females. Less than 2 percent of the population are at risk of inadequate intakes of zinc; women in the more deprived areas have the highest risk (4.8 percent) (Ministry of Health 1999c). The principal sources of zinc in the diet of New Zealanders are beef and veal (19 percent); bread (10 percent); milk (8 percent); vegetables (6 percent); and bread-based dishes (5 percent) (LINZ Research Unit 1999).

Sources of zinc in the diet

Zinc is widely available in the food supply but its bioavailability from different food sources is highly variable (Samman 2002). Good sources of zinc include animal products and some seafoods. Some nuts, including peanuts, almonds, cashew nuts and sesame seeds, are also high in zinc (Athar et al 2003). In animal food sources, the fat content of the food becomes a major determinant of the zinc content as fat tissue contains less zinc than muscle tissue does. In general, dark-red meat has a higher zinc content than white meat and fish (Samman 2002). Some cereals contain zinc. However, this source of zinc is dependent on milling as zinc is mainly located in the outer layers. In highly milled grains (ie, a low extraction rate), the majority of the zinc and other minerals is removed. Because of their high water content, green leafy vegetables and fruits are only modest sources of zinc (Hallberg et al 2001). Cereal grains, legumes and nuts are rich in phytate, which reduces zinc absorption.

Practical advice

- Eat a variety of lean red meats (beef), bread and vegetables.
- If vegetarian, eat nuts (almonds, peanuts), legumes (lima beans), unrefined cereals (including bread) and low-fat milk and milk products.

Iodine

Background

Iodine is an essential component of the thyroid hormones thyroxine (T_4) and 3,5,3'-triiodothyronine (T_3). These hormones are required for normal growth and development and for maintaining a normal metabolic state (Gibson 1990). Most soils in New Zealand are low in iodine, resulting in low concentrations in locally produced foods (Thomson 2002).

Iodine deficiency. The term **iodine deficiency disorder** is used to describe a wide range of effects that low iodine can have on health. Goitre was endemic in many parts of New Zealand before the introduction of iodised salt in 1924 (Hercus et al 1925; Purves 1974). The level added to iodised table salt was raised in 1938. From 1938 to 2002 the level of iodine fortification required in iodised table salt was 40 to 80 mg of iodide per kilogram (Ministry of Health 1997e). Since December 2002 the level required in iodised salt has been 25 to 65 mg of iodine per kilogram (Food Standards Australia New Zealand 2002; Mann and Aitken 2003). It is estimated that 70 percent of table salt is iodised in New Zealand (Sutcliffe 1990).

Recommended iodine intakes for adults

New Zealand has not adopted the Australian RDI for iodine (150 µg per day for men and 120 µg per day for women) because of the extraordinarily low trace-element environment and low dietary intake in New Zealand. The New Zealand adequate daily intake (ADI), set in 1983, was 200 µg per day for both men and women, and this recommendation was retained by the Nutrition Taskforce (Department of Health 1991).

Iodine intakes in New Zealand

It is difficult to quantify accurately the dietary intake of iodine, especially from discretionary use of iodised salt. However, iodine status can be assessed by measuring urinary excretion. Two studies to assess urinary iodine excretion of residents in Otago and Waikato (Thomson et al 1997, 1999) showed lower rates of iodine excretion than previously found in New Zealand (Cooper et al 1984; Simpson et al 1984). One further study by Thomson and colleagues, which focused on urinary iodine and thyroid status in Otago, indicated that the fall in iodine status is being reflected in clinical measures of iodine status. These clinical measures include enlarged thyroid glands and elevated thyroglobulin (Thomson et al 2001).

Dietary iodine intake was not assessed in NNS97. However, iodine intake estimates from the New Zealand Total Diet Surveys (NZTDSs) since 1982 (based on simulated typical diets) suggest that the iodine intake of New Zealanders has decreased for all age-sex groups, to a point where iodine intake is now well below the Australian RDI (Vannoort et al 2000). The NZTDS estimates of iodine intakes do not include discretionary salt intake. There are several reasons for declining intake. One of the major contributors to New Zealanders' daily iodine intake has been from dairy industry cleaning compounds, called iodophors, in milk products. From the 1980s iodophors started to be replaced by other cleaning compounds, resulting in a lower iodine concentration in milk products (Sutcliffe 1990) and hence a reduced intake. In addition, dietary changes (such as the use of more ready-to-eat and pre-prepared foods, in which salt is not iodised), together with the recommendation to reduce salt in cooking and at the table, may account for declining iodine intake (Thomson 2002).

Both the studies on estimates of dietary intake and iodine status indicate that, for some New Zealanders, dietary intake may no longer be adequate. The Ministry of Health and the New Zealand Food Safety Authority are working on a joint project on iodine to address this problem. While iodine intakes are an area of concern, advice for adult New Zealanders needs to be mindful of the risks associated with a higher intake of salt. For these reasons, the following practical advice is given.

Practical advice

- Salt intake should be limited but when salt is used for cooking and at the table it should be iodised salt. (Rock salt and other salts have negligible levels of iodine and are not recommended.)
- Consider including other important sources of iodine such as low-fat milk products, eggs, fish and seafood. Inclusion of foods that contain seaweed, such as sushi, seameal and alginates (food-thickening agents), also provides a good source of iodine.
- Use of kelp and iodine supplements is not recommended, unless under the supervision of a doctor or a dietitian, as these are usually highly concentrated sources of iodine. High intakes of iodine can be toxic and may have adverse health effects.

See also: Chapter 8, Sodium; and Chapter 14, Hypertension.

Selenium

Background

Selenium is a key component of a number of seleno-proteins essential for health. The best known of these is the enzyme glutathione peroxidase which is considered to have a role in cellular antioxidant systems (Thomson and Paterson 2001). Selenium also plays an important role in the control of thyroid hormone metabolism (Arthur et al 1999) in reproduction, and in immune functions (Rayman 2000).

New Zealand soils are generally considered to be low in selenium, which affects its concentration in food (Vannoort et al 2000). Selenium intakes of New Zealanders have been considerably lower than those of people from other western countries (Robinson 1989). Selenium status has, however, increased in parts of New Zealand over the past decade (Thomson and Robinson 1996; Winterbourn et al 1992). It appears that New Zealanders may have adapted to their low selenium intake by excreting selenium more sparingly than people in other western countries (Robinson et al 1985). In addition, there has been an increase in the importation of Australian wheat and other products that have a higher selenium content and an increased use of supplemental selenium in animal feeds (Vannoort et al 2000; Thomson and Paterson 2001). Overseas studies suggest that the selenium status of smokers is lower than that of non-smokers, and that smoking may increase the requirements for antioxidants, including selenium (Thomson and Paterson 2001).

Although potential links of selenium levels to cardiovascular disease and cancer have been studied, to date there is no conclusive evidence of a protective effect of selenium against these diseases (Thomson and Paterson 2001).

Recommended selenium intakes for adults

Recommended selenium intakes for Australia, the United Kingdom and the United States are shown in Appendices 3 to 5. New Zealand did not adopt the Australian RDI for selenium. Thomson and Paterson (2001) have conducted a review of nutrient reference values but a New Zealand reference value has not yet been adopted (Thomson and Paterson 2001).

Selenium intakes in New Zealand

The NNS97 concluded that the estimates of daily selenium intake derived from dietary intake data (males 56 μg and females 39 μg) were not reliable due to difficulties in establishing food composition data for selenium. These data are, therefore, insufficient to allow definitive conclusions on the adequacy of the selenium intake of New Zealanders (Ministry of Health 1999c).

Sources of selenium in the diet

The principal sources of selenium in the New Zealand diet are fish/seafood (29 percent); bread (11 percent); poultry (6 percent); beef and veal, and eggs and egg dishes (both 5 percent) (LINZ Research Unit 1999).

It is possible to increase the dietary intake of selenium with higher intakes of seafood, non-refined cereals, dried peas and beans, and chicken. Routine selenium supplementation is not recommended in New Zealand (Thomson and Robinson 1996). It must also be noted that the margin between selenium deficiency and toxicity is narrower than for many other trace elements, and adverse effects have been described in those taking a selenium supplement (Gibson 1990).

Practical advice

- The consumption of foods rich in selenium should be encouraged. Examples are fish, seafood, meat, poultry, eggs and bread.
- Smokers may require a higher intake of selenium-containing foods.
- Use of selenium supplements is not recommended, unless supervised by a doctor. High intakes of selenium can be toxic and may have adverse health effects.

Fluoride

Background

Fluoride has a role in bone mineralisation and protects teeth against dental caries (Robinson 1998). It is a naturally occurring element in the earth's crust.

All New Zealand water supplies, unless roof-collected, contain some natural level of fluoride. The exact amount depends on the geology of the area; the range is generally 0.1 to 0.3 ppm (PHC 1993). This level is considered an unusually low concentration (Department of Health 1991). Only some reticulated water supplies in New Zealand are fluoridated. In 2002, 84 percent of New Zealanders were on a reticulated water supply. Of these, 62 percent received fluoridated water (Ministry of Health 2003a).

Prevention of dental caries. A significant reduction in dental caries is documented from drinking water with fluoride levels of 0.7 to 1.0 ppm and, to a lesser extent, from the use of fluoride-

containing toothpaste. Food and beverages made from fluoridated water but consumed in non-fluoridated areas have probably played a role in reducing differences between fluoridated and non-fluoridated areas (ESR 1999). However, it appears that water fluoridation provides benefits above and beyond those from other fluoride sources alone (WHO 1994).

Water fluoridation provides significant benefits for both deciduous ('baby') and permanent teeth. The evidence for a protective effect on dental health is strongest in childhood, but can also be demonstrated in adults, for whom fluoridated water has been shown to protect against root caries (NHMRC 1999a).

In New Zealand, as elsewhere, caries prevalence has declined since the 1950s. From about 1992 the prevalence and severity of dental caries have plateaued for children and adolescents. Water fluoridation has been conservatively estimated to reduce dental decay by about 20 to 40 percent. It is further estimated that the lifetime benefit from drinking fluoridated water is the prevention of a total of 2.4 to 12.0 decayed, missing or filled teeth per person (PHC 1994).

The economic argument for fluoridation is still strong. It is particularly strong in regard to communities where the risk of dental decay is high, for example low socioeconomic groups, who can least afford dental care, and for Māori (ESR 1999). The economic advantages do not include the intangible benefits of good oral health status, such as freedom from pain and suffering, improved self-esteem, and improved social interaction (Wright et al 2001).

Fluoridation of community drinking water is also a major factor in reducing ethnic and socioeconomic inequalities in oral health (Public Health Advisory Committee 2003).

Other health effects. Consumption of fluoridated drinking water at the levels of 0.7 to 1.0 ppm does not appear to have any significant health effects other than improved oral health status. For example, there is insufficient evidence to establish a link between fluoridated drinking water and a higher risk of bone or other cancers, or of osteoporosis (NHMRC 1999b; University of York, 2002). Mortality rates and health statistics for communities with fluoridated water are similar to those for communities without fluoridated water. The only marked health difference is in oral health. Decay rates are significantly lower in communities with fluoridated drinking water (Bates 2000). The only effect that has been associated with water fluoridation is a very mild dental fluorosis in a small number of children. Mild fluorosis can sometimes be seen as mottling of the teeth (white spots on the teeth).

Recommended level of fluoride in the water supply

The recommended range for the level of fluoride in the water supply is now 0.7 to 1.0 mg/L (PHC 1994; Expert Committee on Drinking Water Standards 2000). Along with drinking water with optimal fluoride content throughout life, the use of fluoride-containing toothpastes is recommended for the prevention of dental caries (Department of Health 1991; PHC 1994; NHC 1997).

Fluoride intakes in New Zealand

New Zealand studies of adult diets have estimated fluoride ingestion as 1.8 mg fluoride per day, with a maximum of 2.7 mg in teenage males (Pickston et al 1985; Pearce et al 1992). These findings are similar to overseas estimates (NRC 1993). Fluoride intakes come primarily from fluoridated water, tea and seafood, as well as from fluoridated toothpaste. Bottled water usually does not contain fluoride. The relative contributions from the various sources are not accurately known. However, it has been suggested that fluoridated water contributes approximately 50 percent of the fluoride intake of those people drinking fluoridated water (Murray et al 1991). If fluoridated toothpaste is swallowed, fluoride intake can be high. This possibility is of most concern in infants and young children (NRC 1993).

Practical advice

- Fluoridated water is an important source of fluoride intake for New Zealanders.
- For people living in an area that does not have a fluoridated water supply, it is suggested that advice is sought from a dental or other health professional (eg, dentist or dental therapist) about the best way to increase intake.

Vitamin C

Background

Vitamin C is an essential micronutrient involved in collagen production, brain neurotransmitter synthesis, iron absorption and pituitary peptide hormone production. It is an antioxidant thought to be important in the ageing process and carcinogenesis.

Vitamin C is found in many vegetables and fruits but is unstable and therefore easily destroyed (Truswell et al 1990). The vitamin C content of foods varies according to the quality of transportation, shelf-time prior to the consumer purchasing the food, and storage, preparation and cooking practices. Boiling vegetables can cause 50 to 80 percent loss. Cooking vegetables with minimal water or in a microwave oven will decrease losses (Erdman and Klein 1982; Vanderslice and Higgs 1991). Chopping and dicing that expose a large surface area to oxidation also result in loss of vitamin C.

A recent United States review suggests that there may be health benefits from a dietary vitamin C intake of 200 mg per day. Diets containing 200 mg or more of vitamin C from food were associated with a lower risk of some cancers (Levine et al 1999). It is not clear whether the benefit arose from the vitamin C intake or from other constituents in vegetables and fruits that are protective for health. Vitamin C as a supplement has not been shown to decrease cancer risk (Blot et al 1993; Greenberg et al 1994; Schorah 1998).

Recommended vitamin C intakes for adults

Regular daily intake of vitamin C is required because it is readily excreted. With further research into disease prevention and the role of antioxidants, the RDI for vitamin C may need to be re-examined. The RDIs for vitamin C for New Zealand adults are set at 40 mg for males and 30 mg for females (Truswell et al 1990). The current RDI for vitamin C is set at a level to prevent scurvy with a margin of safety.

It has been recognised for many years that smokers have a higher turnover of vitamin C. To maintain their body pool and circulating levels near those of non-smokers, the United Kingdom Panel on Dietary Reference Values (DRVs) for Nutrients advises that their intake would need to be up to 80 mg/d greater (Department of Health (UK) 1991).

Vitamin C intakes in New Zealand

The NNS97 indicates that the usual daily median intake of vitamin C for the New Zealand population is 102 mg (males 111 mg, females 95 mg). Males and females aged 15 to 18 years reported the highest intakes. The overall estimated prevalence of inadequate intakes is less than 1 percent.

In a randomised control trial, an increase in consumption of vegetables and fruits from a regular current intake of three servings per day to an intake of seven servings per day led to a substantial increase in plasma concentration of vitamin C: 63 mg (control group) compared with 257 mg (intervention group) (Zino et al 1999).

Sources of vitamin C in the diet

The principal sources of vitamin C in the New Zealand diet are vegetables and non-alcoholic beverages (both 26 percent); fruits (23 percent); and potatoes and kūmara (13 percent) (LINZ Research Unit 1999). Foods rich in vitamin C include vegetables (potatoes, broccoli, spinach, kūmara) and fruits (strawberries, kiwifruit, oranges, melon).

Adequate consumption of vegetables and fruits should provide enough vitamin C for most people. New Zealanders should be encouraged to eat at least three servings of vegetables and at least two of fruits each day. Dried fruits are not a good source of vitamin C.

Practical advice

- The consumption of foods rich in vitamin C, especially vegetables and fruits, should be encouraged.
- Adults should be encouraged to choose preparation and cooking methods that minimise loss of vitamin C, such as microwaving and steaming.

See also: Chapter 6, Iron; and Chapter 16, Cancer.

Folate

Background

Folate is a generic term for a group of over 100 compounds that have a common vitamin activity (Department of Health (UK) 2000). Folic acid (pteroylmonoglutamic acid) is a synthetic form of folate. It is the form of folate most often used in fortified foods because of its stability and high bioavailability (Shils and Young 1994). Folate is essential for deoxyribonucleic acid (DNA) synthesis, and is especially important during periods of increased cell replication and growth (Gibson 1990; Institute of Medicine 1998).

Folates are widely distributed in food, especially in green leafy vegetables, legumes and liver (the term 'folate' comes from the same Latin word as 'foliage'). Other excellent sources are fruits and fruit juices, nuts and seeds and fortified cereals. Heat and oxidation during cooking and storage can destroy as much as half the folate in foods. Therefore, uncooked vegetables and fruits are better sources of folate than cooked.

Inadequate intakes of folate can result in megaloblastic anaemia. Marginal folate deficiency is common in almost any group undergoing rapid growth.

Secondary folate deficiency may also result from impaired absorption due to diseases involving the small intestine (eg, coeliac disease and Crohn's disease) as well as chronic alcohol consumption (Donnelly 2001). Non-steroidal anti-inflammatory drugs, oral contraceptives methotrexate and other drugs with antifolate activity have been found to impair folate status (Institute of Medicine 1998).

Smokers are also a risk group for folate deficiency. It is thought that smoking impairs absorption. However, more recent evidence suggests that smoking is not the causal factor. Rather, the deficiency may be caused by smokers consuming less folate-containing foods (Institute of Medicine 1998).

Prevention of neural tube defects. There is evidence that a folic acid supplement taken before and during the early stages of pregnancy can reduce both the occurrence and recurrence of neural tube defects (NTDs; see Glossary) by up to 70 percent (Medical Research Council 1991; Czeizel and Dudas 1992; Berry et al 1999). As a consequence, the Ministry of Health recommends

that women who are planning to become pregnant take a 0.8 mg per day folic acid supplement for four weeks before, and 12 weeks after, conception in addition to consuming foods that are rich in folate. It is recommended that women at higher risk of NTDs take 5 mg of folic acid per day for the same period (Ministry of Health 1995, 2003d).

Further information on folate and the prevention of NTDs can be found in the *Food and Nutrition Guidelines for Healthy Pregnant Women: A background paper* (Ministry of Health 1997b) and *Eating for Healthy Pregnant Women* (Ministry of Health 1999b).

Folate intake and homocysteine. Folate may have health benefits through lowering blood homocysteine levels (Ministry of Health 2003d).

An elevated blood homocysteine level, even a moderate one, has been associated with a higher risk for cardiovascular disease (Boushey et al 1995; Homocysteine Studies Collaboration 2002; Wald et al 2002). In turn, randomised controlled trials have demonstrated that increased intakes of dietary folate or folic acid supplements significantly reduce blood homocysteine levels (Homocysteine Lowering Trialists' Collaboration 1998; Wald et al 2001). However, it is unknown whether consuming folic acid supplements will reduce the risk of cardiovascular disease. Randomised controlled trials are underway to determine whether folic acid supplementation will lead to a lower incidence of cardiac events (Eikelboom et al 1999).

An association between high homocysteine levels and Alzheimer's disease has also been found (Seshadri et al 2002). Through its effects in reducing homocysteine levels, increased folic acid consumption could, therefore, be associated with reduced risk of Alzheimer's disease. Further research is needed to explain this association.

Recommended folate intakes for adults

The RDI for folate is 200 μg per day for all adults. This RDI is equivalent to that used in the United Kingdom and the European Union (Department of Health (UK) 2000).

Folate intakes in New Zealand

The NNS97 indicates that the usual daily median intake of folate from food is 242 μg (males 278 μg, females 212 μg), with little variation across age groups (Ministry of Health 1999c).

Although the overall prevalence of inadequate folate intake was 7.1 percent in the NNS97, inadequate intakes are consistently higher for females than for males. Māori females and those in the most deprived areas have the highest rates of inadequate intakes. However, the survey authors have suggested that care should be taken with data interpretation. It is likely that the prevalence of inadequate intake has been overestimated due to difficulty in establishing food composition data for folate (Ministry of Health 1999c).

Sources of folate in the diet

The principal dietary sources of folate in the New Zealand diet are vegetables (18 percent); bread (13 percent), breakfast cereals (11 percent); fruits, potatoes and kūmara (8 percent); non-alcoholic beverages (6 percent); and sauces (5 percent) (LINZ Research Unit 1999).

Practical advice

Adherence to the New Zealand Food and Nutrition Guidelines (see: Part I) will help ensure an adequate folate intake for the majority of the adult population. An emphasis on meeting recommendations for consuming vegetables and fruits, as well as breads and cereals (wholemeal and wholegrain, where possible) is recommended.

- The principal sources of folates in the New Zealand diet are vegetables, bread and breakfast cereals (often fortified with folic acid).
- The consumption of foods rich in folate should be encouraged. Examples are leafy green vegetables such as spinach, citrus such as oranges, wholewheat breads, and legumes such as kidney beans. Liver is also a rich source.
- If a woman is planning pregnancy, folic acid supplements are recommended in addition to a folate-rich diet.

See also: Chapter 13, Coronary heart disease; and Chapter 22, Supplementation and fortification.

Thiamin

Background

Thiamin, as a component of the coenzyme thiamin pyrophosphate (TPP), has an important role in carbohydrate metabolism.

Thiamin deficiency. Thiamin deficiency has almost completely disappeared in developed countries. The exceptions are in selected groups within the population such as people with chronic alcoholism, some older people, and people with chronic disease states involving vomiting, diarrhoea and anorexia (Gibson 1990). Severe deficiency among people with alcoholism is often associated with Wernicke's encephalopathy, a neurological disorder arising from prolonged thiamin deficiency. In the early 1990s Australia began fortifying flour for bread-making with thiamin to decrease the high incidence of Wernicke's-Korsakoff's syndrome (Department of Health 1991). Although the prevalence is still higher than in most other developed countries, there has been a significant reduction in Wernicke's-Korsakoff's syndrome in Australia since fortification began (Harper et al 1998).

Recommended thiamin intakes for adults

The RDIs for thiamin intake are 1.1 mg for males and 0.8 mg for females aged 19 to 54 years, and 0.9 mg for males and 0.7 mg for females aged over 54 years (Truswell et al 1990).

Thiamin intakes in New Zealand

The NNS97 indicates the usual daily median intake of thiamin for New Zealanders is 1.4 mg (males 1.7 mg, females 1.2 mg) (Ministry of Health 1999c). The principal dietary sources of thiamin are bread (29 percent); potatoes and kūmara (8 percent); breakfast cereals (7 percent); vegetables (6 percent); and milk and pork (both 5 percent) (LINZ Research Unit 1999). Fortified breakfast cereals and bread mixes are also important sources of dietary thiamin. The intake of thiamin in the New Zealand population appeared to be satisfactory as even those on the 10th percentile of usual intake did not fall below the 0.4 mg per day level recommended by the United Kingdom DRV panel (Ministry of Health 1999c).

Sources of thiamin in the diet

Wholegrain cereals, pork, dried peas and beans are the richest dietary sources of thiamin. Other significant sources are other meat, fish, green vegetables, fruits and milk. Approximately 25 percent of the thiamin in foods is lost during cooking, with the greatest losses occurring from meat and vegetables.

Practical advice

- Principal sources of thiamin in New Zealand are bread, vegetables, breakfast cereals, milk and pork.

Vitamin B_{12}

Background

Vitamin B_{12} is produced almost entirely by bacterial synthesis in the colon and small intestine. Vitamin B_{12} is found in meat or foods of animal origin (eg, meat, fish, shellfish, milk, cheese and eggs) (Thurnham et al 2000).

Vitamin B_{12} is an important factor in the metabolism of folate for DNA synthesis and thus is important during rapid cell growth (Selhub et al 1993; Shils and Young 1994; Ministry of Health 2003d).

Vitamin B_{12} deficiency. The main cause of vitamin B_{12} deficiency is not dietary deficiency but a failure of intrinsic factor secretion which assists with the absorption of vitamin B_{12} (Department of Health (UK) 1991). Older people are at the greatest risk of vitamin B_{12} deficiency because of an age-related decline in absorption. Reduced secretion of intrinsic factor can result from pernicious anaemia (an autoimmune disease) and occur in people who have had gastric surgery. In the adult population, those at risk of a dietary deficiency of vitamin B_{12} are vegans (Thurnham et al 2000).

Deficiency of vitamin B_{12} may appear either as macrocytic megaloblastic anaemia or neurological abnormalities, or both (Bower and Wald 1995; Department of Health, UK, 2000). The majority of people with vitamin B_{12} deficiency present with symptoms due to their anaemia. Only one-third present with predominantly neurological symptoms.

Because of the similarities in the presentation of vitamin B_{12} and folate deficiency, correct biochemical diagnosis is essential before treatment for megaloblastic anaemia (Truswell and Milne 1998). Treatment with folic acid can resolve the megaloblastic anaemia of vitamin B_{12} deficiency but will not treat the neurologic abnormality. In such cases, the deficiency will be masked, which may delay diagnosis of vitamin B_{12} deficiency, possibly leading to irreversible neurological damage. With this risk in mind, the United States Institute of Medicine has set a tolerable upper intake level (UL) of 1000 μg of synthetic folic acid daily. Regular consumption of levels below the UL is believed to be unlikely to mask vitamin B_{12} deficiency (Institute of Medicine 1998).

Recommended Vitamin B_{12} intakes for adults

The RDI for vitamin B_{12} is 2.0 μg per day for adults (Truswell et al 1990).

Vitamin B_{12} intakes in New Zealand

From the NNS97 the usual daily median intake of vitamin B_{12} is 4 μg (males 5 μg, females 3 μg). The overall prevalence of inadequate intake was 0.4 percent (Ministry of Health 1999c). The principal dietary sources of vitamin B_{12} were beef and veal (18 percent); fish and seafood (16 percent); milk (15 percent); other meat (8 percent); pies and pastries, bread-based dishes, and eggs and egg dishes (all 5 percent) (LINZ Research Unit 1999).

In a New Zealand study of vegetarians, the dietary vitamin B_{12} intake was significantly lower for vegetarians compared with non-vegetarians. Despite this difference, vegetarians and non-vegetarians had similar serum vitamin B_{12} levels (Harman and Parnell 1998).

Routine supplementation with vitamin B_{12} is not recommended for healthy adult New Zealanders. However, health professionals should be aware of the risks of vitamin B_{12} deficiency in high-risk groups such as older people, vegans, and those who have had gastric surgery. Diagnosis should be confirmed using biochemical tests before treatment is initiated.

Sources of vitamin B_{12} in the diet

Meat, seafood, milk and milk products, egg and liver are rich sources of vitamin B_{12}.

Practical advice

- The consumption of foods rich in vitamin B_{12} should be encouraged.
- Vegetarians should be aware of sources of vitamin B_{12} such as milk and yoghurt.
- Vegans need to eat foods fortified with vitamin B_{12} or to take vitamin B_{12} supplements.
- For people with pernicious anaemia or who have had gastric surgery, vitamin B_{12} injections may be required under a doctor's supervision.

10 Fluids

Background

Approximately 70 percent of body weight is water. Water is essential for life and humans cannot survive for more than five days at the most without water. Water is required both within and outside cells and is necessary for biochemical reactions, transport of nutrients, metabolites, waste products, respiratory gases, hormones and heat. Water also provides lubrication for the joints and body surfaces (Robinson 2002).

Recommended fluid intakes for adults

Approximately 3000 ml of water is required per day for the average man and approximately 2200 ml per day for the average woman (NHMRC 2003). Solid food (especially vegetables and fruits) contributes approximately 1000 ml of water, with about 300 ml coming from the water produced by the breakdown of food. The remainder of the water needs to come from fluids such as water, milk, tea, coffee and other beverages.

Fluid intakes in New Zealand

The NNS97 showed that water (80 percent), tea (62 percent) and coffee (61 percent) are consumed regularly by New Zealanders. Fluid consumption differs across genders. Males more frequently consume coffee, soft drinks and cordial. Females prefer low energy soft drinks, water and herbal teas. However, consumption of soft drinks dropped off markedly in the age group of 45-plus years for both males and females. Milk is consumed as a beverage at least once per week by only 35 percent of adult New Zealanders (Ministry of Health 1999c).

Powdered drinks and cordials are more regularly consumed by individuals living in NZDep96 quartile IV (most deprived) areas. Fruit juice, tea (males only), water (females only) and coffee are more popular among individuals living in quartile I (least deprived) and II areas. Pacific peoples are higher regular consumers of fruit drinks and sports drinks compared with Māori and New Zealand European and Others. Māori more often have cordial and soft drinks. Māori and Pacific peoples drink less coffee, tea and herbal tea than New Zealand European and Others (Ministry of Health 1999c).

Sources of fluids in the diet

Water

Although water consumed as such is a major source of fluid, water consumed in other beverages is also important.

There is evidence that drinking reticulated water (ie, water supplied by the local water authority) containing fluoride can help to prevent tooth decay. While bottled water is a convenient alternative to tap water, there are no known benefits over reticulated water. Caution should be taken when consuming water from other than reticulated sources (from tanks, etc) as it can easily be contaminated (eg, with bird or animal faeces).

Milk

Milk is a valuable component of the diet, as an important source of calcium, protein and other essential nutrients. It should, therefore, be included as part of the fluid intake. Achieving the RDI for calcium without some liquid milk or milk products is difficult. The use of reduced-fat or

low-fat milk products will minimise energy intake while retaining the contribution of calcium. Soy beverages can be a suitable replacement for cow's milk, but calcium-fortified varieties should be selected.

Caffeinated drinks

Caffeine and similar substances are found in coffee, tea, cocoa, cola-flavoured drinks, or energy drinks containing guarana or cola nut. Coffee contains about three or four times as much caffeine as an equal volume of cola-flavoured drink. Some energy drinks contain substantial amounts of caffeine, although no more than strong coffee. Caffeine is a central nervous system stimulant and acts as a mild diuretic. Tea, coffee and soft drinks are among the most frequently consumed beverages in New Zealand.

Caffeine has recently been associated with increased blood pressure in individuals prone to hypertension (Nurminen et al 1999). Coffee and caffeine may also be associated with cardiac arrhythmias and raised blood lipids (NHF 1999).

Evidence for caffeine intake as a risk factor for fracture frequency or bone loss is contradictory. Several large cohort studies have reported small but significant increases in either fracture frequency or bone loss associated with increased caffeine intake (Kiel et al 1990; Hernandez-Avila et al 1991; Barrett-Connor et al 1994; Cummings et al 1995). Other studies have found no association (Cooper et al 1992; Johansson et al 1992; Cumming and Klineberg 1994; Lloyd et al 1997).

An important issue with coffee, tea and energy drinks is the amount of energy (in the form of sugar) they may contain. The addition of sugar to tea and coffee can add significantly to an individual's daily energy intake, thus contributing to overweight and obesity.

Tea, especially green tea but also black tea and to a lesser extent coffee, contains substantial amounts of polyphenols. Polyphenols are substances with antioxidant properties which are purported to protect against cancer and cardiovascular disease. In the NNS97 the highest frequency of consumption of herbal teas among New Zealand women was among females 19-64 years (10-13 percent) (Ministry of Health 1999c). While herbal teas commercially marketed in New Zealand are very dilute (Mathews 1997), some herbal teas might interact with prescription drugs (Huxtable 1992).

Fruit juices, soft drinks, cordials and sports drinks

Fruit juices, soft drinks, cordials and sports drinks all contain water. As such, they contribute to total fluid intake. In some cases, they also contribute other nutrients (eg, vitamin C in fruit juices). However, because they provide energy in the form of sugar, they also contribute to energy intake and may also contribute to overweight and obesity. If sports drinks are consumed in large amounts, the phosphoric acid and citric acid added to these drinks are likely to damage teeth by eroding tooth enamel. Their erosive potential is related to their low pH (high acidity) and chemical content. Frequency of intake and salivary flow rate are also important factors. For example, mouth breathing during physical activity leads to less salivary clearance of acids and carbohydrates (Vasan 1999). Sports drinks are one of the fastest growing segments in the Australasian drinks market (Pearce 1996). They are predominantly consumed by people in the 15–24 years age group (LINZ Research Unit 2000).

Practical advice

- Drink plenty of water every day.
- Take an amount of fluid equivalent to 6-8 glasses of water per day.
- Sometimes choose low-fat milk as a nutritious alternative to water or soft drinks.

- Limit the consumption of fruit juice, cordial, energy and soft drinks because of their high sugar content.
- People susceptible to caffeine should minimise consumption of tea, coffee and other caffeinated drinks. The National Heart Foundation suggests a maximum of five cups of coffee a day for the general population (NHF 1999).

11 Alcohol

Background

Alcohol use in New Zealand

Alcohol is both a nutrient supplying 29 kJ/g and a drug that is a central nervous system depressant (Truswell 2002). Drinking alcohol has health, social and economic costs as well as some benefits. In 2000, 88 percent of men and 83 percent of women consumed alcohol (Habgood et al 2001). While most New Zealanders enjoy alcohol in moderation most of the time, there are significant negative health and social consequences associated with excessive drinking.[1]

Health effects

Different levels of alcohol consumption are associated with different levels of health hazard. Modest consumption of alcohol can be protective against, for example, coronary heart disease and other diseases with similar pathophysiology, in particular ischaemic stroke but it is not protective against cancers (Ministry of Health 1999d). Excessive alcohol consumption can produce detrimental effects. Long-term problems include irreparable damage to the brain, liver, intestines and pancreas. Alcohol is also a significant risk factor for some types of cancer, high blood pressure, haemorrhagic stroke, and cardiac conditions such as cardiomyopathy (Ministry of Health 1998d).

The unsafe use of alcohol also contributes to death and injury on the roads, drowning, suicide, assaults, domestic violence, teenage pregnancy, foetal alcohol syndrome, neurological disorders, sexual harassment, other non-traffic-related mortality and morbidity, some mental health disorders and sexual health problems (Ministry of Health 1998c). It has been estimated that at some time in their lives nearly one in five New Zealanders will suffer an alcohol-use disorder (ALAC and Ministry of Health 2001).

Links between alcohol and cancer. There is strong evidence that alcohol is a risk factor for cancers of the oral cavity, pharynx, oesophagus and larynx. Alcohol is a probable risk factor for cancers of the stomach, colon, rectum, liver, breast and ovary (World Cancer Research Fund 1997).

Alcohol consumption is also linked to other cancer risk behaviours such as tobacco smoking (including second-hand smoke), unsafe sex (increasing exposure to HIV), and illicit drug use (increasing exposure to Hepatitis B and C in injecting drug users) (Ministry of Health 2003e).

Links between alcohol and coronary heart disease. Certain subgroups have a lower risk of coronary heart disease associated with alcohol intake. These include post-menopausal women and men over the age of 45 years (NHF 1999). In these groups, light and moderate drinking of alcohol has consistently been associated with lower risk of coronary heart disease (Marmot and Brunner 1991; Maclure 1993; Shaper et al 1994).

A systematic review of ecological, case-control and prospective studies concluded that all alcoholic drinks were linked with a lower risk of coronary heart disease (Rimm et al 1996). However, beyond three drinks per day for men and two per day for women the disadvantages of

[1] It is difficult to review literature on the effects of alcohol consumption since the alcoholic content of drinks varies from one country to another, self-reporting of consumption is usually underestimated, and different studies use different definitions of 'moderate' and 'heavy' alcohol consumption (Cowie 1997).

alcohol consumption rapidly outweigh the advantages (Cowie 1997). This is especially true for those at low risk of death from coronary heart disease. In younger populations, drinking larger amounts of alcohol in one session is associated with injuries and cardiovascular heart disease mortality (Jurgen et al 2001).

Patterns of alcohol consumption

Total alcohol consumption per adult per year was 8.5 litres in 1998, which was below the Ministry of Health's target reducing consumption to 8.7 litres by the year 2000 (Ministry of Health 1999e). There has been a slight increase since then, with an estimated average 8.9 litres of pure alcohol consumed per person aged 15 years and over in 2001 (Ministry of Health 2001c; ALAC and Ministry of Health 2001).

There is considerable variation in the amount of alcohol consumed by New Zealanders. The AUDIT (Alcohol Use Disorders Identification Test) questionnaire was developed as a screening tool to identify people at risk of developing alcohol problems (Barbor and Grant 1989), and has been used to investigate drinking patterns. In the 1996/97 New Zealand Health Survey, just over 80 percent of New Zealanders reported that they drank alcohol. However, of these nearly two-thirds had an AUDIT score that classified them as relatively safe drinkers. The remaining 17 percent of adults had an AUDIT score indicating a pattern of drinking that put them at risk of future physical or mental health effects from alcohol (Ministry of Health 1999f).

Young people aged 15–24 years, especially males, are more likely to indulge in the high-risk alcohol consumption pattern of binge drinking. For example, young people are over-represented in the groups that drink in excess of five or more drinks on a typical drinking occasion, and more than six drinks on one occasion at least weekly (Ministry of Health 1999f). In addition, there is evidence that heavier drinking cohorts of young people go on to be heavier drinkers in later life and to experience more alcohol-related harm. Older people tend to consume alcohol more regularly than do younger people. However, they tend to drink less on a single occasion. They are also less likely to experience alcohol-related harm than younger drinkers (Habgood et al 2001).

Men are more likely than women to drink frequently, and to drink heavily on a typical day when drinking. For example, a nationwide telephone survey conducted in 1995 showed that men consume 73 percent of all alcohol in New Zealand, with 5 percent of male drinkers consuming the equivalent of 63 cans of beer a week (Habgood et al 2001).

In 2000, just under one in five men and one in ten women drank alcohol daily. On a typical drinking occasion, men consume 72 ml of absolute alcohol on average, which equates to just under five cans of beer. Women consume on average 52 ml of absolute alcohol, or between three and four glasses of wine (Habgood et al 2001).

Greater numbers of Māori and Pacific adults abstain from alcohol consumption than do New Zealand European adults. However, disproportionate numbers of Māori and Pacific adults also demonstrate potentially hazardous drinking patterns. Māori and Pacific adults who drink alcohol do so less frequently than New Zealand European adults but are more likely to consume five or more alcoholic drinks on one occasion (Ministry of Health 1999f).

The NNS97 reported mean intakes for alcohol consumption shown in Table 16.

Table 16: Alcohol intake in New Zealand

	Daily mean in (g)	Percentage contribution to energy
Males	20	5
Females	8	3

At the 90th centile of intake alcohol contributed 16 percent of energy for males and 10 percent for females. For those who drink regularly alcohol is an important contributor to overall energy intake and may contribute to weight gain.

Recommendations for alcohol intake

There is no level of drinking that can be called safe for all people at all times. An individual's tolerance to alcohol varies depending on their age, gender, body size, food intake and general health. The Alcohol Advisory Council (ALAC) has developed guidelines for upper limits for responsible drinking and these are shown in Table 17. These guidelines are based on a measurement called the 'standard drink'. Each standard drink contains 10 g of alcohol.

Table 17: Upper limits for responsible drinking

In any one week, drink no more than:	On any one drinking occasion drink no more than:	If drinking every day, drink no more than:
21 standard drinks for men	6 standard drinks for men	3 standard drinks for men
14 standard drinks for women	4 standard drinks for women	2 standard drinks for women

Source: ALAC 2002

Examples of standard drinks are shown in Table 18.

Table 18: Standard drinks contained in typical servings of alcohol

Type of alcoholic drink	Serving of alcohol	Number of standard drinks
Beer	1 can or stubbie of ordinary-strength beer (5% alcohol)	1.5
	1 glass (300 ml) of ordinary-strength beer	1
	1 pint (a 'handle') of ordinary-strength beer	2
	1 jug of ordinary-strength beer	4
Spirits	1 single measure of spirits (25 ml) (eg, whisky, gin, vodka)	1
	1 bottle of spirits (750 ml) (eg, whisky, gin, vodka)	30
Fortified wine	1 glass of fortified wine (eg, sherry, martini, port)	1
	1 bottle of fortified wine (eg, sherry, martini, port)	11.5
Table wine	1 small glass of table wine (80 ml)	1
	1 bottle of table wine	7.5

Source: ALAC 1995

Practical advice

- If choosing to drink alcohol, limit your intake.
- Remember alcohol-containing drinks are high in energy density and may contribute to weight gain. Have some alcohol-free days each week.
- To reduce the risk of cancer, no alcohol is recommended (see: Chapter 16, Cancer).
- To reduce cardiovascular risk, consume only moderate amounts of alcohol.
- When serving drinks, ensure non-alcoholic drinks and food are available.
- Provide non-alcoholic and low-alcohol beverages when serving alcohol.
- Eat food when drinking alcohol.
- Restrict or avoid alcohol when driving, when operating machinery or when in the water.

Part III: Nutrition and Health Outcomes

12 Obesity

Background

Obesity is a major contributor to the global burden of disease and disability. The prevalence of obesity is increasing world-wide and has already reached epidemic proportions in many countries and population groups (Kumanyika et al 2002; WHO and FAO 2003). Obesity is also a major issue for New Zealand (Ministry of Health 2003b; 2003c; Ministry of Health and University of Auckland 2003).

Until recently, obesity had been viewed primarily as a condition of overeating, which could be corrected by a reduction in the quantity and energy content of food ingested. As a result of this oversimplification, obesity has been neglected as a health issue. Obesity is a complex disorder with multiple interactive causes.

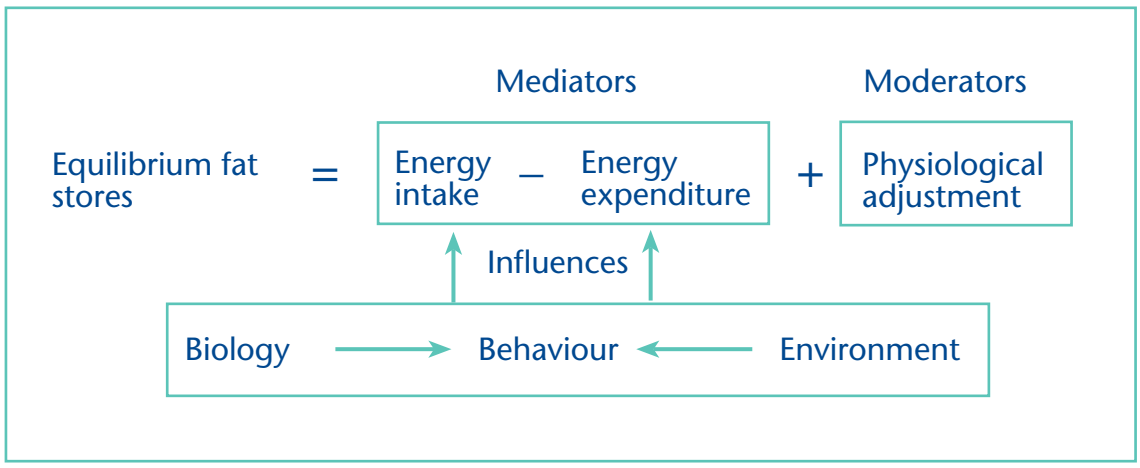
The increase in the prevalence of obesity is largely due to a changing social and physical environment in which people are consuming excess energy through food and drinks and not expending adequate energy through physical activity. When tackling obesity, it is important to intervene to change the environment that promotes obesity as well as to seek to effect change in an individual's behaviour.

What causes overweight and obesity?

In simple terms, obesity is a consequence of an energy imbalance: energy intake exceeds energy expenditure over an extended period. This causes the accumulation of excess body fat to the extent that health may be adversely affected. However, the amount of excess fat, its distribution within the body and the associated health consequences, vary considerably between obese individuals (WHO 2000).

Egger and Swinburn (1997) have proposed an ecological model to aid the understanding of obesity and over-fatness, see Figure 1.

Figure 1: The ecological model of the causes of obesity



Source: Egger and Swinburn 1997

Mediators

At a population level, physical energy expenditure has fallen by more than food energy intake (Egger and Swinburn 1997). This energy imbalance, results in excess energy being stored as fat with an increasing prevalence of overweight and obesity.

Moderators

'Physiological adjustments' are changes that follow an imbalance between energy intake and energy expenditure. A response to loss of weight may be an appetite increase, or a decrease in physical activity.

The resting metabolic rate may decline until a new energy balance is achieved. A lower metabolic rate means that a person would then need less food (energy intake) to remain at the same weight.

Biological influences

Biological factors known to influence body weight and fat levels include:

- ethnicity – some population groups appear to have a greater genetic predisposition to weight gain
- gender – women carry more fat than men
- age – maintenance of a healthy body weight becomes more difficult with age
- hormonal factors
- genetics.

These biological influences explain the variance in body fat in individuals. They do not, however, explain why obesity has increased so significantly at a population level.

Behavioural influences

Eating behaviour and physical activity are the results of complex physiological, psychological and cultural factors, including habits, emotions, conditioning and attitudes.

Environmental influences

Probably the most important cause of the rapid global rise in obesity lies in the profound and rapid changes to the environment and society affecting large parts of the world.

Modernisation, urbanisation and changing occupational structures are creating societies in which physical activity levels are low and the availability of high-fat, high-sugar, energy-dense foods has increased. Populations now live in environments that inadvertently promote sedentary lifestyles and overconsumption of energy-dense foods. Maintaining a healthy weight and optimal fat stores requires considerable effort – an effort that is difficult to maintain in an unsupportive environment.

Definitions of overweight and obesity

Body mass index (BMI)

BMI is an index that is commonly used to classify underweight, overweight and obesity in adult populations. It is defined as weight in kilograms divided by height in metres squared (kg/m^2).

The classification of overweight and obesity according to BMI is shown in Table 19. Obesity is classified as a BMI ≥ 30.00. The classification shown in Table 19 is in agreement with that recommended by WHO (1995), but includes an additional subdivision at BMI 35.00–39.99. This is in recognition of the fact that management options for dealing with obesity differ above a BMI of 35.00. The WHO classification is based primarily on the association between BMI and mortality.

Table 19: WHO classification of overweight and obesity in adults according to body mass index

Classification	Body mass index (BMI)	Risk of co-morbidities
Underweight	≤ 18.50	Low (but risk of other clinical problems increased)
Normal range	18.50–24.99	Average
Overweight:	≥ 25.00	
pre-obese	25.00–29.99	Increased
obese class I	30.00–34.99	Moderate
obese class II	35.00–39.99	Severe
obese class III	≥ 40.00	Very severe

Source: WHO 2000

The BMI values in Table 19 are age-independent and the same for both sexes. However, BMI may not correspond to the same degree of fatness in different populations due, in part, to differences in body proportions and body build. For example, Swinburn et al (1999) found that Polynesians (Māori and Samoan combined) tend to have a lower proportion of fat mass than European New Zealanders at an identical BMI. Rush et al (1997) demonstrated the same results in a similar study on young Polynesian and European New Zealand women. Rush also notes that although percent body fat (% BF) correlates with BMI and mortality and morbidity for European New Zealanders, the correlation of % BF or other adiposity measures in Polynesians needs to be determined and considered in the formulation of what is considered normal or low-risk.

In New Zealand, Swinburn et al (1999) defined a healthy body size as a BMI of 18.5–25.0 kg/m^2 for New Zealand Europeans and 18.5–26 kg/m^2 for Māori and Pacific peoples. Overweight has been defined as a BMI ≥ 26 and < 32 for Māori and Pacific peoples and ≥ 25 and < 30 for all other New Zealanders. Obesity has been defined as a BMI ≥ 32 for Māori and Pacific peoples and ≥ 30 for all other New Zealanders (Swinburn et al 1999). These cut-off points were used to determine the prevalence of overweight and obesity in the NNS97.

Table 20 shows a simplistic relationship between BMI and the risk of co-morbidity. This relationship can be affected by a range of factors, including the type of diet, ethnic group and activity level (see Part IV: Physical Activity – A Partner to Nutrition). The risks associated with increasing BMI are continuous and graded, and begin at a BMI under 25. However, the interpretation of BMI gradings in relation to risk may differ for different populations. Both BMI and a measure of fat distribution (waist circumference or waist/hip ratio (WHR) are important in calculating the risk of obesity co-morbidities.

In summary, BMI can be considered to provide the most useful, albeit crude, population-level measure of obesity. The robust nature of the measurements and the widespread routine inclusion of weights and heights in clinical and population health surveys mean that a more selective measure of adiposity, such as skinfold thickness measurements, provides additional, rather than primary, information. BMI can be used to estimate the prevalence of obesity within a population; it is *not* as useful to assess obesity-related health risk in individuals without other anthropometric measures (WHO 2000).

Other measures of overweight and obesity

The distribution of excess body fat is an important determining factor for some diseases. Table 20 identifies the degree to which obesity is likely to increase the risk of developing such health problems. Excess abdominal fat is a more important predictor of obesity related diseases (eg type 2 diabetes, coronary heart disease) as shown in Table 20 than excess body fat per se. It is useful, therefore, to be able to distinguish between those at increased risk as a result of abdominal fat deposition or 'android obesity' from those with the less serious 'gynoid' fat distribution, in which fat is more evenly and peripherally distributed around the body (WHO 2000). Other measurements that identify individuals at increased risk for obesity-related illness due to abdominal fat accumulation are therefore valuable. Two measures; waist/hip ratio (WHR) and waist circumference (WC) have been found to be useful correlates of abdominal fat accumulation.

Table 20: Relative risk of health problems associated with obesity

Greatly increased (relative risk > 3)*	Moderately increased (relative risk 2–3)*	Slightly increased (relative risk 1–2)*
NIDDM/type 2 diabetes	CHD	Cancer (breast cancer in post-menopausal women, endometrial cancer, colon cancer)
Gallbladder disease	Hypertension	Reproductive hormone abnormalities
Dyslipidaema	Osteoarthritis	Polycystic ovary syndrome
Insulin resistance	Hyperuricaemia	Impaired fertility
Breathlessness		Low back pain due to obesity
Sleep apnoea		Increased anaesthetic risk Foetal defects associated with maternal obesity

* All relative risk values are approximate.

Source: WHO 2000

A high WHR (> 1.0 in men and > 0.85 in women) has been found to indicate abdominal fat accumulation (Han et al 1997). WC is a better measure than WHR. It is a simpler and more convenient measure and is being used increasingly. WC is unrelated to height, correlates closely with BMI and WHR, and is an appropriate index of intra-abdominal fat mass and total body fat. Also, changes in waist circumference reflect changes in risk factors for cardiovascular disease and other forms of chronic disease, even though the risks seem to vary in different populations (WHO 2000).

Obesity in New Zealand

The NNS97 showed that between 1989 and 1997 there was a 55 percent increase in the prevalence of adult obesity. Obesity now affects 17 percent of New Zealand adults; a further 35 percent of adults are overweight. The mean body weight of adults has increased by 3.2 kg over this period (Ministry of Health 1999c). In addition, the NNS97 revealed that that there was an increasing trend towards central obesity as estimated by WHR and measured by skinfold measures. Central obesity is recognised as a significant precursor of high blood insulin, increased plasma triglycerides, decreased HDL levels and elevated blood pressure as well as increased morbidity and mortality (Wilson et al 2001).

Rates of obesity among Māori and Pacific peoples were found to be higher than those of the general population all shown in Table 21.

Table 21: Percentage of New Zealanders overweight or obese

	NZ European and Others		Māori		Pacific peoples		NZ population (age 15+)	
	Male	Female	Male	Female	Male	Female	Male	Female
Percentage of overweight	41.0	29.8	30.0	32.7	59.2	28.8	40.4	30.1
Percentage of obese	12.6	16.7	27.0	27.9	26.2	47.2	14.7	19.2

Source: Ministry of Health 1999c

In 1996 obesity was estimated to account for over 15,000 discounted years of life lost and approximately 1070 deaths (Ministry of Health 1999d). According to projections, there will be a 73 percent increase in the prevalence of obesity in New Zealand – from 17 percent of the population to 29 percent – by the year 2011 (Ministry of Health 2002c).

Financial burden of obesity

The estimated cost of obesity to the New Zealand health sector for the year 1991 was $135 million per annum. This is based on the costs attributable to obesity from coronary heart disease, type 2 diabetes, gallstones and some cancers. This estimate was considered to be very conservative (Swinburn et al 1997b).

This cost of $135 million was estimated to be approximately 2.5 percent of New Zealand's annual healthcare costs in 1991. Based on 2000/01 healthcare expenditure in New Zealand, this would equate to a current financial burden of approximately $247.1 million. The WHO has estimated that the cost of obesity for a country is 2 to 7 percent of the annual health budget (WHO 2000). Therefore, the true cost of obesity in New Zealand could be much higher than the 2000/01 estimate. With the prevalence of obesity increasing, the cost will also be rising.

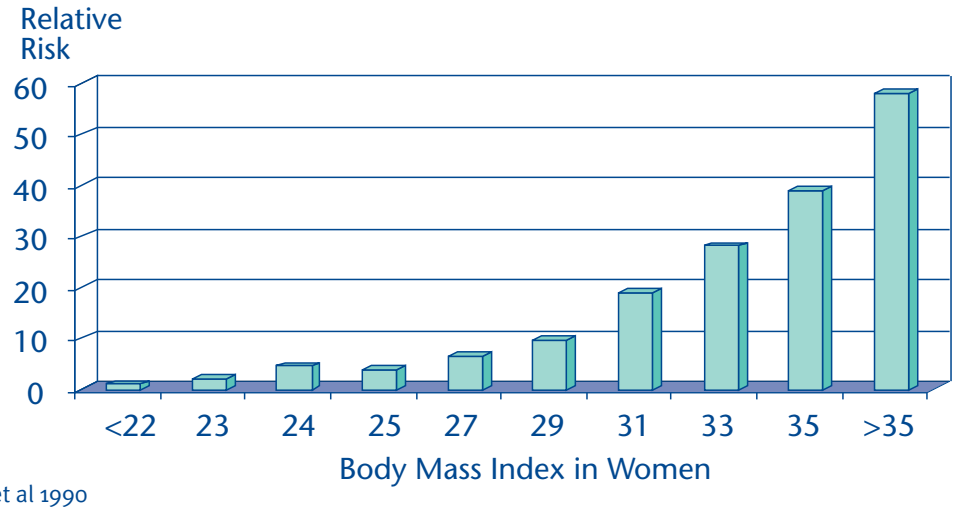
Obesity and disease

Overweight and obesity are associated with a number of threats to health and wellbeing. Both conditions are major risk factors for a wide range of medical and psychosocial problems including:

- chronic, non-communicable diseases that can lead to disability and death (eg, heart disease, type 2 diabetes, hypertension, stroke and some cancers)
- debilitating conditions that can drastically reduce quality of life and are costly in terms of absence from work and use of health resources (eg, osteoarthritis, gallbladder disease, respiratory difficulties, infertility and skin problems)
- psychological problems (eg, clinical depression, lowered self-esteem, job discrimination and other forms of social stigmatisation) (Caterson 2002; Kumanyika et al 2002).

One of the most prevalent consequences of overweight and obesity is type 2 diabetes. The likelihood of developing type 2 diabetes rises steeply with increasing body fatness. Approximately 85 percent of people with diabetes can be classified as type 2; of these, 90 percent are obese. People with type 2 diabetes are at high risk of a range of disabling conditions, including heart disease, hypertension, amputation, stroke, renal failure and blindness. Figure 2 illustrates the relative risk of diabetes in women, based on their BMI.

Figure 2: Relative risk of diabetes in relation to body mass index in women



Source: Colditz et al 1990

Principles of prevention and management of obesity

In obesity and weight gain, both prevention and treatment are problematic because of the complexity of multiple causes of the disease. However, it is now clear that powerful societal and environmental forces influence energy intake and expenditure. These may overwhelm the physiological regulatory mechanisms that operate to keep weight stable. Individual susceptibility to societal and environmental forces is affected by genetic and other biological factors, such as sex, age, ethnicity and hormonal factors. Dietary factors and physical activity patterns are considered to be the major modifiable factors underlying excessive weight gain which, if corrected, can serve to prevent obesity (WHO 2000).

It is important to recognise that the concept of obesity prevention and management does not simply mean preventing normal-weight individuals from becoming obese. Rather, it encompasses a range of strategies that aim to:

- prevent the development of overweight in normal-weight individuals
- promote weight loss in the already overweight or obese

- prevent the progression of overweight to obesity in those who are already overweight
- prevent weight regain in those who have been overweight or obese but who have since lost weight (WHO 2000).

Priority groups

Most adult New Zealanders need to address the issue of energy balance to minimise the risk of overweight and obesity. However, some sectors of the population have been identified as being at higher risk of developing obesity than others. In addition, people are at higher risk of obesity at specific stages of the lifecycle (British Nutrition Foundation 1999). Those in New Zealand at higher risk include:

- children (particularly those with at least one obese parent)
- Māori
- Pacific peoples
- women in low socioeconomic groups
- people with disabilities
- ex-smokers
- women post-pregnancy
- physically inactive people
- people who have been obese previously (Ministry of Health 2003b).

If the population health burden of obesity is to be reduced, interventions should be aimed at changing the environmental factors which lead to obesity in whole populations. Special attention should be to directed at prevention and treatment interventions to high risk groups.

Interventions: public health

Public health interventions targeting food consumption and an increase in physical activity – both of which impact on obesity – are delivered to communities or population groups in a variety of settings. Important settings for obesity intervention are:

- the media – which can influence people's food purchasing and nutrition knowledge, and could promote physical activity
- food consumption and physical activity environments – such as schools, work sites, sports facilities, homes
- the food service industry (restaurants and takeaways)
- the food industry – which influences food composition and marketing
- communities – which influence cultural food consumption patterns and provide physical environments to support physical activity
- the primary care setting (Ministry of Health 2003c).

The current international obesity epidemic is not solely related to energy intake. Energy output, which influences energy balance and weight maintenance, is also important. For this reason, interventions to increase physical activity are also vital. (See: Part IV: Physical Activity – A Partner to Nutrition, and Appendix 6.)

Interventions: individuals

Obesity is a disease that does not always respond to conventional methods of treatment. Its management may require an approach tailored to an individual's needs. Treatment regimes need to focus both on initial weight loss and on *maintaining* an individual's long-term weight reduction (British Nutrition Foundation 1999).

There are many different options for treatment on an individual basis, including:

- dietary interventions
- physical activity and exercise interventions (see: Part IV: Physical activity – A Partner to Nutrition)
- behavioural interventions
- pharmacological interventions
- surgical treatments.

Practical advice

- Most New Zealanders would benefit from a better balance between energy intake and energy output. Negative energy balance can be achieved by a combination of increasing physical activity and/or reducing dietary energy intake (see Appendix 6).
- To reduce dietary energy intake, it is important not to remove the foods that contribute important nutrients, such as vegetables and fruits, breads and cereals, milk and milk products, and meat, poultry, seafood, legumes and eggs.
- It is best to reduce the intake of foods that are high in energy (kilojoules) but low in essential nutrients, such as snack foods and convenience food and drinks (cakes, chips, biscuits, sweets, soft drinks and alcohol).
- Where available, choose lower-fat versions of foods, such as low- and reduced-fat milk options and lean meat.

See also: Chapter 19, Māori, and Chapter 20, Pacific peoples.

13 Coronary heart disease

Background

Coronary (ischaemic) heart disease (CHD) is the leading single cause of death in New Zealand (Ministry of Health 1999e). There is strong evidence that nutritional factors contribute to the progression of coronary heart disease. CHD includes angina pectoris and coronary thrombosis (Mann 2002).

Evidence also shows that dietary modification is important in both prevention and treatment. Lifestyle modification is undoubtedly the most effective means of reducing risk in high-risk populations and individuals (Mann 2002).

Coronary heart disease in New Zealand

CHD event rates fell in New Zealand between 1984 and 1993. Rates of non-fatal CHD events declined on average by 3 percent per year for both men and women (Beaglehole et al 1997). This trend is consistent with improvements in medical treatment and the reduction in the prevalence of major risk factors over this period (Ministry of Health 1999e). Table 22 lists the major identified risk factors for CHD.

Table 22: Identified risk factors for coronary heart disease

Irreversible	masculine gender
	increasing age
	genetic traits, including monogenic and polygenic disorders of lipid metabolism
	body build
Potentially reversible	cigarette smoking
	dyslipidaemia: increased levels of cholesterol, triglyceride, LDL, VLDL and low levels of HDL
	oxidisability of LDL
	obesity, especially when associated with a high WHR
	hypertension
	physical inactivity
	hyperglycaemia and diabetes
	increased thrombosis: increased haemostatic factors and enhanced platelet aggregation
	high levels of homocysteine
Psychosocial	low socioeconomic group
	stressful situations
	coronary-prone behaviour patterns: type A behaviour
Geographic	climate and season: cold weather
	soft drinking water

Notes: HDL = high density lipoproteins; LDL = low density lipoproteins; WHR = waist/hip ratio; VLDL = very low density lipoproteins

Source: Mann 2002

The risk of CHD to an individual is best determined by considering all of the risk factors shown in Table 22. Risk factors have been shown to act in a synergistic way.

One meta-analysis of controlled experiments has concluded that saturated fatty acids raise total and LDL-cholesterol; poly-unsaturated fats lower total and LDL-cholesterol; and mono-unsaturated fats are neutral when compared with carbohydrate (Clarke et al 1997). Other recent research has focused on the important potential protective effects of other dietary components, including antioxidants such as vitamin E and folic acid (Stampfer et al 1993; Boushey et al 1995). However, current evidence from a randomised controlled trial of 20,536 high-risk individuals effectively rules out supplementation with antioxidant vitamins (Heart Protection Study Collaborative Group 2002). In contrast to the evidence against supplementation, establishing a healthy dietary pattern is still to be recommended on the basis of prospective data. A cardioprotective dietary pattern has a low content of saturated and trans fatty acids; a low to moderately low total fat content; uses few refined foods; and involves a higher consumption of foods that have a high fibre content, including vegetables and fruits, wholegrain breads, cereals and legumes (Bremer and Chisholm 2000; New Zealand Guidelines Group 2003). Good evidence of a protective effect associated with higher intakes of plant food has been found in a review of 28 studies relating to vegetable and fruit consumption and the risk of CHD (Ness and Powles 1997).

There are age- and gender-related trends in plasma cholesterol levels seen both in New Zealand (Department of Health 1991) and overseas (Marsarei et al 1981; Huhtasaari et al 1988; Mann et al 1988). Men show a steady increase in mean levels in total and LDL-cholesterol until their mid-40s, after which the mean level stabilises. Women as young adults show lower levels than men, but increases continue through middle age, and older women have higher levels than men of the same age.

The mean total serum cholesterol of the New Zealand adult population, for both males and females, is 5.7 mmol/L. However, in the NNS97, 23 percent of the New Zealand population had total cholesterol levels higher than 6.5 mmol/L (Ministry of Health 1999c). There is a continuous graded risk with increasing blood cholesterol levels and CHD (New Zealand Guidelines Group 2003). The National Heart Foundation (2003) advises that an 'optimal' level of blood cholesterol level is less than 4 mmol/L.

Alcohol and coronary heart disease

See: Chapter 11, Alcohol.

Physical activity

In addition to dietary factors, regular physical activity reduces both the incidence of myocardial infarction (heart attack) and CHD morbidity and mortality (Sherman et al 1999). A dose-response relationship exists between physical activity and CHD. Benefits of physical activity increase with greater intensity (Manson et al 1999; Ades and Coello 2000) and duration (Hakim et al 1999). Where possible, vigorous activity should be included. Physical activity should be performed regularly.

See also: Chapter 2, Energy; Chapter 5, Fat; Chapter 12, Obesity; Chapter 11, Alcohol; and Chapter 18, Physical activity.

Practical advice

Following the Food and Nutrition Guideline statements is advised to protect against the risk of developing CHD. Information specific to those at high risk of CHD is available from the NHF website, www.nhf.org.nz

14 Hypertension

Background

Hypertension (high blood pressure) is an important risk factor for cardiovascular disease. While hypertension is more common in some ethnic groups (eg, Aboriginal Australians and Japanese people), the interplay of genetic and lifestyle factors remains unclear (Ball 1997). Hypertension may be caused or exacerbated by factors that are related to diet including sodium (salt) intake, body weight and alcohol intake. In addition, physical activity has a role to play in reducing hypertension. An average reduction in systolic blood pressure by 2 mmHg across a population is associated with significant benefits – namely, lowering death rates for coronary heart disease and cardiovascular disease by 4 to 5 percent and lowering all-cause mortality by 3 percent (NHF 1999).

Hypertension in New Zealand

Using WHO's cut-off values and irrespective of whether medication was being taken, the NNS97 found 16.5 percent of males and 12.3 percent of females could be considered to be hypertensive. Blood pressure was found to increase markedly with age. Twenty percent of the population had high blood pressure when all individuals who reported taking hypertensive medication and those who were hypertensive were included. The prevalence did not alter across ethnic groups but medication was apparently more effective in the 'New Zealand European and Other' ethnicity (Ministry of Health 1999c).

Factors associated with hypertension

Ten potentially modifiable dietary and lifestyle factors have been found to be related to blood pressure, as summarised in Table 23.

Table 23: Dietary factors related to blood pressure

Major factors
Salt/sodium
Body weight
Alcohol
Less significant/questionable factors
Potassium
Calcium
Vegetarianism
Fatty acids
Dietary fibre
Caffeine
Magnesium

Source: Mann 2002

Sodium

Decreasing sodium (salt) intake in people with hypertension significantly reduces blood pressure (Simpson 1992; Cutler et al 1997; Stalmer 1997; Tobian 1997). The measurement of sodium intake is onerous for respondents in dietary surveys because it requires the collection of a 24-hour urine sample. (See also: Chapter 8, Sodium, for details on sodium intakes in New Zealand.)

Body weight

In a review of clinical guidelines for treatment of obesity, the National Heart Lung and Blood Institute (NHLBI) evaluated the effect of weight loss on blood pressure and hypertension. Thirty-five randomised controlled trials that studied diet and/or physical activity were considered for inclusion. There was strong evidence in both hypertensive and non-hypertensive overweight people that weight loss produced by lifestyle modifications reduced blood pressure levels. The greater the weight loss, the more the blood pressure is likely to reduce (NHLBI 1998). Also, as long as weight loss was maintained, blood pressure remained at the lowered level (Stevens et al 1993; Stevens 1998). Limited evidence was found to support the relationship between reduced abdominal fat and reduced blood pressure, although this evidence was not independent of weight loss. There is considerable evidence that increased aerobic activity reduces blood pressure, independent of weight loss (NHLBI 1998).

Alcohol

The risk of hypertension increases with heavier drinking in men and women (Campbell et al 1999). For those who consume large quantities of alcohol, a reduction in consumption will reduce blood pressure and have other beneficial health effects. Adherence to ALAC's drinking guidelines is an important non-pharmacological treatment to prevent and control hypertension.

Dietary patterns

The Dietary Approaches to Stop Hypertension (DASH) trial was designed to determine the effect of entire dietary patterns. The DASH combination diet (high in vegetables, fruits, nuts and low-fat dairy products, and emphasising fish and chicken rather than red meat) was found to lower systolic and diastolic blood pressure by 5.5 and 3 mmHg respectively (Appel et al 1997). The DASH combination diet may offer an alternative or an addition to drug therapy in hypertensive people. (For further consumer information about the DASH diet, see: www.nhlbi.nih.gov/health/public/heart/hbp/dash/)

Increased consumption of vegetables and fruits has also been shown to reduce blood pressure slightly in healthy adults. Small reductions in blood pressure would result in substantial reductions in cardiovascular disease at the population level (John et al 2002).

Physical activity

In addition to dietary factors, aerobic activity can reduce blood pressure in both the short and long term if the activity level is maintained (Hagberg et al 2000). Results from three meta-analyses show that the extent of the blood pressure reduction depends on the baseline blood pressure (Halbert et al 1997; Fagard 2001; Whelton et al 2002). They also showed that activity at lower intensities (40 to 70 percent peak oxygen uptake) can have as much impact as higher intensity activity (Fagard 2001). This finding should have important implications for prescribing physical activity for older people.

Practical advice

- Following the Food and Nutrition Guideline statements is advised for protection against hypertension.
- Following the guidelines includes having a healthy weight, not drinking too much alcohol, limiting your salt intake, and eating plenty of vegetables and fruits.
- Be physically active every day.

15 Diabetes mellitus

Background

There are two main types of diabetes mellitus (Expert Committee on the Diagnosis and Classification of Diabetes Mellitus 1997; Alberti and Zimmet 1998).

- **Type 1 diabetes** is an autoimmune disease in which the insulin-producing pancreatic beta cells are destroyed. It typically has an abrupt and symptomatic onset, and usually presents in children and young adults under 30 years of age. However, cases of later onset in adults are increasingly being recognised.
- **Type 2 diabetes** is much more common than type 1 diabetes. It has a more insidious onset, and it is commonly asymptomatic for several years before being diagnosed. Type 2 diabetes is caused by reduced insulin secretion together with insulin resistance (resistance to the action of insulin by the body tissues). The incidence of type 2 diabetes increases with increasing age, and it usually presents in adults. However, it is becoming more common in adolescents and children. Obesity is the most important modifiable risk factor for development of type 2 diabetes.

  Population groups at high risk of developing type 2 diabetes in New Zealand include Māori, Pacific peoples and people with a family history of diabetes (Ministry of Health 1999e). It has been estimated that diabetes may cost between $250 million and $600 million in health care costs per year (Simmons 1996).

The WHO has defined diabetes mellitus as a metabolic disorder:

- of multiple aetiology
- characterised by chronic hyperglycaemia with disturbances of carbohydrate, fat and protein metabolism
- resulting from defects in insulin secretion or insulin action, or both (WHO 1999).

The burden of type 2 diabetes in New Zealand

The major burden of diabetes in New Zealand relates to type 2 diabetes. This trend mirrors the international experience. Of all New Zealanders with diabetes, approximately 85 to 90 percent have type 2 diabetes. Type 2 diabetes is more common in Māori and Pacific peoples, among whom 95 percent of people with diabetes have type 2 diabetes, compared with 89 percent of New Zealand Europeans (Health Funding Authority 2000). The overall prevalence of diagnosed diabetes in New Zealand adults has been estimated to be 3 to 4 percent (Health Funding Authority 2000).

The Ministry of Health has recently published estimates of the prevalence and mortality burden of diagnosed type 2 diabetes in New Zealand. It has also published forecasts of the incidence, prevalence and mortality of type 2 diabetes to 2011 (Ministry of Health 2002a, 2002b, 2002c, 2002d). This modelling work takes into account the rapid growth in the percentage of the population that is obese – obesity being the most important risk factor for type 2 diabetes. The estimated prevalence figures for 1996 and forecasts for 2011 are shown in Table 24.

Table 24: Prevalence of diagnosed diabetes (onset 25–89 years), by gender and ethnicity, 1996 baseline and 2011 forecast

	Male			Female			Total
	European	Māori	Pacific	European	Māori	Pacific	
Prevalence rate	3.10	7.95	6.78	2.50	9.78	8.23	
Number 1996	31,790	7014	2003	28,707	9291	2686	81,491
Number 2011	51,408	16,202	4991	44,105	21,649	6558	144,913
Percentage increase	62	131	149	54	133	144	78

Source: Modified from Ministry of Health 2002b

People living in more deprived areas and those with lower incomes tended to have higher rates of diagnosed diabetes (Ministry of Health 1999e).

Nearly 5 percent of all deaths in New Zealand are attributable to type 2 diabetes. Three to four times as many deaths among Māori and Pacific peoples are attributable to diabetes when compared with New Zealand Europeans (Ministry of Health 1999d).

Dietary and lifestyle prevention strategies for type 2 diabetes

The importance of preventing diabetes in high-risk individuals is highlighted by the substantial worldwide increase in the prevalence of diabetes in recent years. Genetic susceptibility appears to play a powerful role in the occurrence of type 2 diabetes in certain populations. However, given that population gene pools shift quite slowly, the current epidemic is likely to reflect marked changes in lifestyle. Lifestyle changes, characterised by decreased physical activity and increased energy consumption, have together promoted obesity. Obesity is a strong risk factor for diabetes that itself is influenced by both genes and behaviour (American Diabetes Association 2003). Both cross-sectional and longitudinal studies have found obesity to be a risk factor for diabetes, with central (abdominal) obesity an independent risk factor (WHO 2000).

Three randomised controlled trials have shown convincingly that prevention or delay in the onset of diabetes is possible in people with impaired glucose tolerance (IGT) (Pan et al 1997; Tuomilehto et al 2001; Diabetes Prevention Program Research Group 2002). The trials were conducted in different countries, settings and populations, and all used lifestyle interventions (diet and exercise) in order to achieve weight loss and higher levels of physical activity. In the United States Diabetes Prevention Program trial of 3234 people with IGT, 1079 participants in the lifestyle arm of the study had the goals of at least 7 percent weight loss and at least 150 minutes of physical activity per week (Diabetes Prevention Program Research Group 2002). The lifestyle intervention reduced the incidence of diabetes by 58 percent compared to the control group, and one case of diabetes was prevented for every 6.9 people treated for three years.

Other epidemiological data suggest that type 2 diabetes could be reduced by 50 to 75 percent by control of obesity and 30 to 50 percent by increasing physical activity (Manson and Spelsberg 1994). Current prevention trials, such as the Early Diabetes Intervention Trial and Diabetes Prevention Programme, and the United States Diabetes Prevention Program are looking at the combined effect of lifestyle changes and drug treatment in the prevention of type 2 diabetes (Adler and Turner 1999; Diabetes Prevention Program Research Group 2002).

The aim of dietary intervention is to improve all the biochemical and physiological parameters associated with type 2 diabetes. The maintenance of blood glucose levels alone will help prevent the microvascular complications of diabetes. Because most people die from the cardiovascular complications associated with diabetes, dietary advice to lose weight, reduce blood pressure and improve lipid profiles (including HDL and triglycerides) is important. In addition, reduced intake of total fat, particularly saturated fat, may reduce the risk for diabetes. Increased diabetes incidence is reported with increased intake of dietary fat, independent of total energy (American Diabetes Association 2003). It appears that all types of dietary fat (except omega-3 fatty acids) may have an adverse effect on insulin sensitivity. Other studies have shown a reduced risk with increased intake of whole grains and dietary fibre (American Diabetes Association 2003). Although moderate alcohol intake has been related to improved insulin sensitivity, there are insufficient data to support a specific recommendation for moderate alcohol intake to reduce the risk in developing type 2 diabetes (American Diabetes Association 2003).

Practical advice

- Follow the Food and Nutrition Guideline statements for the reduction of risk in developing type 2 diabetes.

16 Cancer

Background

Cancer causes over a quarter of all deaths in New Zealand. It is the major cause of years of life lost in women in New Zealand, and is the second major cause for men (after cardiovascular disease) (Ministry of Health 1999d).

Rankings for the major cancers in terms of disability-adjusted life years (DALYs) lost are: lung cancer (17,900), colorectal cancer (16,300), breast cancer (13,500), prostate cancer (7400), lymphoma/myeloma (5500) and melanoma (4000) (Ministry of Health 1999d).

Cancer is caused by a variety of identified and unidentified factors. Among those identified are behavioural factors (eg, physical activity), environmental factors (eg, some forms of pollution) and dietary factors. Except for certain types of familial cancer, the contribution of hereditary factors is thought to be relatively minor (Lichtenstein et al 2000). Dietary factors are thought to account for about 30 percent of cancers in developed countries (Key et al 2002). A wide range of factors related to food, nutrition and physical activity have been linked to a number of cancers, as shown in Table 25, but the strength of both evidence and association vary.

Obesity and cancer

Both case-control and cohort studies have shown associations between high levels of body fat (as indicated by higher BMI during adult life and/or higher waist/hip ratio) and increased risk for colon cancer and colon adenomas. This association is seen for both men and women, although the association with BMI is higher among men. The reason for the gender difference is unknown. One possible explanation is that oestrogen could serve to diminish the obesity-related risk in women (WHO 2000).

Heavier women have been found to be at increased risk of postmenopausal breast cancer. This association is in contrast to the evidence on pre-menopausal breast cancer which is not linked with body weight. The large majority of cohort and case-control studies have seen positive associations between BMI and risk of postmenopausal breast cancer, although increase in risk has been modest. To date, the most consistent body-size predictor of postmenopausal breast cancer risk is adult weight gain. Breast cancer has a positive association with both BMI and weight gain. The association is positive even after adjusting for a wide variety of lifestyle and reproductive risk factors, including levels of physical activity. Other cancers associated with increasing BMI and weight gain are endometrial cancer, kidney (renal cell) cancer, and oesophageal and colorectal cancer (International Agency for Research on Cancer 2002).

Table 25: Summary of dietary and physical activity risk factors, protective factors and other major risk factors for the common cancers

Cancer factors	Risk factors related to diet and physical activity	Protective factors	Other major risk
Oral cavity, pharynx, and oesophagus	obesity (adenocarcinoma of the oesophagus) alcohol very hot drinks Chinese-style salted fish (nasopharnageal cancer)	probably vegetables and fruits	smoking
Breast	obesity after menopause alcohol	30–60 minutes physical activity daily	reproductive and hormonal factors
Endometrium	obesity	physical activity	low parity
Colon and/ or rectum obesity	probably alcohol possibly red and processed meat	probably vegetables and fruits, and other plant foods rich in fibre 30–60 minutes intense physical activity daily (colon only)	
Kidney	obesity	not established	none established
Liver	high alcohol intake foods containing aflatoxins	none established	hepatitis viruses
Larnyx	alcohol	none established	smoking
Stomach	probably high intake of salt-preserved foods and salt	probably vegetables and fruits	infection by *h pylori*
Pancreas	none established	none established	smoking
Lung	none established	4 hours per week of intense physical activity possibly vegetables and fruits	smoking
Cervix	none established	none established	human papillomavirus
Prostate	none established	possibly physical activity	none established

Source: Adapted from Key et al 2002, using additional information from International Agency for Research on Cancer 2002

Physical activity and colon cancer

Current evidence suggests that physical activity has an important protective role in many cancers. One of the problems associated with understanding the relationship between physical activity and cancers is the difficulty of measuring physical activity in a standardised manner. In addition, there is the question of whether to measure occupational activity, leisure time activity, participation in sports or incidental activity. Total activity and specific components of physical activity (such as level of intensity at which activities have been performed) have been examined in a variety of the above settings.

The evidence that physical activity protects against colon (as distinct from rectal) cancer is strong and convincing. The evidence for physical activity being protective against rectal cancer is less consistent (NHMRC 1999b). Other cancers for which physical activity has been found to have a protective effect are shown above in Table 25.

Bauman et al (2002) suggest that at least 60 minutes per day of moderate to vigorous activity is required to reduce the risk of cancer.

Food and nutrients and colorectal cancer

There is some evidence to link colorectal cancer with a number of foods and dietary habits. The proportion of colorectal cancer attributed to dietary factors has been estimated to be about 50 percent. One overview of diet and cancer estimates that 66 to 75 percent of colorectal cancer could be prevented by diet and physical activity (NHMRC 1999b).

Case-control studies consistently show a positive association between energy intake and colorectal cancer risk. The evidence is sufficient to recommend reducing energy intake to prevent colorectal cancer (NHMRC 1999b). Other positive associations of diet with colorectal cancer include high-fat intake (except fish oil, where there is an inverse relationship), low folate intake (especially in habitual alcohol consumers) and total alcohol intake (Baghurst et al 1997).

International correlational studies have shown an association between consumption of meat per capita and deaths from colorectal cancer. One meta-analysis suggests that, overall, risk increases with intake of red meat and processed meat, but risk is not associated with total meat intake (Key et al 2002). However, a yet-to-be-published meta-analysis of cohort studies has found increased risk of colorectal cancer for total red meat consumption (Riboli 2002). The strongest association was for intake of processed meat, while there was no association between intake for *fresh* red meat and increased risk.

There are several possible explanations as to how meat consumption might increase the risk of colorectal cancer. First, when meats are cooked at high temperatures (such as barbecuing), mutagenic heterocyclic amines (HCAs) and polycyclic aromatic hydrocarbons (PAHs) are formed. Second, studies suggest that nitrites and related compounds that are used in smoked, salted and some processed meats are converted to carcinogenic N-nitroso compounds in the colon. It has also been suggested that iron in the colon could increase the formation of mutagenic free radicals (Key et al 2002).

Further studies are needed to clarify the relationship between red meat and the risk of colorectal cancer. Based on present studies, there is no strong evidence that red meat should not be eaten as part of a normal, balanced diet. (See: Chapter 3, Protein.)

Results from many case-control studies have shown a lower risk of colorectal cancer associated with a high consumption of dietary fibre, vegetables and fruits. Key et al (2002) reported that the findings from large prospective studies have been inconsistent, but subsequently Bingham et al (2003) have reported otherwise. It has also been proposed that cereals (especially insoluble

fibre) and phytonutrient compounds found in vegetables (carotenoids, vitamins C and E, folate, indoles, linolenic acid, allylic sulphides, lycopene and others) are protective against colon cancer. These nutrients have been shown to have a possible protective effect when consumed in foods. Supplementation with isolated nutrients (eg, antioxidant vitamins, carotenoids, calcium, folic acid, selenium), however, has not shown any conclusive protective effect, although in some cases it shows promise (NHMRC 1999b).

Vegetable and fruit intake and cancer

Studies have shown the protective effect of vegetables and fruits especially in relation to cancers of the oral cavity, larynx, oesophagus, stomach and colon. This protective effect may be a result of the contact that the vegetables and fruits have with the associated tissue. Significant reduction in risk, however, has also been observed with respect to cancers of the lung, and possibly the breast endometrium and pancreas. The association between vegetable and fruit intake and protection against cancer is recognised to the extent that the United States Food and Drug Administration (1994) has allowed a health claim suggesting that diets low in fat and rich in vegetables and fruits may reduce the risk of some cancers.

It has been suggested that consumption of 400 g per day or more of a variety of vegetables and fruits could, by itself, decrease overall cancer incidence by at least 20 percent (World Cancer Research Fund 1997). Vegetable intake seems to be particularly important, especially intake of cruciferous vegetables, including bok choy, broccoli, brussel sprouts, cabbage, cauliflower, Chinese cabbage, collards, kohlrabi, mustard greens, swedes and turnips.

Dietary fibre and cancer

Dietary fibre assists in regulation of intestinal function. The results of increased dietary fibre include reduced transit time, increased faecal weight and improved laxation. These factors, along with dilution of lumenal contents, have been linked to a reduction in colon cancer risk. Correlational epidemiological evidence suggests a relationship between dietary fibre intake and colon cancer incidence. However, more refined case-control studies have not consistently supported this link. The body of evidence is insufficient at present to determine if increased fibre intake leads to decreased colon cancer risk (Institute of Medicine 2002b). Bingham et al (2003) have reported a protective effect of dietary fibre against colorectal cancer in the European Prospective Investigation into Cancer and Nutrition.

Alcohol and cancer

Alcohol consumption is associated with a higher risk for a number of cancers identified in Table 25 above. The largest meta-analysis to date considered a total of 235 studies on alcohol and cancer (Bagnardi et al 2001). When the relationship between alcohol consumption and cancer was studied, major findings were:

- strong trends in risk for cancers of the oral cavity and pharynx, oesophagus and larynx
- weaker direct relations for cancers of the stomach, colon and rectum, liver, breast and ovary
- no significant or consistent relation for cancers of the pancreas, lung, prostate or bladder
- allowance for tobacco appreciably modified the relations with laryngeal, lung and bladder cancers, but not with oral, oesophageal or colorectal cancers
- there was no evidence of a threshold effect for most alcohol-related cancerous tumours.

Summary

Increasing obesity appears to be an important risk factor for many cancers. Physical activity, particularly of moderate or greater intensity, appears to be protective against some cancers.

Extensive research over the last 30 years has revealed few conclusive dietary determinants of cancer risk. The shortage of such factors may be a result of inaccuracies inherent when estimating food and nutrient intakes and the biases in case-control studies. Large prospective studies and controlled trials are required to gain a better understanding of the role of diet in cancer; the work of the International Agency for Research on Cancer has added to this evidence base.

At present the most prudent advice for maintaining health and reducing cancer risk is to follow the advice given in the Food and Nutrition Guideline statements with regard to a balanced diet, physical activity and alcohol consumption. In addition, the following recommendations may reduce risk.

Practical advice

- No level of alcohol intake is protective against cancer.
- Consume plenty of vegetables and fruits.
- Consume only moderate amounts of preserved meat (eg, sausages, salami, bacon, ham).
- When barbecuing meat, a plate-style barbecue is preferable to grilling on direct flame, in order to reduce the risk of HCA formation.
- Limit the consumption of fermented, salted fish.

See also: Chapter 11, Alcohol; and Chapter 12, Obesity.

17 Osteoporosis

Background

Osteoporosis is a serious and expensive public health problem, particularly in women. It causes significant pain and morbidity among older people (Goulding 2002).

Osteoporosis is characterised by loss of bony tissue from the skeleton and deterioration of bone structure. It is associated with enhanced bone fragility and increased risk of fracture (Consensus Development Conference 1991). European and Asian New Zealanders have a higher risk of osteoporotic fracture than Māori and Pacific peoples (Sainsbury and Richards 1997). If costs for osteoporosis in New Zealand are extrapolated from Australian data, they may be as high as $150 million to 200 million (Randall et al 1995). An ageing population is likely to increase the burden of osteoporosis in the future.

Dietary and lifestyle factors

The strength of bones depends on the peak bone mass reached during adolescence and young adulthood. It also depends on the rate of bone mass loss after the age of 40 years. While osteoporosis is rare in young adulthood, clues to future bone health may be present at this age. A healthy body weight is the single most important determinant of healthy bone density in young adults (Reid et al 1995b).

Meeting the body's calcium needs optimises skeletal health. The amount of calcium-rich foods in the diet of New Zealanders is insufficient (Ministry of Health 1999c). It has been suggested that, unless daily calcium intake exceeds 1000 mg (O'Brien et al 1993), calcium balance is not maintained in either men between the ages of 25 and 65 years or pre-menopausal women older than 25 years. The rate of skeletal loss as a result of menopause can be reduced by the ingestion of at least 1000 mg per day of calcium during the perimenopausal and postmenopausal years (Cumming 1990; Elders et al 1991; Reid et al 1994; Prince et al 1995; Reid et al 1995a). Suboptimal vitamin K status has also been implicated in the pathogenesis of osteoporosis (Olson et al 2001).

Changes in bone mass and the development of osteoporosis are multifactorial. Calcium is one of many factors. The other major nutrient is vitamin D; low vitamin D status will reduce bone strength (Sainsbury and Richards 1997). Most adults receive adequate vitamin D from 15 to 30 minutes of exposure to ultraviolet B radiation each day. Those most at risk of inadequate vitamin D status include older people, those living in institutions and those with limited exposure to sunlight/ultraviolet (UV) light.

Lifestyle factors influencing bone mass include physical activity, hormonal status, genetics, co-morbidity, medication use, smoking and alcohol (Sainsbury and Richards 1997). People with anorexia are also at higher risk of developing osteoporosis, as are female marathon runners and those who take excessive exercise (Smith 2001).

Osteoporosis and osteopenia (ie, decreased bone mass) may develop as a consequence of alcohol misuse. Osteoporosis may also arise as a consequence of cirrhosis of the liver. However, musculoskeletal damage can be halted or often reversed by prolonged abstinence from alcohol and nutritional support (Marshall et al 2001).

There is evidence that moderate and vigorous physical activity in childhood increases bone mass and strength. Physical activity is recommended for asymptomatic adults to help preserve bone density. Modified physical activity is also recommended for those with osteoporosis to improve posture and muscle strength and maintain bone mass (Forwood and Larsen 2000).

Prevention of osteoporosis can start in childhood and continue throughout life, and recommendations apply to those who are healthy as well as those who already have osteoporosis (Sainsbury and Richards 1997). New Zealanders are encouraged to follow the Food and Nutrition Guideline statements and the advice below.

Practical advice

- Limit your salt intake. (See: Chapter 7, Calcium; and Chapter 8, Sodium)
- Take part in regular, moderate, weight-bearing physical activity, such as walking.
- Be smoke-free.
- Have a small amount of sun exposure each day to ensure adequate vitamin D status.
- Vitamin D supplements may be necessary for the institutionalised who do not have exposure to sunlight.

See also: Chapter 7, Calcium; Chapter 8, Sodium; and Chapter 22, Supplementation and fortification

Part IV: Physical Activity – A Partner to Nutrition

18 Physical activity

Background

Increasing physical activity (as defined in Glossary) is a priority health objective in the New Zealand Health Strategy (Minister of Health 2000a). A joint policy statement of physical activity, setting out key messages, was made in 1999 by the Minister of Sport, Fitness and Leisure and the Minister of Health (see: Appendix 6).

The benefits of regular physical activity for adults are well established. Physical activity has many benefits for the cardiovascular and musculoskeletal systems, as well as for the functioning of the metabolic, endocrine and immune systems. The health benefits of increased physical activity include reducing the incidence of the following diseases.

- **Coronary heart disease.** Aerobic activity is important for the prevention and control of coronary heart disease (Sherman et al 1999). A dose-response relationship exists. Greater benefits are obtained through increasing intensity (Manson et al 1999; Ades and Coello 2000) and duration (Hakim et al 1999). Activity should be performed regularly.
- **Cerebrovascular accident (stroke).** Aerobic activity (particularly vigorous activity) in middle-aged and older adults is associated with a reduction in the risk of ischaemic stroke (Ellekjaer et al 2000; Hu et al 2000). Stroke risk decreases with increasing intensity of aerobic activity (Hu et al 2000). At least some vigorous activity is, therefore, recommended.
- **Cancer.** Aerobic activity reduces the risk of colon and breast cancers (Batty and Thune 2000; Marrett et al 2000; International Agency for Research on Cancer 2002). Recent evidence suggests that 45 to 60 minutes of moderate to vigorous activity is required to protect against colorectal cancer (International Agency for Research on Cancer 2002). For cancers of the endometrium and prostate, there is some evidence that physical activity has a cancer-preventive effect (International Agency for Research on Cancer 2002).
- **Depression.** Regular aerobic activity of light or moderate intensity can improve mood in those with major depressive disorders (Dimeo et al 2001) and reduce the risk of depression in others (Morgan and Bath 1998).
- **Diabetes.** Regular moderate-intensity physical activity reduces the risk of developing type 2 diabetes (Manson and Spelsberg 1994; Hu et al 1999), especially in those at high risk (Tuomilehto et al 2001). Physical activity should be coupled with a healthy diet and professional nutritional advice.
- **Hypertension.** Aerobic activity can reduce blood pressure in the short term and, if the activity level is maintained, in the long term (Hagberg et al 2000).
- **Obesity.** Regular moderate-intensity physical activity aids in the prevention, maintenance and treatment of obesity (Grundy et al 1999).
- **Osteoporosis.** Moderate and vigorous activity is recommended for children to increase bone mass and strength. It is also recommended for asymptomatic adults to help preserve bone density and reduce fracture risk. Modified physical activity is recommended in those with osteoporosis to improve posture and muscle strength, and to maintain bone mass (Forwood and Larsen 2000).

Physical activity can also reduce the risk of, or improve the outcomes for, a number of other health conditions including Alzheimer's disease (Laurin et al 2001), anxiety (Scully et al 1999), asthma (Huovinen et al 2001; Rasmussen et al 2000), chronic obstructive respiratory disease (Mink 1997; Weiner et al 2000), osteoarthritis (Kovar et al 1992; Sevick et al 2000) and stress (Carmack et al 1999).

In addition to the evidence above, a lifelong commitment to a high level of physical activity in terms of frequency, duration and (to a lesser extent) intensity can improve disability-free life years and life expectancy (Ferrucci et al 1999; Leveille et al 1999).

Dimensions of physical activity

Physical activity has several dimensions and is influenced by both environmental and individual factors. The dimensions of physical activity are: type, intensity, frequency, duration and context (eg, recreation, occupation, transport and incidental). The wider environment provides opportunities and presents barriers to physical activity (eg, urban design, safety, pollution, availability of parks and facilities). In addition to environmental factors, an individual's physical activity level is influenced by preferences and constraints, such as perceived enjoyment, skill, income, social/cultural attitudes, family commitments and health status as well as knowledge and motivation.

Approaches to increase physical activity must take account of all these elements, and bring together key players to collaborate and co-ordinate in their efforts to support and encourage more people to be physically active.

Extent of physical activity in New Zealand

Survey programmes that provide information about the physical activity levels of adult New Zealanders are the New Zealand Health Survey (1996/97) and the New Zealand Sport and Physical Activity Surveys (1997/98, 1998/99 and 2000/01). The majority of the following results come from combined data from the New Zealand Sport and Physical Activity surveys and include the first national trend data on physical activity participation (Ministry of Health 1999f; SPARC 2003a).

How has physical activity been measured?

Activity level categories that are used in the New Zealand Sport and Physical Activity surveys are shown in Table 26.

Table 26: New Zealand Sport and Physical Activity survey categorisations

Active/inactive	Category	Description
Physically inactive	Sedentary	No sports/activities in the previous 4 weeks (2 weeks for young people 5–17 years)*
	Relatively inactive	Took part in some leisure-time activity in the previous 7 days, but less than 2.5 hours in total
Physically active	Relatively active	Took part in at least 2.5 hours, but less than 5 hours of leisure-time activity in the previous 7 days
	Highly active	Took part in 5 hours or more leisure-time activity in the previous 7 days

* The New Zealand Health Survey 1996/97 asked about no activity (being sedentary) in the last 7 days. It did not ask about physical activity among young people.

Sources: Ministry of Health 1999f; SPARC 2003a

Key results of New Zealand Sport and Physical Activity Surveys

Overall

- Among adults and among young people aged 5 to 17 years, 68 percent are physically active for 2.5 hours each week.
- In total, 10 percent of adults and 9 percent of young people are sedentary.

Gender

- Men (69 percent) and boys (73 percent) are more active than women (66 percent) and girls (64 percent).

Age

- Adults aged 18 to 24 years (70 percent) and older adults aged 50 to 64 years (71 percent) and aged 65+ years (70 percent) are the most active.

Ethnicity

- Māori, New Zealand European and Pacific men are similarly active. Men from other cultures[2] are less active. New Zealand European (71 percent) and Māori young people (71 percent) are more active than young people of Pacific origin (53 percent) and from other cultures (59 percent).
- Among women, New Zealand Europeans and Māori are the most active.
- Among sedentary adults, Māori are more likely to be sedentary (12 percent) than New Zealand Europeans (9 percent) and Pacific peoples (10 percent). Adults from other cultures are the most sedentary (17 percent).

Trends

- Trend analysis shows that adults were more active in 2000/01 (70 percent) than they were in 1997/98 (67 percent). In raw figures, this means around 150,000 more adults were active in 2000/01 than in 1997/98.

Physical activity by region

- Activity levels for adults are similar across Regional Sports Trust areas.

Detailed results from the New Zealand Sport and Physical Activity Surveys are available at SPARC's Push Play website (www.pushplay.org.nz).

Socioeconomic status

According to the New Zealand Health Survey (Ministry of Health 1999e), people with a lower level of education tend to participate in less physical activity. People who have no qualifications are more likely to be sedentary than those with school and postschool qualifications.

Duration of physical activity is not significantly associated with level of household family income or NZDep96 score. Levels of vigorous activity, however, are significantly associated with both household income and NZDep96 score, as well as with level of education.

[2] 'Other cultures' refers to all people who did not identify themselves as Māori, European or Pacific peoples.

Strategies for increasing levels of physical activity

Strategies for increasing physical activity are summarised in the District Health Board toolkit on physical activity (Ministry of Health 2001b), available online on the Ministry of Health's website (www.moh.govt.nz) and in the *Healthy Eating – Healthy Action* (HEHA) papers (Ministry of Health 2003b, 2003c).

Strategies to promote physical activity need to focus on both the wider environment and individual lifestyles. Co-ordinated initiatives to support physical activity are required across a range of sectors and settings (eg, health, transport, local government, recreation, sport and fitness, education, the workforce; schools and tertiary institutions; health care settings; and local community settings such as clubs, churches and marae). The health promotion approach in HEHA is based on the Ottawa Charter (WHO et al 1986). It includes building healthy public policy, creating supportive environments, strengthening community action, developing personal skills, monitoring and evaluation, and reorienting services (Ministry of Health 2003c).

Some examples of strategies and programmes are:[3]

- building healthy public policy – *New Zealand Health Strategy* (Minister of Health 2000); a joint policy statement on physical activity (Minister of Sport, Fitness and Leisure and the Minister of Health 1999); Physical Activity Taskforce Report (Hillary Commission 1998); the Graham Report (Graham et al 2001)
- creating supportive environments: Heartbeat Challenge/Let's Get Moving (National Heart Foundation); Walking School Bus; Active Christchurch (local government, partnerships)
- strengthening community action: Walking School Bus; Push Play television commercials: KiwiWalks; KiwiSeniors; He Oranga Poutama (Kaiwhakahaere programme); Hikoi 2000; Green Bikes (Porirua, Palmerston North)
- developing personal skills: Physical Activity Guidelines
- reorienting health services: Green Prescriptions, whereby doctors and practice nurses write out a prescription for physical activity, with patients receiving follow-up and support from Regional Sports Trusts.

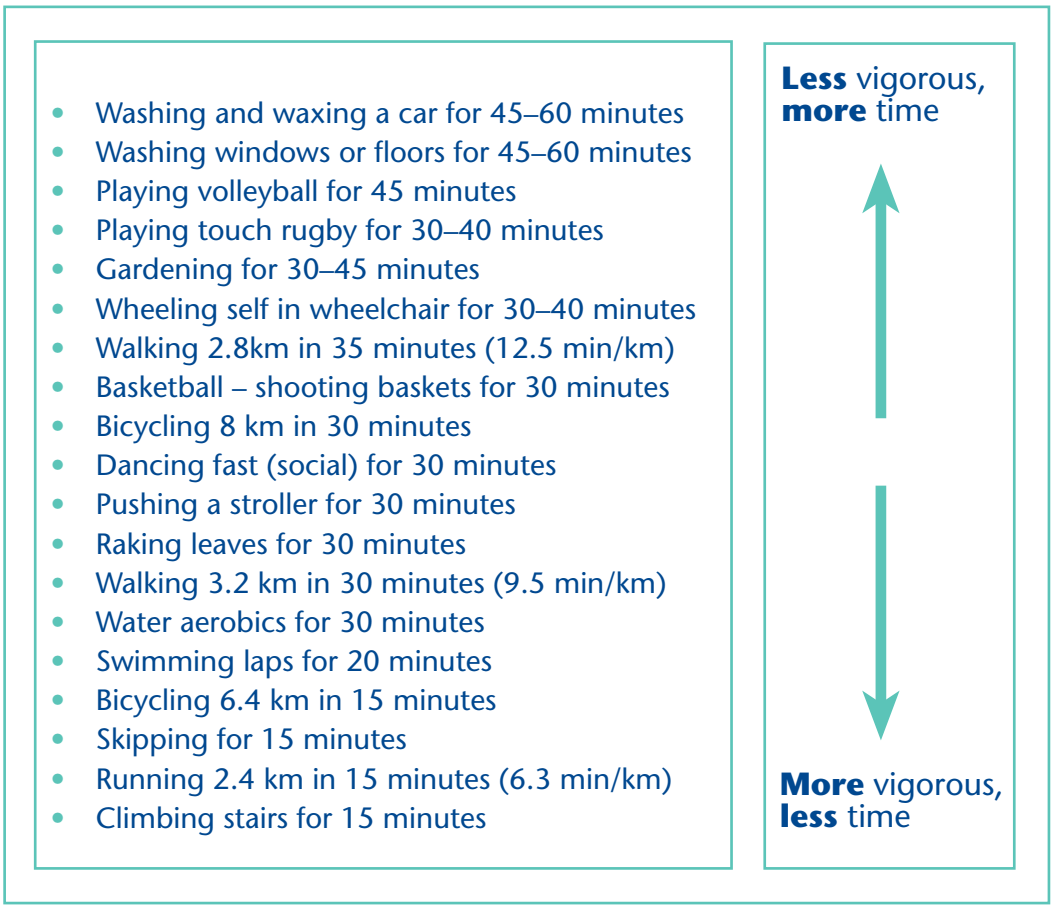
Public and personal health providers (government, non-government, Māori and Pacific providers, and primary care) deliver a range of programmes and services to promote physical activity and nutrition, using a combination of the approaches outlined above. They often work in partnership with other organisations.

Recommendations for levels of activity

Significant health benefits can be obtained from doing at least 30 minutes of moderate-intensity physical activity on all or most days of the week (eg, brisk walking, cycling, climbing stairs). Additional benefits can be achieved by including some vigorous activity. This recommendation has been made for people of all ages (Department of Health and Human Services (US) 1996). Some possible ways of meeting this recommendation are shown in Figure 3.

[3] For more examples of physical activity initiatives, see the associated DHB toolkit (Ministry of Health 2001a, online at www.moh.govt.nz) and Ministry of Health (2003b).

Figure 3: Ways of meeting the moderate physical activity guidelines (in daily life)



Source: Modified from Centers for Disease Control and Prevention 1997

Wherever possible, physical activity must link with nutrition. Good nutrition is essential to supporting physical activity. Good nutrition and physical activity are particularly important to maintaining a healthy weight, and to preventing and treating obesity (Grundy et al 1999).

The Hillary Commission (now SPARC) has developed guidelines for promoting physical activity under the Push Play campaign. Push Play aims to encourage people to become more physically active for the benefit of their health. Its four guidelines are as follows.

- View movement as an opportunity, not an inconvenience.
- Be active every day in as many ways as possible.
- Put together at least 30 minutes of moderate-intensity physical activity on most if not all days of the week.
- If possible, add some vigorous exercise for extra health and fitness (Hillary Commission 2001).

Part V: Nutrition and Health in Māori and Pacific Peoples

19 Māori

Background

Māori are more likely than non-Māori to experience poor health as a consequence of inappropriate nutrition. The factors that have contributed to this trend include:

- the impacts of colonisation on Māori, including the adoption of a European diet and the loss of mahinga kai (traditional food-gathering areas) through land loss and the pollution of coasts and waters
- changes to Māori economic and social status, with the result that Māori are concentrated in low socioeconomic groups
- possible genetic factors (such as those that may predispose Māori to diabetes, or lead to lower rates of bowel cancers)
- cultural factors in Māori society that may affect the types of food eaten (Pōmare et al 1995).

There could be significant Māori health gain if all Māori were able to access good nutrition and dental care, and there were fewer barriers to regular physical activity. Health promotion programmes have been found to be most effective in reaching Māori when they are tied to a positive promotion of Māori identity. A key element in Māori health gain is developing Māori providers that are based in Māori world views and that support Māori aspirations (Ministry of Health 1998c). Such providers have been able to improve both the access and quality of service provided to Māori.

This chapter briefly discusses Māori models of health, the place of Māori traditional foods in the diet, the burden of disease, and Māori initiatives to improve Māori nutrition.

Māori models of health

Māori approaches to health are primarily based on the view that hauora, or holistic health, is the product of wellbeing at physical, spiritual, psychological and social levels. There are many Māori models of health in use that encompass this view. These models include *Te Whare Tapa Whā* (the four cornerposts of health; Pōmare et al 1995), *Te Pae Mahutonga* (the Southern Cross; Durie 1999) and *Te Wheke* (the octopus; Pōmare et al 1995). Public health services being delivered to Māori need to address specific Māori health needs and must reflect an understanding of hauora Māori (Minister of Health and Associate Minister of Health 2002a).

Frameworks for improving Māori health need to incorporate the principles of the Treaty of Waitangi. Effective health care for Māori will recognise their cultural diversity (Health Promotion Forum 2001).

Traditional foods and practices

Pre-European Māori had a subsistence economy. Food shortages were not uncommon. Significant effort was required to gather, process and store food. The practices that were developed for gathering and conserving foods served as protective health measures and, at the same time, were grounded in the spiritual value of food to Māori society. While Māori have adopted a largely European-style diet, a number of traditional foods still form part of the diet for

many Māori. A significant part of Māori tradition is the retention of traditional foods within the culture. Many iwi have their own significant foods, with particular traditions associated with their production and preparation (Department of Health 1991).

Kūmara is a special food. It is believed to offer spiritual sustenance not found in other foods. Other traditional vegetables include kamokamo (marrow), pūhā, watercress, pikopiko (fern fronds) and (postcolonisation) kāngawai (steeped corn). Kaimoana (seafood) forms a significant part of traditional diets in coastal areas; it includes kina (sea urchin), pipi, kōura (crayfish), ngaeti (periwinkles), parengo (a type of seaweed), pāua, tuna (eels), pātiki (flounder), inanga (whitebait) and kuku (mussels). Tītī (mutton bird) and rēwena (bread) are other highly regarded foods (Department of Health 1991).

Traditional Māori foods are generally compatible with dietary guidelines. However, the addition of fat, salt, sugar and cream to traditional foods may make them less appropriate as part of a healthy diet. Foods that have added salt, sugar or fat, or that are naturally high in them (eg, Tītī), should be consumed only occasionally or prepared in a way that removes most of the fat (Department of Health 1991).

Connected to the spiritual and cultural significance of food for Māori are such practices as manaakitanga (honouring manuhiri or visitors) and mana-ā-iwi (food provision demonstrating the mana of the hosting group).

In the NNS97, three in ten Māori women and two in ten Māori men reported that their households were often or sometimes 'stressed because they cannot provide the food they wanted for social occasions' (Ministry of Health 1999c). Not being able to follow tikanga relating to food practices can lead to feelings of misery and depression (McKerchar 1999).

The burden of disease

The following information on the burden of disease for Māori is drawn from the NNS97 (Ministry of Health 1999c).

Body weight and cholesterol

While mean body weight in the total New Zealand population increased from 71.3 kg in 1989 to 74.5 kg in 1997, it did not change significantly for Māori.

Mean total serum cholesterol has decreased from 5.9 to 5.7 for the population. Serum cholesterol is lower for Māori than for New Zealand Europeans and Others.

Body size

Māori are on average heavier (males 87.3 kg, females 75.2 kg) than New Zealand Europeans and Others (males 78.9 kg, females 67.1 kg) but do not differ significantly in height. In a study of Polynesians (Māori and Samoan), Swinburn et al (1999) found that although they had more body fat on average than Europeans, their corresponding BMI values indicated significantly lower body fat.

Using BMI adjusted for Māori and Pacific populations, Māori (males 27 percent, females 27.9 percent) are more likely to be classified as obese than New Zealand European and Others (males 12.6 percent, females 16.7 percent). However, Māori males are less likely to be classified as overweight (30 percent) than New Zealand European and Other males (41 percent). The proportion of overweight females was not affected by ethnic group (Ministry of Health 1999c).

In the NNS97 a waist/hip ratio equal to or greater than 0.9 for males and 0.8 for females was used to indicate higher cardiovascular risk (Ministry of Health 1999c). Among Māori, 47.5 percent of males and 38.0 percent of females have an excess WHR. By comparison, among New Zealand Europeans and Others 46.8 percent of males and 34.4 percent of females are in the same category (Ministry of Health 1999c).

Blood pressure

Using the WHO cut-off values for hypertension, 16.5 percent of males and 12.3 percent of females in the total population were hypertensive. There were no differences among ethnic groups in the prevalence of hypertension. Close to 10 percent of the population were on some form of hypertensive medication, and 4.2 percent of respondents were still hypertensive at the time of their blood pressure measurement. The medication was apparently more effective in New Zealand European and Others (6.1 percent males and 6.4 percent females) than in Māori (1.6 and 3.3 percent respectively).

Cholesterol

The mean total serum cholesterol (mmol/L) of New Zealanders overall was 5.7, with no difference between males and females. Twenty-three percent of all New Zealanders had cholesterol levels greater than 6.5 mmol/L, which is the WHO cut-off point above which people should be counselled. The proportion of Māori females above the cut-off point (10.0 percent) was low compared with New Zealand European and Other females (25.6 percent). Among males, a higher proportion of Māori (27.6 percent) exceeded 6.5 mmol/L than New Zealand Europeans and Others (23 percent).

Iron

The NNS97 found that low iron stores, iron deficiency and iron-deficiency anaemia primarily affected females (6 percent, 3 percent and 2 percent respectively). Prevalence of all three conditions was highest among Māori females (11 percent, 9 percent and 6 percent). Males were not affected to the same extent.

Energy intake

In females aged 15 to 24 years, Māori had higher median energy intakes than New Zealand Europeans and Others. Māori females had a higher mean energy intake from fat.

Household food security

The NNS97 statements on household food security revealed that 13 percent of New Zealanders 'can afford to eat properly only sometimes'. Of these, the highest proportion was young females (31 percent). More Māori (males 24 percent, females 33 percent) reported that their households 'can afford to eat properly only sometimes' than did New Zealand Europeans and Others (males 9 percent, females 10 percent).

About one-third of Māori (26 and 36 percent males and females, respectively) reported that 'food runs out' often or sometimes. By comparison, about one-tenth of New Zealand Europeans and Others (7 percent and 11 percent, respectively) agreed with the same statement. In response to the statement, 'The variety of foods I eat is limited by a lack of money', a higher proportion of Māori (males 48 percent, females 47 percent) reported this as an issue for their households. Among New Zealand Europeans and Others, 20 percent of males and 26 percent of females reported this as an issue.

In response to the statement 'I/we rely on others to provide food and/or money for food, for my/our household when I/we don't have enough money', more Māori reported this as an issue

'sometimes or often' (males 19 percent, females 22 percent) than did New Zealand Europeans and Others (males 3 percent, females 5 percent).

Nineteen percent of Māori females aged 15 to 24 years reported using food grants or food banks; this proportion was higher than for any other group. Feeling stressed because of not having enough money for food ('sometimes or often') was most often experienced by the households of females aged 24 to 44 years. Among females, Māori were more often in this position than New Zealand Europeans and Others. Among females, Māori were twice as likely to report being stressed ('sometimes or often') because they were unable to provide the food they wanted for social occasions than New Zealand Europeans and Others (Ministry of Health 1999c).

Physical activity

Te Puni Kōkiri found a number of barriers for Māori wanting to increase physical activity levels. In addition to cost, transport difficulties, work and whānau commitments, and lack of childcare, a number of other issues were raised, including:

- lack of whānau support for Māori women taking time out of childcare for active leisure
- lack of appropriate programmes for Māori
- whakamā (sense of shame or embarrassment)
- low self-esteem
- communication difficulties
- transience due to seasonal work
- perception of cost
- low awareness of the impact on their own lives, as well as of the facilities and opportunities available (Te Puni Kōkiri 1997).

Effective interventions

To improve Māori health, effective interventions need to incorporate the principles of the Treaty of Waitangi. They also need to recognise that the 'collective' and individual wellbeing of Māori are equally important. Effective interventions must look beyond just healing physical symptoms to understanding and working with people in their social context. *He Korowai Oranga* (Minister of Health and Associate Minister of Health 2002) aims for whānau ora: Māori families being supported to achieve their maximum health and wellbeing. It identifies four pathways to progress whānau ora:

- development of whānau, iwi and Māori communities
- active participation by Māori at all levels of the health and disability sector
- health and disability services that are timely, high quality, effective and culturally appropriate to improve health and reduce inequalities
- taking a leadership role in facilitating work across government sectors and government agencies to achieve whānau ora by addressing the broader determinants of health.

Whakatātaka: Māori Health Action Plan 2002–2005 (Minister of Health and Associate Minister of Health 2002b) is the implementation plan for *He Korowai Oranga*. It provides a framework and specific priority action areas to improve Māori health outcomes over the next two to three years.

Nutrition initiatives

In the early 1990s initiatives to improve Māori nutrition focused on getting people to reduce the amount of fat in their meals and increase their intake of vegetables, fruits, breads and cereals. However, dietary behaviour changes were difficult to identify. Services were usually delivered outside traditional Māori society – the whānau, hapū and iwi framework – and there was little recognition of cultural values, beliefs and practices (Pihema 1998).

Between 1993 and 1995 the Māori community nutrition pilot projects to improve nutrition and physical activity were implemented (Ministry of Health 2001a). The Government funded four Māori community nutrition initiatives, set up by iwi and Māori organisations in collaboration with health agencies. These initiatives aimed at 'improving nutrition at a community level by training community workers in basic food and nutrition' (Moewaka Barnes et al 1998a, 1998b, 1998c; Pipi et al 1994; Tunks et al 1998). All the initiatives were based on strong community development perspectives, and the approaches used are described in the *DHB Toolkit: Improve nutrition* (Ministry of Health 1999c).

An example was the Nutrition Kaiawhina Pilot Project, based in the Tairawhiti region. It was found from the pilots that:

- tikanga Māori must be an integral part of any nutrition programme for Māori
- there must be clear definitions of roles
- support networks are necessary for the success of the programme
- adequate funding is essential
- relevant information must be recorded (Pihema 1998).

Through evaluation, it was also found that all pilots achieved a great deal of Māori community involvement, empowerment and a sense of local ownership. There was significant change in each community's awareness of nutrition issues. There were also some changes in eating habits and in the kind of food provided at social gatherings. At participating marae in the Tairawhiti pilot, for instance, there were significant changes in food offered, including offering more wholemeal bread, vegetables, fruits, lean meat, cereals and water (Maskill and Hodges 2001). There were also spin-off benefits, such as the extension of smokefree initiatives and safer food-handling practices.

These pilots are now being run as programmes. The evaluation findings need to be considered by all health professionals to assess Māori-specific programmes as well as health services targeting the general population that are accessed by Māori.

Current and future work

There is a limited pool of qualified Māori nutritionists and dietitians. However, an increasing number of Māori community health workers have some working knowledge of both nutrition and health promotion. A number of programmes are available for training community workers in nutrition. Examples are those offered by Te Hotu Manawa Māori and specific community nutrition-based pilot programmes, all of which have undergone formal evaluation (Moewaka Barnes et al 1998a, 1998b, 1998c). These programmes work on a train-the-trainer approach and have focused on both rural and urban Māori communities (see: 'Effective interventions' above). There are also a number of publicly funded Māori health promotion services around New Zealand that have a specific focus on nutrition in Māori communities.

Current services and programmes have begun to address the need for promoting improved nutrition, increased physical activity and maintenance of a healthy body weight for Māori. These initiatives need to be further supported by encouraging Māori to participate in the planning and delivery of nutrition and physical activity services at a community level. Such programmes should focus on increasing access to nutritious foods and opportunities for physical activity among Māori.

A significant factor in improving nutrition and increasing physical activity for Māori is the development of a comprehensive Māori public health workforce. Future work should support the development of 'by Māori for Māori' approaches to nutrition and physical activity. But there is also a need for mainstream providers to increase responsiveness to Māori, in programme development, implementation and evaluation.

Monitoring and evaluating Māori-specific and mainstream services are essential to ensure they are effective. These processes will also contribute to a more robust research base. Improved data collection is important to build a better picture of the nutrition, activity and health status of Māori and to measure trends over time. In many cases gathering the data needed will require Māori-specific approaches. For example, the validation phase of the New Zealand Sport and Physical Activity Survey has a particular focus on establishing the energy and intensity involved in a number of Māori activities, and optional surveying using te reo Māori.

20 Pacific peoples

Background

Good nutrition, physical activity and a healthy lifestyle have a major role to play in improving the health status in Pacific populations. Lifestyle diseases such as obesity, diabetes mellitus, hypertension and heart disease are more common among Pacific peoples than among New Zealand Europeans. In some cases, these same diseases are more common among Pacific peoples than among Māori (Tukuitonga et al 1990; Scragg et al 1991). Several factors have been advanced as reasons for this link between Pacific peoples and lifestyle diseases, including the following.

- **Genetic factors** may predispose Pacific peoples to a higher risk for developing diabetes and coronary heart disease (Simmons et al 1995).
- **Impacts of migration** include the sudden abundance, ready availability and wider variety of foods as well as changes in the climate, language, housing and living arrangements (Harding et al 1986). Working to grow, gather and hunt for food has now become an option rather than a necessity. Hence physical activity has decreased (Prior 1976).
- **Low socioeconomic status compared with other New Zealanders** means that Pacific peoples are over-represented at the lower end of the socio-economic spectrum (Statistics New Zealand 1999). The NNS97 highlighted food security as an issue for Pacific peoples (Ministry of Health 1999c).
- **Cultural factors** form the basis of how Pacific peoples perceive health and the role of food, particularly traditional foods.

Pacific peoples have a holistic view of health. The Fonofale Health Model was created by Fuimaono Karl Puluto-Endemann as a Pacific model of health for use in the New Zealand context (Ministry of Health 1997f; Moata'ane 1999). The concept of the Samoan fale, or house, not only reflects what is most important for Pacific peoples – family, culture and spirituality – but also identifies important components of the health of Pacific peoples.

The Fonofale Health Model is based on a metaphor for a house, with a roof and foundations.

- The roof represents the cultural values and beliefs, including traditional methods of healing that shelter life.
- The foundation represents the family – the foundation of Pacific culture.
- The pou, or posts, connect the roof to the foundations, representing the connection between family and culture and dimensions of:
  - spiritual wellbeing
  - physical wellbeing
  - mental and emotional wellbeing
  - other variables such as gender, sexual orientation, age and social class.

The fale does not exist in isolation. It is influenced by other dimensions, especially the environment, time and social context in which people live.

Understanding the underlying concepts of such a model is important when developing frameworks for improving the health status of Pacific peoples. Other important issues include the diversity of cultures, languages, values, beliefs and ways of doing things among the different ethnic groups that make up the Pacific population. Each Pacific ethnic group interprets health from its own cultural perspective.

Traditional foods and practices

Traditional Pacific island diets tend to consist mainly of coconuts, starchy root vegetables, fish, fruits (when in season), and occasionally chicken or pork (Prior 1976; Pollock 1992). Coconut was the main source of fat. Traditional green leafy vegetables such as taro leaves, pele (edible hibiscus leaves), kūmara leaves and fern shoots were occasionally eaten and usually cooked with coconut cream in an umu (traditional earth oven).

Since migrating to New Zealand, leading to the introduction of processed foods (usually high in fat, sugar and salt) and cheap cuts of meat, Pacific peoples have had a higher fat content in their diets (Prior 1976; Harding 1986). Pacific peoples tend to choose cheaper cuts of meat such as mutton flaps and corned brisket, which is usually high in fat and salt. In addition to saturated fat from fatty meat, coconut cream is still widely used in cooking, particularly in the cooking of traditional foods such as taro (both the tuber and the leaves) and fish. Starchy root vegetables such as taro, cassava (manioka) and kūmara are still eaten, but less often as they are usually more expensive in New Zealand. Pacific peoples do not seem to consume a great variety of fruits and green leafy vegetables despite their ready availability all year around.

To be consistent with the Food and Nutrition Guidelines, Pacific peoples should be encouraged to grow and eat more vegetables and fruits and to choose leaner cuts of meat.

Food has an important social function within Pacific cultures (Pollock 1992; Guthrie et al 1998; Moata'ane and Guthrie 2000). It provides a link with tradition, an affirmation of belonging and identity. Some foods, such as taro, yams, pork, fish and povi masima (corned beef), are associated with wealth and prestige. Although early European settlers and missionaries introduced corned beef into their diet, it has now become a part of the food culture of Pacific peoples. Foods such as cassava, kūmara, bananas (ripe and green), mangoes, other seasonal fruits and green leafy vegetables are not generally considered to be prestige foods.

Sharing, giving and receiving foods are important aspects of Pacific culture (Moata'ane and Guthrie 2000). The giving of food is a visible expression of love, care and respect. In the NNS97 survey, Pacific peoples were more than twice as likely than other respondents to be stressed because they could not provide the foods they wanted for social occasions (Ministry of Health 1999c).

In their study of adult Tongans with diabetes, Moata'ane and colleagues (1996) found that the association of food with a higher health risk was a foreign concept to Tongan people. This notion is generally the same in other Pacific cultures. The association of food to lifestyle and health must be made clear in health education and promotion programmes.

Nutrition strategies

The Pacific Health and Disability Action Plan outlines the vision, strategic direction and specific actions for improving health outcomes for Pacific peoples (Ministry of Health 2002). Priority areas include promoting healthy lifestyles and wellbeing. One objective in the plan is to encourage and promote healthy nutrition practice (Objective 3.1). Health promotion actions aim to activate greater community participation and ownership, recognising that Pacific peoples play an important role in determining and improving their own health and wellbeing.

This approach is supportive of by Pacific for Pacific health provider/promotion initiatives (Ministry of Health 1997d, 1997f, 1998b). The Ottawa Charter for Health Promotion (WHO et al 1986) and the principles of the Treaty of Waitangi, particularly the principles of partnership and participation, will guide the processes; these documents are cited in priority two of *The Pacific Health and Disability Action Plan* (Minister of Health 2002).

Community nutrition and physical activity initiatives of Pacific peoples

Several community-based programmes, aimed at improving nutrition and promoting regular physical activity, have been piloted in Auckland. These pilot programmes were a response by Pacific health professionals to a prevalence of non-communicable diseases (such as type 2 diabetes) among Pacific peoples in New Zealand (Swinburn et al 1997a; Simmons et al 1998). The programmes encourage positive behaviour changes, with activities such as:

- nutrition education to raise awareness
- practical cooking lessons to demonstrate low-fat and low-salt cooking methods
- supermarket tours to assist programme participants in making healthy food choices
- aerobic exercise classes and walking groups to promote regular physical activity.

Evaluation indicated that these intervention activities were taking root within the targeted communities. These pilots are now being run as programmes within Pacific communities in Auckland. Although the Pacific Island Heartbeat Programme of the National Heart Foundation is based in Auckland, its programmes can be used nationally in conjunction with other projects run by the National Heart Foundation.

Pacific health providers in other regions also offer nutrition education and regular physical activity sessions to Pacific peoples in their regions. Agencies for Nutrition Action (ANA 2003) reported that Puniani had been the co-ordinator for an innovative gardening programme that supported South Auckland communities to create vegetable and fruit gardens in the Pacific early childhood centres. Parents and teachers were all involved in the workshop sessions with input from Auckland Regional Council. Auckland Regional Health Promotion, which was also involved, had the aim of assisting in practical ways to improve nutrition, to increase appropriate food choices and physical activity.

The *Pacific Health and Disability Action Plan* provides a guide to positive nutrition action. It aims to reduce health risks by improving overall diet and nutrition of Pacific peoples in New Zealand. Effective collaboration is needed between Pacific communities and all key agencies to achieve Pacific nutrition goals.

See also: Chapter 21, Food security.

Part VI: Other Issues

21 Food security

Background

Definitions

Food security is an internationally recognised term that encompasses the ready availability of nutritionally adequate and safe foods, and the assured ability to acquire personally acceptable foods in a socially acceptable way.

Food insecurity is characterised by anxiety about not having enough food to eat, running out of food, and having no money to purchase more (Hamilton et al 1997). Adults who are anxious there is not enough food may try to avoid hunger by cutting the size of meals, skipping meals or even going without food for one or more days (Klein 1996).

Income inequalities

The Rome Declaration on World Food Security affirmed the 'right of everyone to have access to safe and nutritious food, consistent with the right to adequate food and the fundamental right of everyone to be free from hunger' (FAO 1996).

Inadequate food intakes and hunger are not confined to developing countries (Ministry of Agriculture, Fisheries and Food (UK) 1996; Department of Agriculture Center for Nutrition Policy and Promotion (US) 1996). The poorer health of people in the lower socioeconomic groups of developed countries is also now well recognised (Colhoun and Prescot-Clarke 1996).

In New Zealand, the National Advisory Committee on Health and Disability (1998) concluded that income is the single most important modifiable determinant of health and wellbeing. Māori and Pacific households are disproportionately represented in the two lowest income quintiles (Statistics New Zealand 1999). Single-parent, Māori and Pacific households experienced the greatest income reductions between 1991 and 1993. The highest rates of illness and premature death are generally experienced by those who are worst off financially (NHC 1998). In its report reviewing social policy and food security, the New Zealand Network Against Food Poverty (1999) found that actual food costs were much higher than most low-income households had available after meeting their basic expenses such as for housing, power and transport.

Health consequences of food insecurity

Low-income groups are food insecure more often and frequently have higher rates of obesity than high-income groups (Kuskowska-Wolk and Bergstrom 1993; Ford et al 1994). The Whitehall II Study showed a strong inverse social gradient in the prevalence of risk factors for coronary heart disease (Brunner et al 1997). Mortality from all cancers is higher in lower socioeconomic groups, although breast cancer and bowel cancer are more prevalent in higher socioeconomic groups (Sharp et al 1995).

As food security status worsens, diet quality declines (Cristofar and Basiotis 1992) and eating patterns become more disordered (Kendall et al 1996).

Issues for women

Dowler and Calvert (1995) concluded that 'poor material circumstances combined with severe constraints on disposable income were the main factors characterising nutritional deprivation in lone parents, and sometimes their children'.

It is also important to understand female poverty and the consequences for children. When examining the distribution of children within New Zealand society, we find that children are likely to live in households in the lower part of the income distribution. Of all children in 1996, 26 percent were in households in the bottom income quintile, and 23 percent in the second-lowest quintile. A significant number of homes where the sole parent is female are in the lowest income groups (Statistics New Zealand 1998, 1999). A child of a female sole parent is more likely to be in a home of lower income and, therefore, is at higher risk of nutritional disadvantage. Furthermore, the average income of bottom income quintile households fell by 4 percent between 1991 and 1996 in real terms. The position of bottom quintile households relative to the disposable income of the average equivalent household has also deteriorated (Statistics New Zealand 1999).

In a New Zealand study of low-income households, 70 percent of mothers said they restricted their own meal size to feed their children (Parnell 1997). Parnell (1997) also reported that these women were getting insufficient energy, iron and calcium. These households had been on a low income for an average of 4.5 years. Similar studies overseas found that women who report hunger in their households have significantly lower energy and nutrient intakes than those who do not (Bell et al 1998; Tarasuk and Beaton 1999).

Food skills

The available evidence on the diets in low-income households indicates that they are low in vegetables, fruits, lean red meat and dairy products, but tend to be too high in fat, salt and sugar (Farrell 1994; Ministry of Agriculture, Fisheries and Food (UK) 1996; Parnell 1997). The evidence suggests that this imbalance is not due to ignorance; that is, low-income households are aware that they are not eating healthy foods (Lang 1992; Leather 1995; Tarasuk et al 1998). Educational efforts are unlikely to make much impact if a wide range of socioeconomic factors remain unchanged (New Zealand Network Against Food Poverty 1999).

Socioeconomic disadvantage

The NNS97 included eight statements about access to food, the responses to which provide a nationwide assessment of food poverty in New Zealand (Ministry of Health 1999c). Almost half of Māori and Pacific peoples and a quarter of New Zealand Europeans and Others reported that the variety of foods they were able to eat was limited by lack of money. Māori and Pacific peoples were disproportionately more likely to access food banks than others, and women accessed food banks more than men (Ministry of Health 1999c). Statistics from food banks suggest that close to 10 percent of all households are now seeking help from food banks at least once during the year. These households include people who are in paid work. Waged work does not guarantee the absence of poverty (Hackwell 1998).

Women living in Māori and Pacific households (31 percent and 32 percent respectively) were more likely to experience 'stress because of not having enough money for food' than were European and Other women (12 percent) (Ministry of Health 1999c).

The NNS97 made comparisons between those living in households in most and least deprived areas based on NZDep96 quartiles. There was a significant relationship between living in the most deprived areas of New Zealand and inadequate intakes of zinc, vitamin A, riboflavin and folate, dietary fibre, calcium and vegetables (particularly for women) and fruits (for both sexes)

(Ministry of Health 1999c). There was also a strong relationship between female obesity and the level of deprivation. Females living in the less deprived areas (13.1 percent) had lower levels of obesity than those in the more deprived areas (25.4 percent). This relationship was not significant for males (Ministry of Health 1999c).

Before giving advice about food to New Zealanders who may be at risk of food insecurity, it is important to give forethought to this issue (Parnell 2001). Food insecurity is primarily a result of inadequate income rather than due to ignorance or lack of education (New Zealand Network Against Food Poverty 1999).

22 Supplementation and fortification

Supplementation

Good nutrition primarily depends on appropriate food choices. Consuming a wide variety of foods in moderate amounts reduces the risk of both inadequate and excessive nutrient intakes (American Dietetic Association 1996). However, in some circumstances, dietary supplements may be used to treat nutritional deficiency, including:

- vitamin B_{12} for vegans (who eliminate all animal products from their diet)
- injections of vitamin B_{12} for those who have had gastric surgery
- vitamin D for those with low sunlight exposure, especially the institutionalised and older people
- calcium for those who consume little or no milk or milk products (eg, those with lactose intolerance or allergies to milk and milk products) (American Dietetic Association 1996).

Supplementation may also be indicated for therapeutic use, such as folic acid for women of childbearing age who are planning a pregnancy, to reduce the risk of neural tube defects in newborn babies. There may also be a case for supplementation of some nutrients in other at-risk groups, such as older people, who require more nutrients because of a reduced physiological ability to absorb them.

Low-dose multivitamin supplements may benefit those with limited dietary intakes. However, these supplements will provide little advantage to those who eat a variety of foods according to dietary guidelines. Ironically, consumers of supplements generally have higher dietary nutrient intakes than those who do not take supplements (Wright 1997; Ministry of Health 1999c). Recommendations for low-dose multivitamin and mineral supplements should be made only where inadequate intakes are identified by individualised dietary assessment.

There has been growing interest in the use of antioxidant supplements for protection against some cancers and coronary heart disease. Because there is conflicting evidence as to the efficacy of these supplements, no recommendation can be made (Omenn et al 1996; Woodson et al 1999).

Based on a recent review of literature on randomised controlled trials, the National Heart Foundation concluded that vitamin E supplementation achieves no demonstrated benefit in relation to the prevention or treatment of cardiovascular disease. Therefore the NHF does not recommend supplementation with antioxidants. Furthermore, neither ß-carotene nor vitamin C has proven effective in preventing or managing cardiovascular disease (NHF 1999).

For those who choose to use supplements, the American Dietetic Association (1996) recommends consuming supplements with low levels of nutrients, such that a daily dose does not exceed the recommended dietary allowance.

Current dietary supplement use

During the year before the NNS97, about half the respondents (51 percent) used vitamin and/or mineral supplements (Ministry of Health 1999c). Such supplements were used on a regular basis by 28 percent of the population, while 23 percent used them occasionally. More females (59 percent) than males (42 percent) reported taking vitamin and/or mineral supplements; females aged 19 to 24 years reported the highest use of supplements (69 percent). For both males and females, frequency of regular use declined from least deprived to most deprived areas based on in the NZDep96 quartile (Ministry of Health 1999c).

Multivitamin and/or mineral supplements were the supplements most frequently chosen by users (19 percent), followed by vitamin B complex (10 percent). Vitamin C (7 percent) and iron (4 percent) were the most common single supplements used (Ministry of Health 1999c). A variety of other dietary supplements were also being consumed by the New Zealand population. They included garlic preparations, evening primrose oil and botanical products. The benefit and safety of these products are not well documented.

The best nutrition strategy for promoting optimal health and reducing the risk of chronic disease is to eat well by including a wide variety of nutritious foods in the diet, as recommended in the Food and Nutrition Guideline statements. Foods contain protective substance as well as vitamins and minerals, and provide value for money in terms of the protection they provide.

Vitamin and mineral supplementation is only appropriate in specific circumstances, preferably on the advice of a health professional. For example:

- folic acid supplements, taken four weeks before conception and 12 weeks after conception, are recommended to women planning a pregnancy (Ministry of Health 1995)
- vitamin B_{12} sources of food or supplementation are necessary for vegans
- vitamin B_{12} injections may be necessary for other groups at risk such as older people with pernicious anaemia or those who have no intrinsic factor
- vitamin D may be necessary for the institutionalised or the elderly
- iron supplementation may be warranted in the treatment of iron-deficiency anaemia before end-stage anaemia.

Fortification

Nutrients are sometimes added to foods to improve the nutritional quality of food or to improve the dietary intakes of individuals. They are often added by the manufacturer to add value to the product without any evidence that there will be any positive benefit to the nutritional status of the consumer. Manufacturers are, however, required to ensure that the added nutrients are safe and cause no harm.

In 1995 the New Zealand Government adopted the Australian standard for the addition of vitamins and minerals to foods. Related legislation came into force in January 1996. The new standard allowed, for the first time, fortification of a wide range of foods. For example, a number of ready-to-eat breakfast cereals and beverages now have vitamins and minerals added.

Australian and New Zealand food standards outline the foods that can be fortified in the *Australia New Zealand Food Standards Code* (Food Standards Australia New Zealand 2002). The Code specifies the nutrients that can be added, their permitted form, the quantities of nutrients that can be added to the food, and how the food should be labelled. Awareness of fortification of food products is particularly important for people with nutrient-related medical conditions so that they can choose either to consume or to avoid foods that are fortified, to meet their own particular nutritional requirements. All packaged foods with added nutrients must identify in the list of ingredients which vitamin or mineral has been added.

23 Food safety

Background

Since July 2002 the primary government organisation responsible for food safety has been the New Zealand Food Safety Authority with its own Minister of Food Safety. The Ministry of Health is still responsible for foodborne illness. To be safe to eat, food should be handled so that it does not cause foodborne illness and is free of physical, chemical and microbiological hazards.

Foodborne illness notification and trends

Over the past decade New Zealand has experienced an increase in the incidence of enteric foodborne illness, particularly campylobacteriosis, salmonellosis, shigellosis and shiga-toxin-producing *E coli* (VTEC/STEC). Recent research estimated there are 119,000 cases of foodborne illness in New Zealand each year, resulting in 19,000 general practice visits, 400 hospitalisations and 2 deaths (Lake et al 2000). In addition to the costs in terms of human health, the economic costs are an estimated $55.1 million per year, or $462 per case (Scott et al 2000).

The number of notified cases of campylobacteriosis has risen rapidly since the disease became notifiable in 1980 (Ministry of Health 1999a). New Zealand now has the highest reported rate of campylobacteriosis of any developed country in the world (Orchard et al 2000). Although the reasons for the continuing rise in campylobacteriosis are not clear, the trend indicates that food safety practices are less than optimal. Since 2000 New Zealand has also experienced a rapid increase in salmonellosis associated with the emergence of a new phage type (DT160) of *Salmonella typhimurium* (Thornley et al 2002).

The current 'passive' system of communicable disease notification is likely to under-report the true rates of foodborne illness in the community. Overseas research has shown that the proportion of cases occurring in the community relative to those reported to national surveillance is low; for example, 3.2:1 for salmonellosis and 7.6:1 for campylobacteriosis (Wheeler et al 1999). When these ratios are applied to the New Zealand notification data, the annual number of community cases of campylobacteriosis and salmonellosis is estimated to be in excess of 75,000 and 8500 respectively (Lake et al 2000).

The relatively low proportion of notified cases is the result of several factors: the small percentage of community cases seeking medical help; a low proportion (25 percent) of those with symptoms of foodborne illness being requested by their doctor to supply faecal samples (Sarfati et al 1997), and an even lower proportion complying; and the approximately 20 percent of laboratory-confirmed cases that may not be notified (Simmons et al 2002).

Commercial food safety

There is a growing trend for New Zealanders to eat more meals and snacks prepared outside the home. For the year ending June 2001, 23 percent of the household food dollar was spent on meals prepared by the food service industry (Restaurant Association of Zealand 2002). Sales of food purchased outside the home grew by $206 million to $3,024 million in 2000/01. This food is prepared and served by more than 67,500 people (Restaurant Association of Zealand 2002). In New Zealand, consumption of takeaway and restaurant food has been associated with campylobacteriosis (Eberhart-Phillips et al 1997) and salmonellosis (Thornley et al 2002). Manufacturers and sellers of food, as part of their food safety programmes, must be able to

demonstrate that all reasonable steps are taken to ensure the safety of the food they produce, prepare and sell.

The New Zealand Food Safety Authority is encouraging all sectors of the food industry to develop food safety programmes. In 2000 the Ministry of Health produced food safety programme guidelines for industry and regulators (Ministry of Health 2000a, 2000c). A food safety programme has been designed to identify and control hazards in the production, processing and sale of food. A systematic risk assessment tool, known as hazard analysis critical control point analysis (HACCP) (Department of Agriculture (US) 1989), is employed. HACCP is a system used to identify hazards associated with a food product and ensure that controls are established at critical points in the process. Its most important controls in relation to foodborne illness deal with microbial hazards.

Staff training and the support of management are critical to introducing a food safety programme. Food workers must have an understanding of food safety and of how to apply this knowledge to a food safety programme. Staff must then be supervised and supported to ensure compliance.

Domestic food safety

Foodborne illnesses are more likely to be traced to food prepared in the home or by the food service industry, rather than to the stages of food production or harvesting (Bryan 1988). It is being increasingly recognised, however, that there is a need for a collective responsibility for food safety in New Zealand, spanning all stages from production (farm) to consumption (plate). To this end, safe domestic food-handling practices from the point of sale to the point of consumption are critical in order to maintain food safety. A number of consumer-level surveys have identified a poor level of understanding of basic food safety practices in New Zealand (Bloomfield and Neal 1997; Hodges 1993; Kerslake 1995). Unsafe domestic food handling is thought to contribute between 10 and 40 percent of foodborne illness cases overseas (Lake and Simmons 2002). Data from notified New Zealand foodborne illness outbreaks suggest that at least 12 percent are due to unsafe domestic food handling (Lake and Simmons 2002).

Inadequate cooking, cross-contamination and storage at ambient temperature, and inadequate refrigeration have been identified as key critical control point failures likely to affect food safety and foodborne illness in New Zealand (Simmons et al 2001).

Food safety promotion

In 1998 concern about the high levels of foodborne illness prompted the formation of the New Zealand Foodsafe Partnership. This partnership comprises representatives from the food industry, consumer groups, public health services, the Ministry of Health and MAF Food (the New Zealand Food Safety Authority since July 2002). The goalof the partnership is to reduce the incidence of foodborne illness by promoting consistent and appropriate food safety messages to consumers.

The key food safety messages promoted by the partnership are based on local and international literature documenting unsafe domestic food handling (Simmons et al 2001). These messages are promoted in an annual food safety campaign similar to that carried out in Australia (Warnock 1998). These messages can be summarised as the '4 Cs': clean, cook, cover, chill.

Clean

- Wash and dry hands thoroughly before preparing food, after handling raw food and after using the toilet.
- Scrub chopping boards with soap and very hot water between handling raw and cooked foods, or use separate boards.
- Scrub cookware, eating utensils and work surfaces between preparing raw and cooked foods.
- Wash dish cloths daily – rinse and microwave them on high for one minute or soak them in a solution of household bleach overnight.
- If people develop symptoms such as diarrhoea or vomiting, they should pay special attention to hand hygiene and should not prepare food for others until they have had formed faeces for at least 24 hours.
- For cases of notifiable foodborne diseases, seek advice from the local public health unit.

Cook

- Cook foods thoroughly, particularly poultry, pork, meat patties and sausages to the point where the flesh is not pink and the juices are clear.
- Reheat foods in small volumes until steaming hot, and reheat only once.
- Stir food regularly in the microwave to permit even reheating.
- Pre-cook poultry and sausages before barbecuing.
- Defrost frozen meat and poultry thoroughly before cooking.

Cover

- Cover foods when thawing.
- Cover foods when storing; separate cooked and raw foods, storing cooked above raw.
- Use a watertight covering to prevent raw juices from dripping on to ready-to-eat foods or salad vegetables.

Chill

- Refrigerate perishable foods as soon as possible after purchasing.
- If the refrigerator is more than 10 years old, check that the seals are intact and, using a thermometer, that the temperature is between 0ºC and 4ºC.
- Thaw frozen meat and poultry in the refrigerator.
- Use a chilly bin, frozen drinks and slicker pads to keep perishable foods cold during picnics or barbecues.
- Refrigerate cooked leftovers as soon as they are cool.
- Discard cooked food that has been left at room temperature for more than two hours.

Food safety information

Food safety information links for the consumer can be found on the New Zealand Food Safety Authority's website (www.nzfsa.govt.nz). Copies of health education resources on food safety are available from health education providers of public health services (as listed on www.healthed.govt.nz). In addition, many food industry groups and non-government organisations have produced promotional material on food safety. Consumer food safety information is also available on the Foodsafe Partnership's website (www.foodsafe.org.nz).

Appendix 1: Serving sizes of the four food groups and samples of two types of three-day meal plans

Note: These meal plans demonstrate how an eating plan could work using the Food and Nutrition Guidelines. They are not intended to be used and followed rigidly.

Table A1.1: Serving size examples

Vegetables and fruits

Vegetables

- 1 medium potato, kūmara or similar sized root vegetable such as yam or taro (135 g)
- ½ cup cooked vegetable eg, puha, water cress, parengo or corn (50–80 g)
- ½ cup salad or mixed vegetables (60 g)
- 1 tomato (80 g)

Fruits

- 1 apple, pear, banana or orange (130 g)
- 2 small apricots or plums (100 g)
- ½ cup fresh fruit salad
- ½ cup stewed fruit (fresh, frozen or canned) (135 g)
- 1 cup fruit juice 250 ml or a serving of dried fruit *(only one counts)*

Breads and cereals

- 1 bread roll (50 g)
- 1 muffin (80 g)
- 1 medium slice rewena
- 1 medium slice bread (26 g)
- 1 cup cornflakes
- ½ cup muesli (55 g)
- ½ cup cooked porridge (130 g)
- 1 cup cooked pasta (150 g)
- 1 cup cooked rice (150 g)
- 1 cup cassava or tapioca (150 g)
- 2 plain sweet biscuits (14 g)

Milk and milk products

- 1 large glass milk (250 ml)
- 1 pottle yoghurt (150 g)
- 2 slices cheese (40 g)
- 2 scoops ice cream (140 g)

Lean meat, chicken, seafood, eggs, cooked dried beans, peas, lentils

- 2 slices cooked meat (approximately 100 g)
- ¾ cup mince or casserole (195 g)
- 1 egg (50 g)
- 1 medium fillet of fish cooked (100 g)
- 1 medium steak (120 g)
- ¾ cup dried cooked beans (135 g)
- 2 drumsticks or 1 chicken leg (110 g)

Meal plan 1 with some luxury foods

Day One	Day Two	Day Three
Breakfast		
2 slices multigrain toast 2 tsp olive oil margarine 1 Tbsp peanut butter ½ tsp Vegemite 125 ml trim milk for Milo 20 g Milo 1 small banana	1 small bowl muesli flakes 125 ml trim milk 1 slice multigrain toast 1 tsp olive oil margarine 1 cup tea	1 cup porridge 125 ml trim milk 1 slice wholemeal toast 1 tsp olive oil margarine ½ Tbsp berry jam
Morning tea		
1 cup latte	1 medium apple	1 cup black tea 50 g cheese scone 1 tsp olive oil margarine
Lunch		
1 bowl minestrone soup 2 rolls brown bread 1 tsp olive oil margarine 1 medium orange 1 glass apple/mango juice	1 cup fresh pasta 1 Tbsp parmesan cheese ½ cup lettuce salad 1 blueberry muffin	1 sandwich (2 slices bread) beef and vegetables 1 large kiwifruit 2 medium mandarins 1 cup latte
Afternoon tea		
4 crackers 1 cup instant coffee	2 cups instant coffee 75 ml trim milk	1 large glass apple juice 30 ml trim milk
Dinner		
1 glass white wine 300 g chicken with stir-fried vegetables 1 cup white rice 150 g fresh fruit salad 100 g yoghurt	1 glass fruit juice ½ cup lean beef stew 1 medium baked potato ½ cup peas ½ cup carrots 2 scoops hokey pokey ice cream ⅔ cup canned apricots	1 glass white wine 1 125 g fillet gurnard fish, grilled ½ cup broccoli 1 medium tomato 1 cup latte 1 piece uniced carrot cake
After dinner		
1 cup coffee 30 ml milk	1 cup coffee 1 cup Milo 75 ml trim milk	1 cup herb tea

Meal plan 2 with basic foods

Day One	Day Two	Day Three
Breakfast		
3 slices multigrain toast 3 tsp polyunsaturated margarine 1 Tbsp jam fruit 1 glass (180 ml) trim milk	2 biscuits Weetbix 150 ml trim milk 2 slices wholemeal toast 2 tsp polyunsaturated margarine 1 cup tea 30 ml trim milk 1 small banana	1 cup porridge 200 ml trim milk 3 tsp brown sugar 2 slices white toast 1 tsp polyunsaturated margarine 1 Tbsp peanut butter
Morning tea		
1 medium apple	1 cup coffee 30 ml trim milk	1 slice wholemeal toast 1 tsp polyunsaturated margarine ½ Tbsp berry jam
Lunch		
4 slices multigrain bread 3 tsp polyunsaturated margarine 20 g lettuce 1 med tomato 60 g cold roast beef 1 small banana	3 slices wholemeal bread 10 g mayonnaise 25 g mild cheese 40 g canned tuna 135 g apple	50 g cheese scone 1 tsp polyunsaturated margarine 1 glass trim milk
Afternoon tea		
2 digestive biscuits 1 cup mega latte	2 digestive biscuits	1 cup latte 2 tsp sugar 2 digestive biscuits
Dinner		
400 g rice and vegetable casserole with bacon, egg and cheese 1 cup canned peaches ½ cup custard	1 glass fruit juice ½ cup beef mince 1 medium boiled potato ½ cup cooked cabbage ½ cup carrots 1 scoop vanilla ice cream 15 g fruity topping	140 g chicken, leg flesh grilled ⅓ cup gravy 1 large boiled potato ½ cup green peas ½ cup pumpkin 150 g fruit yoghurt
After dinner		
1 cup coffee 30 ml milk	1 cup Milo made with trim milk	1 medium apple

The three-day meal plans above were analysed using FoodWorks 2002 with the 2002 version of FoodFiles. The plans are for healthy New Zealand adults eating about 8000 kJ a day. Plan 1 includes some luxury items such as alcohol and some more expensive food choices, whereas Plan 2 comprises basic food items. Table A1.2 summarises approximate nutritional analyses.

Table A1.2: Summary of nutritional analyses

	Plan 1 average per day	Plan 2 average per day
Energy (kJ)	8100	7940
Total fat (g)	61	65
Percentage energy from protein	21	20
Percentage energy from carbohydrate	49	50
Percentage energy from total fat	28	30
Percentage energy from saturated fat	About 10	About 10
Calcium (mg)	890	1250
Iron (mg)	13	15
Fibre (NSP) (g)	24	22
Total sugar (g)	118	115
Sucrose (g)	43	39

Appendix 2: National Nutrition Survey 1997

The NNS97 was a voluntary, cross-sectional population survey of 4636 New Zealanders living in selected households, aged 15 years or above. Data were collected over a 12-month period beginning December 1996. Survey methods used included 24-hour diet recall, a food frequency questionnaire, food-related questions, and a study of environmental chemicals, physical measurements and blood samples. It provides information on food and nutrient intakes, dietary habits and nutrition-related clinical measures on a representative sample of New Zealanders (Ministry of Health 1999c).

These findings need to be considered in light of under-reporting of dietary intakes, which is a recognised problem in dietary surveys (Klesges et al 1995; Lafay et al 1997) and is acknowledged by the author of the NNS97 (Ministry of Health 1999c).

A detailed description of the survey design is included in *Food Comes First: Methodologies for the National Nutrition Survey of New Zealand* (Quigley and Watts 1997).

Appendix 3: Australian Recommended Dietary Intakes

The report of the Nutrition Taskforce to the Department of Health, *Food for Health* (Department of Health 1991), recommended that New Zealand use the revised Australian Recommended Dietary Intakes (RDIs) 1990 (Truswell et al 1990) until an extensive revision of New Zealand RDIs is conducted.

Table A3.1: Recommended Dietary Intakes for adults (mean daily intake)

Nutrient	Males 19–64 years	Females 19–54 years	Females 54+ years
Protein (g)	55	45	45
Iron (mg)	7	12–16	5–7
Calcium (mg)	800	800	1000
Sodium (mg)	920–2300	920–2300	920–2300
Total folate (μg)	200	200	200
Zinc (mg)	12	12	12
Vitamin A: retinol equivalents (μg)	750	750	750
Vitamin C (mg)	40	30	30
Vitamin B_6 (mg)	1.3–1.9	0.9–1.4	0.8–1.1
Vitamin B_{12} (μg)	2.0	2.0	2.0
Niacin equivalents (mg)	18–20	12–14	10–12
Riboflavin (mg)	1.7	1.2	1.0
Thiamin (mg)	1.1	0.8	0.7
Vitamin E (mg): α-tocopherol equivalents	10.0	7.0	7.0
Iodine (μg)	150*	120*	120*
Magnesium (mg)	320	270	270
Potassium (mg)	1950–5460	1950–5460	1950–5460
Selenium (μg)	85*	70*	70*
Phosphorus (mg)	1000	1000	1000

* These values have not been accepted by New Zealand. See: 'Selenium' and 'Iodine' in Chapter 9, Other nutrients.

Table A3.2: Australian recommended energy intakes for adults (MJ/day)

Height (cm)	Weight (kg)	Males (MJ/day)	Females (MJ/day)
Age group 18–30 years			
150	50.6	–	7.2–8.3
160	57.6	9.1–10.4	7.9–9.0
170	65.0	9.8–11.2	8.5–9.7
180	72.9	10.5–12.0	9.2–10.5
190	81.2	11.2–12.8	9.9–11.3
200	90.0	12.0–13.7	–
Age group 30–60 years			
150	50.6	–	7.2–8.3
160	57.6	9.0–10.3	7.7–8.8
170	65.0	9.5–10.8	8.0–9.2
180	72.9	10.0–11.4	8.4–9.6
190	81.2	10.6–12.1	8.8–10.1
200	90.0	11.2–12.8	–
Age group over 60 years			
150	50.6	–	6.5–7.5
160	57.6	7.4–8.5	6.9–7.9
170	65.0	7.9–9.0	7.3–8.4
180	72.9	8.4–9.6	7.7–8.8
190	81.2	9.0–10.3	8.2–9.3
200	90.0	9.6–11.0	–

Source: Truswell et al 1990

Appendix 4: Dietary Reference Intakes in the publications of the Institute of Medicine, United States

Table A4.1: Recommended dietary allowances for men

Nutrient	Reference source	Men 19–30 years	Men 31–50 years	Men 51+ years
Protein (g)	2002c	56	56	56
Iron (mg)	2002a	8	8	8
Dietary folate equivalents (μg)	1998	400	400	400
Zinc (mg)	2002a	11	11	11
Vitamin A: retinol activity equivalents (μg)	2002a	900	900	900
Vitamin C (mg)	2000	90	90	90
Vitamin B_6 (mg)	1998	1.3	1.3	1.7
Niacin equivalents (mg)	1998	16	16	16
Riboflavin (mg)	1998	1.3	1.3	1.3
Thiamin (mg)	1998	1.2	1.2	1.0
Vitamin E (mg): α-tocopherol	2000	15	15	15
Iodine (μg)	2002a	150	150	150
Calcium (mg)	1997	1000	1000	1200
	Adequate Intake			
Magnesium (mg)	1997	400	420	420
Selenium (μg)	2000	55	55	55
Phosphorus (mg)	1997	700	700	700

Note: A table on estimated energy requirements for men and women aged 30 years, based on height and four activity levels is available in Table 5-22 in Institute of Medicine 2002c.

Table A4.2: Recommended dietary allowances for women

Nutrient	Reference source	Women 19–30 years	Women 31–50 years	Women 51+ years
Protein (g)	2002c	46	46	46
Iron (mg)	2002a	18	18	8
Dietary folate equivalents (μg)	1998	400	400	400
Zinc (mg)	2002a	8	8	8
Vitamin A: retinol activity equivalents (μg)	2002a	700	700	700
Vitamin C (mg)	2000	75	75	75
Vitamin B_6 (mg)	1998	1.3	1.3	1.5
Niacin equivalents (mg)	1998	14	14	14
Riboflavin (mg)	1998	1.1	1.1	1.1
Thiamin (mg)	1998	1.1	1.1	0.9
Vitamin E (mg): α-tocopherol	2000	15	15	15
Iodine (μg)	2002a	150	150	150
Calcium (mg)	1997 Adequate intake	1000	1000	1200
Magnesium (mg)	1997	310	320	320
Selenium (μg)	2000	55	55	55
Phosphorus (mg)	1997	700	700	700

Note: A table on estimated energy requirements for men and women aged 30 years, based on height and four activity levels is available in Table 5-22 in Institute of Medicine 2002c.

Appendix 5: United Kingdom Dietary Reference Values

Table A5.1: Reference Nutrient Intakes for nutrients for the United Kingdom and Estimated Average Requirements for food energy

Nutrient	Males 19–50 years	Males 50+ years	Females 19–50 years	Females 50+ years
*Energy (MJ)	10.60		8.10	
Protein (g)	55.5	53.3	45.0	46.5
Iron (mg)	8.7	8.7	14.8	8.7
Calcium (mg)	700	700	700	700
Sodium (mg)	1600	1600	1600	1600
Total folate (µg)	200	200	200	200
Zinc (mg)	9.5	9.5	7.0	7.0
Vitamin A: retinol equivalents (µg)	700	700	600	600
Vitamin C (mg)	40	40	40	40
Vitamin B_6 (mg)	1.4	1.4	1.2	1.2
Niacin equivalents (mg)	17	16	13	12
Riboflavin (mg)	1.3	1.3	1.1	1.1
Thiamin (mg)	1.0	0.9	0.8	0.8
Iodine (µg)	140	140	140	140
Magnesium (mg)	300	300	270	270
Potassium (mg)	3500	3500	3500	3500
Selenium (µg)	75	75	60	60
Phosphorus (mg)	540	540	540	540

* Estimated average requirement rather than Reference Nutrient Intake.

Source: Department of Health (UK) 1991

Appendix 6: Policy Statement on Physical Activity: Minister of Sport, Fitness and Leisure and the Minister of Health

In 1999 the Minister of Sport, Fitness and Leisure and the Minister of Health released a *Joint Policy Statement on Physical Activity*. This document endorses the recommendation of 30 minutes of regular, moderate-intensity physical activity on most or all days of the week. It also encourages the promotion of the following key messages:

- We can all benefit from regular, moderate-intensity physical activity – including activities such as brisk walking, taking the stairs, cycling, swimming, active gardening and some types of housework (eg washing floors, washing windows).
- Health benefits can be obtained from being moderately active for 30 minutes on all or most days of the week.
- Accumulating smaller amounts of physical activity is also beneficial. Ten-minute sessions of moderate-intensity physical activity to total at least 30 minutes on all or most days of the work.
- Physical activity can be fun.
- Physical activity doesn't have to be hard to be good for us.
- Some activity is better than none.
- It is never too late to start being physically active.
- Physical activity should be incorporated into our everyday lives and routines – take the stairs rather than the lift, walk around the farm rather than riding the farm-bike, walk instead of taking the car.
- Physical activity improves mental health and enhances our ability to perform.
- You don't have to spend money to gain the benefits of physical activity.

Source: Minister of Sport, Fitness and Leisure and the Minister of Health 1999

Glossary and Abbreviations

Glossary

Adequate intake (AI): when there is insufficient scientific evidence to set a Recommended Dietary Allowance (RDA) or estimated average requirement (EAR) the AI is set based on the intakes of a nutrient in healthy adults. It is used in the United States.

Adult: a person aged 18 to 65 years.

Alcohol Use Disorders Identification Test (AUDIT): a 10-item screening questionnaire developed by the WHO, which is designed to identify people with potentially hazardous or harmful alcohol consumption.

Anaemia: a reduction of the haemoglobin below normal for age and sex. A diagnosis of iron-deficiency anaemia is made when anaemia is accompanied by laboratory evidence of iron deficiency, such as low serum ferritin.

Anencephaly: a nural tube defect (NTD) where infants have underdeveloped brains and incomplete skulls. Most infants born with anencephaly do not survive more than a few hours after birth.

Antioxidants: agents that prevent or inhibit oxidation of a substance (eg, vitamin C, vitamin E).

Bioavailability: the degree to which a drug, medication or another substance (eg, iron) becomes available for use by the body after administering.

Body mass index (BMI): an indicator of body fatness, calculated from the formula weight divided by height squared, where weight is in kilograms and height is in metres.

Cardiomyopathy: a general term meaning primary heart disease.

CHD: coronary heart disease.

Constipation: infrequent or difficult bowel motions.

Diabetes: diagnosed when levels of glucose are abnormally elevated in blood. It is usually caused either by a lack of insulin or by the body's inability to use insulin efficiently. The two most common types of diabetes mellitus are type 1 and type 2.

Dietary Reference Intake (DRI): a term used in the United States to cover varying levels of recommended intakes of nutrients.

Dietary Reference Value (DRV): a term used in the United Kingdom to cover varying levels of recommended intakes of nutrients.

Disability adjusted life years (DALYs): a measure with one unit representing the loss of one year of *healthy* life.

Diverticular disease: multiple pouches formed in the large bowel that can become infected, bleed or perforate.

Erythrocyte: red blood cell.

Erythropoiesis: the function of making red blood cells *(erythro* = red blood cell, *poiesis* = creating).

Essential amino acids: nine amino acids required for protein synthesis that cannot be synthesised by the body and must be obtained through the diet. These amino acids are histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine.

Estimated average requirement (EAR): the amount of a nutrient such as protein, or of a vitamin or mineral suitable to recommend for a population.

Ethnicity: for the purpose of reporting ethnicity in the New Zealand Nutrition Survey 1997 (NNS97), where participants identified more than one ethnic group the following hierarchical rules were applied.

- If New Zealand Māori was one of the groups reported, the participant was assigned to New Zealand Māori.
- If any of the Pacific groups was one of the groups reported, the participant was assigned to Pacific peoples.
- All remaining participants were assigned to New Zealand European and Others.

Exercise: planned, structured and repetitive bodily movement done to improve or maintain one or more components of physical fitness.

Fatty acids: a basic component of fats in combination with glycerol, some of which are essential.

Food safety programme (FSP): a written document that, when implemented, should give reasoned assurance that the food produced is safe to consume. Development of FSPs must employ the techniques of hazard analysis critical control points (HACCP) and quality management systems such as the ISO 9000 series.

Food security: access to adequate, safe, affordable and acceptable food.

Fruit: generally includes the sweet, fleshy edible portion of a plant that arises from the base and flower and surrounds the seed.

Glycaemic index (GI): the rise in blood glucose after a portion of carbohydrate-containing food compared to the rise in blood glucose after a standard food, usually white bread or glucose. The GI is normally expressed as a percentage.

Green Prescriptions: a brief intervention that delivers physical activity in a primary health care setting. The programme is designed to address a range of diseases resulting from inactivity or to reduce the burden of disease. Currently a range of independent practitioner associations, primary health care organisations, District Health Boards and Māori health providers are engaged in the programme.

Haem: the iron-holding part of the haemoglobin and myoglobin proteins. About 40 percent of the iron in meat, fish and poultry is bound into haem; the other 60 percent is non-haem iron.

Haemoglobin: the protein carrying oxygen in the red blood cells.

Hazard analysis critical control points (HACCP): a system identifying and controlling critical points in the production of food to ensure safety.

Homocysteine: a byproduct of the amino acid methionine and an intermediate in the synthesis of the amino acid cysteine. Elevated levels of homocysteine in blood are associated with coronary heart disease (CHD).

Irritable bowel syndrome: a syndrome characterised by lower gastrointestinal symptoms, such as cramping, bloating, diarrhoea and constipation, without any evidence of underlying disease.

LDL: low density lipoprotein.

Moderate activity: as defined by the New Zealand Guidelines for promoting physical activity (*Movement = Health*), activity that will cause a slight but noticeable increase in breathing and heart rate. This level of activity is equivalent to brisk walking.

Neural tube defect (NTD): a major group of birth defects where the brain or spinal cord, or the covering of these organs may not have developed properly. Spina bifida and anencephaly are the most common types of NTD.

New Zealand National Nutrition Survey 1997 (NNS97): a cross-sectional survey of adult New Zealanders aged 15 years and older.

New Zealand Total Diet Survey (NZTDS): examines contaminants and nutrients in a number of commonly eaten New Zealand foods.

Non-communicable diseases: those diseases that cannot be transmitted from one person to another, such as obesity, hypertension, diabetes, cardiovascular disease and gout.

Nutrient Reference Values (NRVs): a term used in New Zealand and Australia to cover varying levels of recommended intakes of nutrients.

NZDep96: an index of deprivation based on the individual's residential address. The index is based on eight dimensions of deprivation: income, access to a car, living space, home ownership, employment, qualifications, support, and access to a telephone (Salmond et al 1998).

- In the New Zealand National Nutritional Survey 1997 (NNS97), quartile I is defined as individuals living in the least deprived areas and quartile IV as individuals living in the most deprived areas.
- When reported by Statistics New Zealand, quintiles rather than quartiles are used.

Obesity: having a body mass index (BMI) ≥ 32 for Māori and Pacific peoples, and a BMI ≥ 30 for all other New Zealanders.

Osteopenia: a reduction in bone mass below normal levels.

Overweight: having a body mass index (BMI) ≥ 26 and < 32 for Māori and Pacific peoples, and a BMI ≥ 25 and < 30 for all other New Zealanders.

Physical activity: the entire spectrum of 'bodily movements' that a person can undertake in daily life, ranging from normal active living conditions to 'intentional' moderate physical activities, to structured and repetitive physical exercises, to physical fitness and training sessions, to collective sport activities, especially leisure and recreational sports.

Recommended Dietary Allowance (RDA): the amount of a nutrient recommended daily that is enough or more than enough for about 97 percent of people in a population. RDA is a term used in the United States and is usually based on age and sex.

Reference Nutrient Intake (RNI): the amount of a nutrient that is enough or more than enough for about 97 percent of people in a population. This term is used in Australia and the United Kingdom.

Socioeconomic status: social position, measured by an ordinal scale, indicating an individual's (or a family's or household's) relative position in the social hierarchy, based on criteria such as income level, occupational class or educational attainment.

Spina bifida: the most common neural tube defect (NTD). It results from the failure of the spine to close properly during the first month of pregnancy. Children with spina bifida can have varying degrees of paralysis of their lower limbs, some children have to use a wheelchair, whereas others have almost no symptoms at all. The condition can also cause bowel and bladder problems.

Tolerable upper intake level (UL): the highest recommended intake level of a nutrient that is likely to pose no harm for specific population groups. This term is used in the United States.

Vegetable: all leafy greens, members of the crucifer family, all root (including potatoes) and tuber vegetables, edible plant stems, gourd vegetables, allium vegetables and corn.

Vigorous activity: as defined by the New Zealand Guidelines for physical activity (*Movement = Health*), activity that makes people 'huff and puff'.

Waist circumference (WC): a measure of health risk in relation to obesity. The WHO defines excessive waist circumference as ≥ 94cm in males and ≥ 80 cm in females and is thought to be associated with an increased health risk.

Waist/hip ratio (WHR): the ratio of waist size to hip size, calculated by dividing the waist measurement by the hip measurement. A high WHR indicates a central fat distribution; a low WHR indicates a peripheral fat distribution.

Name abbreviations

AIN American Institute of Nutrition

ALAC Alcohol Advisory Council

ANA Agencies for Nutrition Action

ASCN American Society for Clinical Nutrition

ESR Institute of Environmental Science and Research

FAO Food and Agriculture Organization

IARC International Agency for Research of Cancer

LINZ Life in New Zealand Research Unit

NHC National Advisory Committee on Health and Disability

NHF National Heart Foundation

NHLBI National Heart, Lung and Blood Institute

NHMRC National Health and Medical Research Council of Australia

NNS97 New Zealand National Nutrition Survey 1997

NRC National Research Council

PHC Public Health Commission

SPARC Sport and Recreation New Zealand

WHO World Health Organization

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