Food and Nutrition Guidelines for Healthy Adolescents

A Background Paper

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Foreword

This background paper reviews key nutrition areas affecting adolescent health. It has provided the material for the development of the guidelines presented in the health education booklet, *Food Fantastic – Eating for Healthy Adolescents* (Code 4389) and presents a comprehensive set of references relevant to the guidelines.

These guidelines are an important part of the National Nutrition Policy and will be a valuable resource for health professionals, educators and caregivers.

New Zealand offers a wide variety of healthy food to choose from and the guidelines will give adolescents sound information on which to base their food choices.

Karen O Poutasi (Dr)
Director-General of Health

Contents

Background

Adolescence is a time of newly discovered independence and freedom of choice. This puts adolescents in a group susceptible to external influences, particularly from the media, school and their peers.

Adolescents experience periods of rapid growth associated with hormonal, cognitive and emotional changes. These are often confounded by lifestyle changes, such as leaving home, changing schools or starting work.

Healthy eating during adolescence is an extension of healthy eating during childhood but often in an environment that relies on snacking and irregular meal patterns.

This background paper has been prepared to support *Food Fantastic – Eating for Healthy Adolescents* by the Ministry of Health in March 1998 (A*ppendix 6).*

These guidelines recommend that healthy adolescents should:

- eat many different kinds of food each day
- eat enough for growth and physical activity
- choose foods low in fat, sugar and salt
- choose snacks well
- drink plenty every day
- not drink alcohol
- take part in regular physical activity.

The suggested minimum serving sizes for the four food groups outlined in *Food Fantastic – Eating for Healthy Adolescents* (Code 4389) do not necessarily need to meet 100 percent of the Recommended Dietary Intake (RDIs) for all nutrients. This is because:

- RDIs apply to a population group's needs rather than individual needs
- RDIs incorporate a safety margin
- people usually eat more than the recommended number of servings
- foods that do not fit into a specific food group, that is, mixed foods are likely to make up the additional energy and nutrient requirement
- cooking and preparation methods will influence energy intake.

Introduction

Dietary habits and food preferences which affect energy consumption and nutrient intake, are generally developed over a period of time and particularly during adolescence. Two major factors affect food choices during adolescence. The first is a greater quest for independence; as in earlier periods of life, one of the ways independence is exhibited is through eating, or not eating. It is often a time for making rebellious or non-conformist statements and adopting social causes. This, coupled with a lack of knowledge and experience necessary to make adequate evaluations of dietary practice, may lead to the adoption of ill-conceived diets. The second factor is greater purchasing power to obtain meals, snacks and beverages. Rather than relying solely on family foods, sources of food may include food outlets, vending machines and school canteens.

There are many other factors noted to influence the food choices and nutritional intake in this age group, including general nutrition knowledge, socioeconomic status, urban or rural residence, family composition, cultural and religious events, participation in sport and food advertising (Worsley et al 1993; Fuamatu et al 1996; Maskill et al 1996). However, the living situation during adolescence is noted as an important influence on food choice during this period, with families serving as role models that reinforce and support the acquisition and maintenance of eating behaviour (Epstein 1996; Rolls 1988; Fuamatu et al 1996; Maskill et al 1996). Some individuals in the adolescent age group live independently with little or no family contact. However, there is a lack of research about the dietary practices of independent adolescents in New Zealand.

Peer influence through increased social activity also affects food choices of adolescents (Truswell and Darnton-Hill 1991; Huenemann et al 1968; Farthing 1991). Loss of appetite or refusing to consume food, overeating, eating whatever is available and eating convenience or junk foods are some of the food-related responses to the stress of teenage lifestyle (King and Parham 1981; Hetzler and Owen 1984). Alcohol, tobacco and drug use can also affect nutrition status and food choice in the adolescent, and they also need to be considered (Crawley and While 1996).

Research into the eating behaviours and patterns of adolescents indicate the unique lifestyle of this age group that creates a particular context for nutrition education and intervention. Also, it must be noted that the onset of the pubertal growth spurt varies for individuals and thus, any advice given to adolescents as a group must consider the wide variation in individual needs. It is also important to consider cultural-specific dietary practices when evaluating and promoting nutrition education for this age group (Fuamatu et al 1996).

Definition of Adolescence

The period of adolescence has wide cultural and individual variation. The World Health Organization (WHO) defines 'young people' as those aged between 10 and 24 years (World Health Organization 1989).

Adolescents of a given chronological age usually vary in their physiological development. Because of this variability among individuals, age is often a poor indicator of physiological maturity and nutritional needs (Lifshitz et al 1993).

Physiologically, adolescence can be defined as the period between pubescence (the time of initial physiological development during which the reproductive organs mature) and the time when the changes are complete.

While the dietary recommendations are expressed by chronological age, the information in this paper will encompass adolescence as defined physiologically.

Energy

Energy requirements

Absolute energy needs for growth are higher during adolescence compared to earlier in childhood, though they rarely exceed 10 percent of the total energy requirements (Underwood 1991). Even during the adolescent growth spurt, the energy needed for maintenance is greater than the need for growth. However, if the energy needs are not met, the pubescent growth spurt can be delayed or decreased. Thus, energy requirements for adolescence may be best estimated as kJ/cm of height varying with sex and age (Gong and Heald 1994). Adolescents who tend to be overweight grow taller during the growth spurt than those adolescents who are underweight (Forbes and Brown 1989).

Energy requirements vary with physiological state, and the need for energy increases as body weight increases. Variation between individuals in requirements also exists due to variable levels of physical activity. Adolescents involved in higher levels of physical activity generally have a higher requirement than those who are inactive. Changes in lean body mass rather than in total body weight also affect energy requirements (Forbes and Brown, 1989; Forbes 1991). Males (who on average are leaner) have a greater requirement for energy than females per unit of body weight.

The maintenance of all body functions requires a constant supply of energy. Energy in the diet is provided by carbohydrates, fats and proteins: one gram of carbohydrate (sugars and starches) provides 17 kJ of energy, one gram of fat provides 37 kJ of energy and one gram of protein provides 17 kJ of energy.

Energy intake

There is a wide individual variation in energy intake for both sexes.

A US study showed that female adolescents generally did not tend to increase energy intake with increasing age. Consequently, many female adolescents were unable to meet the energy and nutrient requirements for optimal growth at this crucial part of their life. The study showed that for male adolescents, there was a gradual increase in food intake with age, and most were able to meet their energy and nutritional requirements throughout the adolescent period (Lacey et al 1978). Data from the Australian Bureau of Statistics (1995) reveal similar trends: energy intake for boys increased by 17 percent from 11,590 kJ to 13,530 kJ between the ages of 12–15 years and 16–18 years and, in contrast, the energy intake reported by girls increased by only 2 percent to 8690 kJ for those aged 16–18 years.

A study by Brinsdon et al (1993) looked at dietary intakes of New Zealand form three and four students. On a weekday during September and October 1992, 366 students from 10 schools throughout New Zealand completed one 24-hour diet record. The study showed that the males had significantly higher energy intakes than females. The energy intakes for males were reported to be within the range recommended by WHO. The female adolescents' intakes, on the other hand, were lower than WHO recommendations. The authors' report that this is either a genuinely low intake or under-reporting of intakes by the female group.

Studies in the UK demonstrated that both sexes had higher nutrient intakes during weekends than weekdays, due to family food patterns being different during weekends than on weekdays (Post et al 1987; Crawley 1993). No such data exist in New Zealand since most studies have been done during school days only.

Snacks are higher contributors of energy during adolescence than any one individual meal (Post et al 1987; Brinsdon et al 1993). Snacks contribute from 25 to 38 percent of the daily energy during adolescence (Bigler-Doughten and Jenkins 1987; Post et al 1987; Harding et al 1988; Brinsdon et al 1992; Brinsdon et al 1993; Adamson et al 1996). Carbonated drinks play an important part in the food intake of adolescents. Data from the Australian Bureau of Statistics (1995*)* highlighted the high consumption of non-alcoholic beverages, which was found to contribute between 9 percent and 11 percent of energy intake in this age group. It must be noted that since sucrose is cariogenic and may result in the accumulation of excess adipose tissue, restricting consumption of snacks high in sucrose is recommended. Instead, nutrient-dense high-energy snacks should be encouraged.

A number of studies in the UK have shown that alcohol is consumed on a regular basis by over 40 percent of 17 year olds and contributes on average 2 percent of daily energy intakes (Townsend et al 1991; Crawley 1993). This is similar to the data from the Australian Bureau on Statistics (1995) where alcohol contributed 2 percent of the energy intake of 16–18 year olds.

Many adolescents are particularly concerned about their body image and body weight (either real or perceived) and are under constant pressure to enhance their body image. This emotional stress is often associated with dietary restrictions and slimming phobias; all can lead to eating disorders, the most serious of which are anorexia nervosa and bulimia nervosa, which are more common among female adolescents (Harris 1991; O'Dea 1995).

Obesity

Obesity is a disease in its own right as well as a precursor for atherosclerosis, cardiovascular disease, hypertension, adult onset diabetes mellitus and other diseases of adulthood (Must et al 1992). Obesity in adolescence, as well as contributing to long-term medical problems, has tremendous impact on psychosocial aspects of teenagers both present and long-term (Gortmaker et al 1993; Dietz 1994). Adolescent obesity is diverse in cause, including both genetic and environmental factors. It is a significant risk to health when it appears so early in life, and it is estimated that 70 percent of obese adolescents will become obese adults (Dietz and Gordon 1981; Filer 1993).

In the US, the prevalence of childhood obesity has remained at about 15 percent for 2–19 year olds from 1963 to 1980 (with obesity assessed as being at or above the 85th percentile of the body mass index (BMI)). However, a definite upward trend has been identified in the proportion of children who are most overweight (greater than 95th percentile). In addition, triceps skinfold values are increasing, reflecting an increase in obesity for this group (Kuczmarski 1993).

An Australian study of 213 adolescents aged 14–15 years found 21 percent of males and 18 percent of females had a BMI greater than the 90th percentile (Tienboon et al 1994). No data on the prevalence of overweight or obesity for adolescents are available in New Zealand.

Definition

Obesity is body fatness significantly in excess of that consistent with optimal health. There are no agreed national standards for assessing overweight or obesity in New Zealand adolescents. The issue of defining overweight and obesity in this age group is problematic and controversial. Height and weight percentile charts can be useful to assess changes in weight with respect to height over time. However, height-weight charts for school-aged children have not been developed since 1969 (Department of Health 1969) and therefore should only be used as a general guide.

In the absence of sufficient comparative data on clinical validity, the BMI is becoming the most widely accepted measure for routine clinical assessment of adiposity. The BMI has certain limitations due to the biological variation in weight and height during adolescence. It has been suggested that recommendations for weight control therapy should be focused on adolescents who currently manifest adiposity-related morbidity, those with a BMI above the 95th percentile or those above the 85th percentile who perceive their adiposity to be a significant psychosocial problem (Robinson 1993). Ideally, population-specific centile charts (of which there are none for this age group in New Zealand) should be used to define cut-off values. Otherwise, misclassification of obesity may occur which could be detrimental to individuals' health and emotional functioning.

Although useful, the BMI has the disadvantage of being influenced by the size of the lean body mass as well as the fat mass; other measures such as skinfold thickness (triceps or scapula) which yield an estimate of subcutaneous fat and height-weight charts may help in defining obesity in the clinical and community setting.

Inactivity and obesity

Inactivity is considered one of the determinants of obesity. It has been suggested that the recommended energy intake in adolescents should be reduced to take into account that most in this age group do not expend more than 10 percent of energy for physical activity. In the US, television viewing rather than excessive dietary energy intake is considered a leading determinant associated with early life obesity. Other contributing factors to the sedentary lifestyle are increased use of cars and lifts (Gortmaker et al 1990; Gortmaker 1996).

In New Zealand, both girls and boys have similar participation rates in physical activity until the age of 10 years, but from 11 years onwards, males show a slight increase and females a decrease in physical activity (Hillary Commission 1991). The trend observed may be of concern given that the lifestyle established during adolescence may influence lifestyle displayed as an adult.

Diet composition

Diet composition independent of total energy intake, resting energy expenditure and physical activity have been shown to be important in contributing to childhood and adolescent obesity. In diets of the same energy content, high-fat diets promoted more weight gain than low-fat diets (Gazzaniga and Burns 1993). However, results from studies in the adult population show that despite reductions in total fat in the diet, the prevalence of obesity has increased, which suggests that obesity is a complex problem that will not be solved by solely reducing the percentage of fat in the diet (Willett 1994; Prentice and Jebb 1995; Katan et al 1997).

In New Zealand, adolescents' dietary intake of fat is reported to be in the upper limit of the recommended levels (Brinsdon et al 1992; Brinsdon et al 1993).

Treatment

Diet, exercise and behavioural approaches to the treatment of adolescent obesity have shown no significant long-term effectiveness. However, the family-based treatment of obesity has demonstrated remarkable long-term maintenance of weight loss (Epstein 1996). These programmes target not only changes in family lifestyle but also the psychosocial development of the adolescent

within the family. In addition, adolescents are taught to develop a broad range of skills that enhance their social interactions, body- and self-image. These family-based management programmes should be run by multidisciplinary teams. The recommended treatment team may include a dietitian, exercise physiologist (or persons experienced in the delivery of appropriate exercise programmes), a mental health care worker and a clinician or nurse practitioner (McCarty and Mellin 1996).

Recommendations for achieving a healthy body weight

Apart from the use of exercise to control body weight, other methods are also used to control weight during adolescence. These include restricting food intake, missing meals, taking laxatives and dieting (Pearce 1984). These methods are not recommended.

Studies show that adolescents, especially females, are concerned about their health and body image (McHugh et al 1980; Agencies for Nutrition Action 1994; Worsley and Skrzypiec 1997). It is therefore important to provide education for them on health, nutrition, physical development and improving self-esteem. However, good information may be insufficient without change in cultural expectations and assistance from the fashion and advertising industries (Nowak et al 1996). All nutrition education and dietary advice directed at this age group must always take into account the psychological impact it may have. Adolscents are particularly vulnerable to issues of weight concern.

A balanced diet having a variety of food with sufficient energy and nutrient content to provide for growth and maintenance during adolescence is recommended. The FAO/WHO expert consultation report has stated that the combination of a varied diet containing at least 55 percent of total energy from carbohydrate and regular physical activity is the most beneficial way to maintain energy balance and avoid overweight and obesity in the adult population (Lauer 1997). However, the Ministry of Health's Food and Nutrition Advisory Committee recommended in 1997 that the current New Zealand carbohydrate recommendation should remain. That is, 50–55 percent of total energy in the diet should come from carbohydrate (Department of Health 1991).

Recommended energy intakes for adolescents

The energy needs of an individual depend on body size and composition, level of physical activity, environmental temperature, and genetic metabolic considerations (Underwood 1991). Dietary recommendations are difficult to set for adolescents because of the need to allow for growth and development to progress at the same time. The recommendations given by Australia (Truswell et

al 1990), the US (National Research Council 1989) and the UK (Department of Health, 1991) are tabulated in Appendices 1, 2 and 3. Since the level of physical activity is so variable, highly active adolescents may not fall within the recommended range. Food intake will need to be increased in order to meet the requirements for energy and nutrients of these individuals.

The best way to ensure that the individual adolescent is meeting their energy needs is to assess the adolescent regularly using a standardised weight for height chart. It must be noted that the percentile charts used in New Zealand are not based on New Zealand data for growth data and therefore may be inappropriate for different ethnic groups.

Protein

Protein is an essential nutrient for growth and maintenance of tissues. During the adolescent growth spurt, protein needs are high and utilisation of protein is dependent on adequate energy intake. Even if the protein intake is sufficient, it cannot be utilised for growth unless energy requirements are met (Whitney and Hamilton 1990). Some female adolescents may be at risk of developing protein deficiency due to their low energy intake. The New Zealand form three and four survey indicates sufficient protein intakes for females in absolute amounts, but their energy intakes are comparatively low (Brinsdon et al 1993). Data from the Australian Bureau of Statistics (1995) showed that the contribution of protein to energy intake was approximately 15 percent for Australian adolescents. A cohort study of 4760 teenagers in the UK reported the contribution of protein to energy intake was 12.5 percent: the largest contribution of protein was from meat and meat products (33 percent) followed by cereals and cereal products (24 percent) and milk and milk products (15 percent) (Crawley 1993).

Recommended protein intake

The Australian recommendations for adolescents include safe levels of intake that take into consideration growth and maintenance rates. They suggest further allowance to be made if the protein source is of predominantly low quality. The US-recommended daily allowance (RDA) is based on similar considerations but also expresses the RDA for protein in relation to height, with the daily protein recommendations for adolescents being approximately 0.3 g/cm height.

The New Zealand Nutrition Taskforce recommended that the total protein intake not exceed twice the recommended dietary intake for each age group. Peak requirements of protein will coincide with peak energy requirements and therefore can be summarised as 12–14 percent of energy requirements. Protein intake is recommended to be in the range of 0.8–1.6 g/kg body weight. The aim is to maintain protein intake at moderate levels (Department of Health 1991).

Fat

Lipids in the body have three major roles:

- in adipose tissue, they form the chief store of energy
- in all tissues, they are the main part of the structure of cell membranes
- they are the precursors of many hormones (Shils and Young 1994).

Fat in the diet

Dietary fat is found in both animal and vegetable foods.

- Saturated fats are commonly found in meat, such as beef, mutton, poultry, and animal products like egg yolks and dairy products (cheese, butter and whole milk).
- Polyunsaturated fats are found in plant oils, such as peanut, soybean, cotton seed, corn, safflower and those used in margarines.
- Monounsaturated fatty acids present in olives, olive oil, canola oil, peanuts, peanut oil, almonds, pecans and avocadoes.
- Essential fatty acids are linolenic acid and linoleic acid fatty acids, which must be obtained from the diet, as they cannot be produced by the body. Docosohexanoic acid is synthesised from linolenic acid (18:3n-3) and plays an essential role in brain and retinal visual function (Ziegler and Filer 1996).

Fat in food can be divided into two components.

- The visible component, which is butter, margarine, lard, vegetable oils and visible fat on meat. This is easy to measure and is easier to restrict in a dietary intervention.
- The invisible component, the fat closely associated with foods includes the fat in cakes, biscuits, cream, pastries and snack foods. The invisible component is variable and harder to measure and its restriction is dependent on food selection.

Fat intake

The New Zealand form one survey (Brinsdon et al 1992) and the New Zealand form three and four survey (Brinsdon et al 1993) both showed that the dietary intake of all the components of fat, that is, total fat, saturated fat and monounsaturated fat was close to the range recommended by the New Zealand Nutrition Taskforce. Energy contribution made from total fat was about 35 percent for 10–11 year olds and 37 percent for 13–15 year olds. The evening meal is the highest contributor to daily fat intake. Data from the Australian National Nutrition Survey (Australian Bureau of Statistics 1995) showed intakes comparable to those of New Zealand, that is, energy intake from fat was 34 percent for 12–15 year olds and 32 percent for 16–18 year olds. Snacks, including some fast foods, can also be major contributors of daily fat intake. Data from the UK show that fried potatoes (crisps and chips) contribute 13 percent of the total fat intake of teenagers aged 16–17 (Crawley 1993).

Cardiovascular disease and fat intake

A high level of low density lipoprotein (LDL) cholesterol has been shown to be the most significant risk factor for coronary heart disease. The other risk factors – for example, physical inactivity, obesity, cigarette smoking, high blood pressure – tend to influence the occurrence of cardiovascular disease only when people have high plasma cholesterol levels. Coronary mortality has fallen in the US, Australia and New Zealand. Diet has been identified as one of the environmental factors most likely to be responsible for this trend.

The largest change of any dietary component is the increase in polyunsaturated fat intake and in the polyunsaturated/saturated fat ratio. Meta-analysis of controlled experiments confirm saturated fatty acids raise total and LDL cholesterol, polyunsaturated fats lower total and LDL cholesterol and monounsaturated fats are neutral when compared to carbohydrate (Clarke et al 1997). The aetiology of coronary heart disease is multifactorial and fat can clearly not be the only determinant. Recent research has focused on the potential important protective effects of other dietary components, including antioxidants and, in particular, vitamin E and folic acid (Stampfer et al 1993; Boushey et al 1995).

The mean total blood cholesterol level of the New Zealand adolescent population is shown in Appendix 4. The National Heart Foundation of New Zealand states the population goal is to achieve a feasible population mean for plasma cholesterol of less than 5.2 mmol/L (National Heart Foundation 1988). There are striking 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.

Obesity during the second decade of life has been shown to significantly correlate to obesity in adulthood (Must 1996). While obesity is not an independent risk factor for cardiovascular disease, obesity tends to exacerbate other risk factors of cardiovascular disease, for example, hypertension and hyperlipidemia (Laskarzewski et al 1980; Berenson et al 1982; Aristimuno et al 1984; Garrow 1988; Must 1996). The Bogalusa Heart Study has shown that obesity is related to clustering of risk factors of cardiovascular disease in children and young adults (aged between 5–24 years) (Smoak et al 1987). Since reduction of obesity has been shown to improve levels of other risk factors (Ahrens 1984; Zimmerman et al 1984), the prevention of the onset of obesity in childhood may be important in reducing the risk of coronary heart disease in later life (Smoak et al 1987). Restricting an individual's fat intake is one way to help in weight control.

Tracking coefficients have been shown to increase significantly for low density lipoproteins in those aged between 13 to 15 years, and this effect was seen for fat and energy intake in this age group (Boulton et al 1995). Thus, restricting fat intake in children with hyperlipaedemia may reduce their risk of ischaemic heart disease. However, this approach requires population screening in order to start early intervention for these high-risk individuals. The population screening approach is costly, and therefore low-risk population intervention is favoured, based on dietary and lifestyle change through health education for the whole population.

There is some confusion about when in life programmes should be initiated to control or modify the risks of cardiovascular disease. This is illustrated by the differences between the recommendations for dietary fat intakes in children and adolescents from various international committees (Michaelsen and Jorgensen 1995). The difference of opinion is due to the concern of some experts that restriction of dietary fat in this age group may contribute to an inadequate dietary intake and thus potential growth failure, others acknowledge that lifelong eating and lifestyle habits can begin in childhood and it is appropriate to start to modify dietary fat intake in this age group.

Recommended fat intakes for adolescents

The New Zealand Nutrition Taskforce recommended the total fat intake should provide 30–35 percent of total energy, saturated fatty acids plus trans fatty acids should provide no more than 12 percent of total energy, polyunsaturated fatty acids should provide approximately 8 percent of total energy and monounsaturated fatty acids should provide up to 20 percent of the total energy. These recommendations apply to everyone over five years of age (Department of Health 1991).

Since fat levels in New Zealand adolescent diets are close to the upper limit of the recommended levels (Brinsdon et al 1992; Brinsdon et al 1993), reduction in total fat intake is recommended.

To ensure fat reduction and change in fat composition in adolescent diets, adolescents can:

- eat more fresh fruits and vegetables
- eat more bread/bread products, rice, pasta and cereal
- eat more low-fat dairy products

- choose the above as alternatives to snacks such as potato crisps, biscuits or pastries
- trim fat from meat, choose lean meat and remove the skin from poultry
- use less fat in cooking – when using fat choose a vegetable oil or olive oil
- select lower fat dairy products, – for example, reduced fat milk, cheeses (cottage cheese, Edam), yoghurts
- minimise salad dressing consumption unless it is low in saturated fat
- eat chocolate, chocolate-containing confectionery and toffees sparingly
- choose lower fat fast foods
- eat sausages, processed meats and luncheon meats infrequently. These tend to be high in fat, particularly saturated fats
- eat fried foods, – for example, fried potatoes (chips and crisps) or fried fish – only occasionally.

Carbohydrate

Carbohydrate and dietary fibre

Foods with a high carbohydrate content, for example, breads, rice, pasta, cereals, beans and potatoes – are not only important sources of energy that can replace saturated fatty acids in the diet but they also contain vitamins, minerals and are rich sources of dietary fibre.

The main components of dietary fibre come from plant cell walls and are made up of cellulose, hemicellulose and pectin (the non-starch polysaccharides (NSP)). Lignin, a non-carbohydrate component of the cell wall, is often included. The precise definition of dietary fibre is controversial. There is general agreement that the main component of dietary fibre is NSP, but there is no agreement on whether the other components should be included in the definition. It has been proposed at the joint Food and Agriculture Organization (FAO)/WHO expert consultation that the term dietary fibre be gradually phased out (Lauer 1997).

Non-starch polysaccharides (NSP)

Water-insoluble NSP found in wheat bran, cereals and vegetables may increase stool weight and normalise bowel transit time. As a result, insoluble NSP can appreciably reduce the problem of constipation. On a long-term basis, insoluble NSP may be useful in preventing and managing a range of bowel diseases such as diverticular disease, irritable bowel syndrome and gall stones.

Water-soluble NSP found in peas, oats, dried beans, lentils, barley, pasta and fruits, delays gastric emptying and increases the viscosity of the contents of the small intestine. Soluble NSP reduces the glycaemic index of the carbohydrate foods, increases bile acid excretion and may reduce low-density lipoprotein cholesterol levels (Baghurst et al 1996*).*

Resistant starch

Resistant starch is resistant to small bowel digestion. In the colon both resistant starch and some NSP are fermented to short-chain fatty acids. The profile of fatty acid production depends on the nature of the substrate fibre. These short chain fatty acids provide energy both locally for the lining of the intestine and also energy for the general metabolism.

Most of the health benefits of resistant starch relate to its impact on the colon. It increases bowel action with its mild laxative effect, increases the bowel's beneficial microflora, reduces the secondary bile acids in the faeces, beneficially lowers faecal pH and increases the level of short-chain fatty acids, in particular proprionate and butyrate (Baghurst et al 1996).

Carbohydrate, dietary fibre, NSP and resistant starch intake

Depending on the method used to determine dietary fibre intakes, the description of dietary fibre intake differs according to the component of dietary fibre measured, that is, dietary fibre and/or NSP and resistant starch. In New Zealand, dietary fibre intake has been reported to be 31 g/day and 17 g/day in males and females (15–18 years) respectively, with the fibre/energy ratio being similar for both sexes (Russell and Wilson 1991). Breads and cereal foods (other than rice and pasta) were the major contributors to fibre intake. Resistant starch intakes have been approximated to be 8.5 g/day and 5.2 g/day in 15–18 year old males and females respectively (Baghurst et al 1996). Carbohydrate intake of adolescents in New Zealand contributes to approximately half the daily energy intake.

The Australian National Nutrition Survey (Australian Bureau of Statistics 1995) reported a lower frequency of consumption of fruit and a higher frequency of consumption of cereal and vegetables in the 16–18 year age group; carbohydrate provided about half the energy intake for adolescent boys and girls. The study of food and nutrient intakes of teenagers in the UK showed average NSP intakes were 15.2 g/day and 12.6 g/day in males and females respectively (Crawley 1993). Recent studies of the fibre intake of US children show that there has been a significant decline in NSP consumption from fruit and vegetables but an increase from cereals, especially from ready-to-eat breakfast cereals (Saldanha 1995).

Ensuring an adequate carbohydrate and dietary fibre intake

While New Zealand adolescents appear to have intakes within the recommended range for carbohydrate, a high proportion of the carbohydrates are from refined sugars, especially sucrose. The major contributors of sucrose are sugary products, many of which are consumed as snacks – for example, sweet biscuits, cakes, confectionery and carbonated drinks (Brinsdon et al 1992; Brinsdon et al 1993). Since sucrose can be cariogenic and may lead to accumulation of excess adipose tissue, there needs to be a restriction in the frequency of eating foods high in added sugars. Sugary foods should be taken during meal times instead of as snacks.

The major sources of dietary fibre in the adolescent age group are breads and cereals followed by fruits and vegetables (Department of Health 1991). Adolescents tend to fall short of fibre because

of their relatively low intakes of fruit and vegetables (Reid et al 1992). A desirable carbohydrate and dietary fibre intake should be achieved by increasing consumption of fruits, vegetables, legumes, breads and cereals (Lauer 1997).

Recommended intakes for adolescents

The joint FAO/WHO expert consultation on carbohydrate in human nutrition recommends that an optimum diet contains at least 55 percent of total energy from a variety of carbohydrate sources for all ages except children under the age of two (Lauer 1997). The Nutrition Taskforce recommended that New Zealand adults should obtain 50–55 percent of total energy from carbohydrate. Sucrose and other free sugars should be restricted to no more than 15 percent of the total energy. Their recommended intake for dietary fibre was 25–30 g/day (Department of Health 1991). The UK dietary reference values propose an intake of NSP, based on their effect on stool weight, of 18 g/day for adults with an expected range of individual intakes from 12 g/day to 24 g/day (Department of Health, London 1991).

Since the energy intakes of adolescents are likely to be higher than those of adults, the aim for adolescents should be for no less than 'adult' levels of carbohydrate intake and dietary fibre levels.

Iron

Iron needs are greatest in the first six months of life and during the pubertal growth spurt. Iron is required for expanding cell mass and growing body tissues in adolescents (Underwood 1991) and, in female adolescents, iron is also required to replace that which is lost through menstruation (Hallberg et al 1996). The level of physiological requirement varies between individuals.

Dietary iron and absorption

The iron absorption from food is dependent on a number of factors, including the iron status, the dietary iron intake of the individual and the individual iron requirement. Iron absorption is increased when the iron stores are low. Iron absorption also increases when the need is high, for example, during adolescence. The iron absorbed by the individual depends on the iron content of the diet and on the bioavailability of iron from the diet. The haem form of iron found in meat, seafood and chicken is more readily absorbed than non-haem iron found in cereals, vegetables and fruit. Non-haem iron absorption is dependent on the presence of promotors and inhibitors (Shils and Young 1994).

The major promotors of non-haem iron absorption from the common food pool are meat and organic acids, including citric acid, lactic acid and particularly ascorbic acid. Meat has a twofold beneficial effect on iron nutrition. Not only is it a good source of the bio-available haem iron, but it also promotes absorption of non-haem iron from the common pool. As a result, the absorption of non-haem iron from a variety of staple foods is substantially improved in the presence of meat (Bjorne-Rasmussen and Hallberg 1979).

Ascorbic acid is the most powerful promotor of non-haem iron absorption (Lynch and Cook 1980; Ballot et al 1987). The inhibitory effect of phytate and tannic acid can be overcome by ascorbic acid (Siegenberg et al 1991). Prolonged heating of foods causes destruction of ascorbic acid, thus affecting the bioavailability of non-haem iron.

Inhibitors of non-haem iron absorption include polyphenols (from tea, vegetables, legumes and condiments), phyates (from cereals, nuts and legumes), the dietary fibre complex (wheat), calcium and phosphorus (Department of Health 1991).

Iron deficiency

Iron-deficiency anaemia is defined as a haemoglobin below a standard cut-off point based on race, age and sex. However, before iron-deficiency anaemia is reached, there are interim stages of

iron deficiency. Therefore, a combination of biochemical measures is used as an index of biological iron status (Table 1). The level of these parameters reflects different stages of iron status, but it must be noted that they can also be affected by dehydration, recent strenuous exercise, and the presence or absence of pathological conditions such as infection, inflammation or malignancy.

Table 1: Biochemical measures of iron status for each stage of iron deficiency

Stage	Description	Biochemical measures
1	Low iron stores	Low serum ferritin
2	Deficient iron stores: iron deficiency	Low serum iron, high serum total iron binding capacity, reduced transferrin saturation index, high free erythrocyte protoporphyrin
3	Iron-deficiency anaemia	Low haemoglobin

While iron deficiency is associated mainly with iron deficiency anaemia (low haemoglobin level), there is abundant evidence to suggest that unsatisfactory iron status can produce pathological effects in the presence of haemoglobin and haemotocrit being within the normal range. Iron deficiency and low iron stores have been associated with problems in both humoral and cellular response to infection (Walter et al 1997), decreased work capacity ('Tired blood can slow your workout' Anon 1989) and specific cognitive learning effect (Webb and Oski 1973; Pollitt 1997).

Adolescents are vulnerable to low iron stores and iron deficiency due to the high physiological requirements for growth, high losses which accrue in menstruating female adolescents, and diets which are often low in haem iron.

Prevalence data from the third National Health and Nutritional Examination Survey 1988–99 (NHANES III) study found 11 percent of 12–15 year old females, 14 percent of 16–19 year old females and ≤1 percent of 12–19 year old males were iron deficient (Looker et al 1997). In Australia a survey to determine the iron status of children showed a significantly higher prevalence of iron deficiency among the 15-year-old girls than boys. Nine percent of this group were iron deficient (English and Bennett 1990). There are no data on the prevalence of iron deficiency in New Zealand adolescents.

Dietary iron intakes

The New Zealand form one survey (Brinsdon et al 1992) showed that iron intake for that particular age group was adequate. However, the New Zealand survey on nutrient intakes of form three and four students showed 14 percent of males and 37 percent of females in this group had dietary iron intakes <70 percent of the RDI (Brinsdon et al 1993). Given the growth rate and the onset of menstruation, the low median iron intake for girls (9.6 mg) is of particular concern. The availability of iron from particular food sources was not investigated in this study. The low intake may be related to low energy and protein intake in these girls. It is recommended that girls be encouraged to increase overall food intake (especially foods with a high nutrient density), thus increasing the intake of energy, protein and minerals such as iron.

Ensuring an adequate iron intake

It is important to consider the food sources of iron. Iron is found in many foods. About 40 percent of the total dietary iron is available as haem iron which is found in animal tissues: meat, liver, fish and poultry. The remaining 60 percent of iron and all the iron in plant foods such as cereals, vegetables, legumes, nuts and fruits is non-haem. The absorption of non-haem iron is increased when raw fruit or vegetables (sources of vitamin C) are eaten at the same time as non-haem iron foods and is further enhanced by a small piece of fish or meat (Department of Health 1991).

To meet their high requirements, adolescents are not only encouraged to consume adequate amounts of iron-rich food (meat, chicken, seafood) but also to have appropriate combinations of food, particularly when the iron is in the non-haem form.

Vegetarian, vegan or other diets not containing animal tissues

Vegetarianism is common practice in this age group. Studies by Worsley and Skrzypiec (1997) in South Australia reveal that teenage vegetarianism is primarily a female phenomenon, with 8–10 percent of female adolescents being full vegetarians and up to 32–37 percent of women restricting their meat intake. This study and others highlight the strong association between vegetarianism and restrained eating behaviour and suggests that dieting and vegetarianism are closely associated in young women (Nelson et al 1993).

Non-muscle protein – for example, egg and cheese – do not have the enhancing effect of meat on iron absorption and good sources of plant protein, for example, soy bean and nuts have a negative effect on iron availability (Ballot et al 1987). Therefore, adolescents on these diets need to make use of vitamin C to improve iron availability. Raw fruits, fruit juice or vegetables should be eaten with all meals.

Pregnancy

Rapid expansion of the red cell mass during adolescence and the typically iron-poor diet that female adolescents consume put adolescents at increased risk of iron-deficiency anaemia during pregnancy. Since the pre-menarcheal growth spurt can deplete endogenous iron stores, it is suggested that adolescents who conceive soon after menarche may need to meet a greater proportion of their pregnancy-related requirements for iron from exogenous sources. Thus, pregnant adolescents should be encouraged to increase their intake of iron-rich foods, and health professionals must be aware of the importance of regularly checking maternal iron stores during pregnancy. Supplementation is usually necessary in the adolescent who has conceived soon after her pre-menarcheal growth spurt but must always be in conjunction with the appropriate dietary advice and under medical supervision (Stevens-Simon and Andrews 1996).

Iron supplements

Iron supplements are only necessary when there is evidence of iron-deficiency or depletion (Balaban 1992; Gerrard 1987). The UK recommendation states that for 'women with high menstrual losses, the most practical way of meeting iron requirements is to take iron supplements' (Department of Health, London 1991). This situation may well apply to many adolescent women. However, when iron supplements are required their use should be under medical supervision.

It can be inferred from a number of studies that iron supplementation of iron-deficient adolescents improves mood, psychomotor skills and learning (Groner et al 1986; Ballin et al 1992; Bruner et al 1996). The findings of these studies support the importance of prevention of iron deficiency in this age group.

Adolescent athletes

While it has been stated that iron deficiency is common in the exercising population (Clement and Asmundon 1982; Manore et al 1989), to date there is no large-scale study that has compared the iron status of those who exercise with those who do not. Although increased iron loss due to haemolysis, increased faecal and urinary excretion and sweat may occur in some athletes, these losses tend to be insignificant. Evidence suggests that iron requirements are similar for both adolescent athletes and the normal adolescent population (Weight, Jacobs et al 1992; Weight, Klein et al 1992).

Inadequate iron intake is in general the main cause of deficiency in adolescent athletes (Weight, Jacobs et al 1992). Thus, adolescent athletes need to maintain adequate iron intake and to utilise food iron efficiently.

Recommended iron intakes for adolescents

The recommendation for daily iron intakes is based on an estimated average of dietary iron absorbed (15–20 percent of dietary iron is absorbed). The recommendations are given in Appendices 1–3. The difference in recommendations is due to variation in bioavailability of iron in different foods and the particular dietary habits of a given country or region.

The New Zealand Nutrition Taskforce (Department of Health 1991) recommended that the Australian recommended dietary intakes (RDIs) 1990 (Truswell et al 1990) be adopted for New Zealanders.

Table 2: Recommended Dietary Intakes for Iron (mg/day)

	Iron mg/day		
Age	**8–11 Years**	**12–15 Years**	**16–18 Years**
Females	6–8	10–13	10–13
Males	6–8	10–13	10–13

Calcium

Skeletal calcium and peak bone mass

The period between nine and 20 years seems to be critical for achievement of peak bone mass. Since the contribution of the third decade to peak bone mass is relatively small (Matkovic et al 1977), the critical period for the maximal bone mass formation is during puberty and early adolescence (Matkovic et al 1990). Peak bone mass is probably the result of the interaction between endogenous (heredity and endocrine) and exogenous (nutrition, physical activity) factors.

Among nutritive factors, calcium seems to be the most important determinant of peak bone mass in young adults (Halioua and Anderson 1989). Calcium deficiency or factors which interfere with calcium intake may be crucial at this time of life. Many female adolescents may be at increased risk for the development of skeletal inadequacy due to an imbalance between calcium intake and high requirements for calcium during this period of increased bone modelling and skeletal consolidation (Sander et al 1985). It is also possible that anorexic females may have low bone mineral density due to low food intakes and amenorrhoea (Henderson 1991).

Improvements in bone mass have been demonstrated in a number of calcium intervention trials. However, other cross-sectional studies have not found an association between current calcium intake and bone mass (Heaney 1997). Studies of calcium supplementation using dairy products have indicated that increased milk consumption may be associated with higher peak bone mass in adolescent girls, suggesting that protein may mediate some of the skeletal anabolic effects of milk (Cadogan et al 1997; Gilchrist 1997). The dietary calcium/protein ratio has been shown to be important in determining calcium balance (Heaney 1993).

Although osteoporosis generally appears later in life in both sexes or after the menopause in women, chronic deficiency in calcium intake starting early in life is responsible for osteoporotic development (Heaney et al 1982). A maximal bone mass at skeletal maturity is considered to be the best protection against age-related bone loss and subsequent bone fracture risk.

Calcium absorption and excretion

Adolescents have higher rates of calcium absorption than children and young adults (Weaver 1994). The major determinants of calcium absorption are the amount of bio-available calcium in the diet and the vitamin D status of the individual. The absorption of calcium may increase with lactose, protein and calcium to phosphorus ratio of 0.6 to 1.0. Under normal circumstances, the efficiency of intestinal calcium absorption is carefully regulated to meet the body's need for calcium. Negative imbalances can be caused by caffeine and alcohol consumption. High caffeine intake and high alcohol consumption are two potential areas of concern with respect to adolescent bone

health. Calcium may also be bound by phytates present in wholegrain cereal products, and polyphenols from tea (Department of Health 1991). New Zealand adolescents have a low intake of tea (Harding et al 1988; Hillary Commission 1991).

Calcium intake has little influence on urinary calcium excretion during the period of most rapid skeletal formation. The average urinary excretion of calcium is 175 mg/d and calcium loss through skin and faeces can be as much as 60 mg/d. The obligatory urinary calcium loss increases with high intake of sodium and protein (Sander et al 1985).

Calcium intake

It has been suggested that calcium intakes of up to 1600 mg per day may be required during adolescence (Matovic 1992). The Life in New Zealand Survey (Russell and Wilson 1991) and the 1992 form one survey (Brinsdon et al 1992) and the 1992 form three and four survey (Brinsdon et al 1993) all show that the intake of many New Zealand adolescents appears to be inadequate. The mean daily intake for girls in form three and four was 636 mg, and for the boys it was 807 mg, per day. The mean daily intake for the girls was 675 mg and 762 mg for boys in the form one survey. A two-fold daily increase in calcium intake is therefore suggested.

Ensuring an adequate calcium intake

Milk and milk products (but not cottage cheese, cream cheese, cream and butter) are excellent sources of calcium. Concerns that dairy products are fattening often lead to avoidance during adolescence. However, the Christchurch girls' osteoporosis study showed that increased dairy product intake in the intervention group did not cause an increase in weight, total body fat or blood cholesterol levels despite a difference in energy intake of 1000 kJ between the control and supplemented group (Gilchrist 1997). Snacks are the major source of daily calcium during adolescence. Therefore, low fat cheese, milk drinks and yoghurt should be encouraged as options for snacks. Salt intakes should be moderated by reducing the intake of salty snacks as a high sodium intake increases the urinary excretion rate of calcium.

Those adolescents who do not eat dairy products – for example, those with a lactose intolerance and those on vegan diets – must ensure that they maintain adequate calcium intakes from non-dairy sources such as green vegetables, whole grain cereals and bread, canned fish with bones and tofu. Soymilk is also recommended as an alternative to regular milk. Calcium supplements are not recommended except under medical advice.

Recommended calcium intakes for adolescents

Calcium requirements during adolescence are associated with growth of lean body mass and mineral skeleton (Underwood 1991). During adolescence approximately 45 percent of the total adult skeleton is laid down. Variation between individuals is due to sex, physiological age as well as body size. Average daily increments of body calcium are still debatable since values differ according to the method of measurement. At the peak of the adolescent growth spurt, the calcium increment can be two to three times greater than normal states of growth (Forbes and Brown 1989). A positive correlation exists between positive calcium balance and calcium intake.

Table 3: Recommended Dietary Intake for Calcium (mg/day)

Age	Calcium mg/day		
	8–6 Years	12–15 Years	16–18 Years
Male	800	1200	1000
Female	900	1000	800

Note: it has been suggested that calcium intakes of up to 1600 mg per day may be required during adolescence (Matovic 1992).

Other Nutrients

Sodium

There is still international debate in the literature concerning the effect of sodium intake on normotensive individuals. A meta-analysis of controlled clinical trials provides evidence that sodium restriction in normotensive individuals is unnecessary (Midgley et al 1996). However, hypertensive individuals appear to benefit from sodium restriction (Elliott et al 1996). Adolescents who present with hypertension usually have mild to moderate hypertension associated with overweight or obesity.

However, a meta-analysis by Law et al (1991) of 24 different communities, 47,000 people worldwide, found that the association between blood pressure and sodium intake increases with age and initial blood pressure. They found the difference in sodium intake of 100 mmol/24 hr was associated with an average difference in systolic blood pressure of 5 mmHg for 15–19 year olds. The differences in diastolic blood pressure were about half as great.

Current research suggests that in the adult population diets low in minerals particularly calcium are associated with increased blood pressure (Bucher et al 1996; Appel 1997). Urinary calcium is dependent on protein and salt intake (Linkswiler et al 1974; Gray et al 1977). Therefore the high sodium intake of adolescents and low calcium intake seen in the two New Zealand surveys (Brinsdon et al 1992; Brinsdon et al 1993) is of concern. Since foods popular with adolescents are often high in sodium (Ackley et al 1983), some adolescents may be placed at risk of developing negative calcium balance.

There are no accurate data on the sodium intakes of New Zealand adolescents, however, foods such as potato crisps, pies and savoury biscuits are popular and contribute to the adolescent's sodium intake. Therefore, encouraging foods such as fruit, low fat dairy products and bread-based products will help in ensuring a nutrient-dense diet, which may also assist in weight control and therefore may reduce the risk of hypertension.

It is recommended that adolescents minimise the consumption of:

- foods which are high in salt
- the addition of salt at the table and during cooking.

This is because dietary habits formed in childhood and adolescents may continue into adulthood, and there is still debate about the effect sodium restrictions have on normotensive individuals.

Folate

Folate is essential for deoxyribonucleic acid (DNA) synthesis and is especially important during periods of increased cell replication and growth, for example, adolescence (Department of Health 1991). Folate in foods is easily destroyed during storage and cooking, so careful food preparation is necessary. Leafy vegetables, fruits, beans, peanuts, bran, and yeast are good sources of folate, with liver and kidney being the richest sources. Adolescents may be at risk of low intakes due to low popularity of the folate-rich foods.

Folate is important in early pregnancy. Studies have found that periconceptional supplementation of folic acid reduces the reoccurrence (Medical Research Council 1991) and occurrence (Czeizel and Dundas 1992) of neural tube defects. The Public Health Commission and the Ministry of Health has recommended, for all women considering pregnancy, to increase dietary intakes of folate and take a folic acid supplement (0.8 mg/day) starting four weeks before conception, and continuing daily through to the 12th week of pregnancy (PHC 1995).

Low blood folic acid concentrations have been associated with high blood homocysteine levels in adults. There is growing evidence that a raised level of this amino acid is an independent risk factor for coronary heart disease (Boushey et al 1995).

Zinc

Zinc is integral in the synthesis of protein and essential for normal growth and development (Sandstead 1973). The Life in New Zealand Survey found the mean zinc intake of 15–18 year old males to be 14 mg per day and females 9 mg per day (Russell and Wilson 1991). Vegan adolescents may be at greater risk of zinc deficiency since absorption of zinc is inhibited by high fibre foods, phytates and iron (Ackley et al 1983). Meat, poultry and fish are good sources of bioavailable zinc. Nuts legumes and wholegrain cereals have good a zinc content but it is less bioavailable. (See Appendix 1 for Australian recommended zinc intakes in adolescents).

Vitamin A

It is possible that adolescents on vegan diets are at risk of developing vitamin A deficiency because the main sources of vitamin A are dairy products, eggs, liver, meats and fatty fish. Alternatively, vegetable sources of provitamin A include, carrots, pumpkin and dark green leafy vegetables, such as silverbeet and broccoli, and should be encouraged for this group.

Vitamin C

Vitamin C acts as a co-substrate in hydroxylations requiring oxygen and is a powerful antioxidant. Randomised controlled trials examining the effect of vitamin C supplementation on specific cancers and cardiovascular morbidity have been equivocal (Mackerras 1995). However, population studies suggest that intakes of antioxidants from fruits and vegetables are protective against some degenerative diseases. Therefore, it is recommended that vitamin C ingestion should approximate that from five servings of fruit and vegetables per day (Levine et al 1995).

Regular daily intake of vitamin C, a water soluble vitamin, is required as it is readily excreted. The New Zealand form three and four survey is encouraging in that the vitamin C intake is adequate (although much of the intake is from beverages) and therefore may be able to assist in the absorption of non-haem iron, given the low iron intake of adolescent females (Brinsdon et al 1993).

Vitamin B6

Vitamin B6 is involved in a large number of enzyme systems associated with nitrogen metabolism (Shils and Young, 1994). The form three and four survey (Brinsdon et al 1993) shows a significantly low intake of vitamin B6 in this particular age group. There is documented evidence of vitamin B6 deficiency in adolescents from low income groups in the US (Schor et al 1972).

On the other hand, the UK is concerned about toxicological evidence which shows the consumption of high doses of vitamin B6, usually as supplements, over a period of time is harmful to health and may cause sensory peripheral neuropathy (Committee on Toxicity of Chemical in Food, Consumer Products and the Environment 1997). The UK is currently consulting on draft regulations for dietary supplements which propose a maximum daily dose of 10 mg of vitamin B6 sold under food law.

Adolescents should be encouraged to include whole grain cereals, poultry, fish, eggs, green and leafy vegetables and fruit in their diet to ensure an adequate dietary intake of vitamin B6.

Vitamin B12

Vitamin B12 is required for rapid growth of cells (Shils and Young 1994). Adolescents would appear to have an increased need for vitamin B12, particularly during the growth spurt. Animal products are the only sources of vitamin B12, adolescents on a vegan diet may be at risk.

Niacin, riboflavin, thiamin

These vitamins are involved in energy metabolism, so there is an increase in requirements for these vitamins during adolescence. Niacin, riboflavin, thiamin should be met through increased food intakes, thus supplying both the necessary energy and the vitamins. This is best achieved by encouraging increased dietary intakes of bread, cereal, fruit and vegetables low-fat dairy products and meat.

Fluid Intakes

Water balance

The water requirement is the amount of water necessary to:

- balance the insensible losses which varies both within and between individuals
- maintain a tolerable solute load for the kidneys which may vary with dietary composition and other factors.

A general requirement for water intake is hard to set (Truswell et al 1990).

Fluid intakes of adolescents

Carbonated drinks tend to be high on the list of foods liked by adolescents. The popularity of soft drinks (including sports and energy drinks) has been reinforced by sponsorship of high rating television programmes and endorsement by sporting celebrities. While soft drinks may serve a useful function by encouraging an adequate intake of dietary water, they can depress appetite, substitute for milk and therefore have a negative effect on the intakes of magnesium, riboflavin and vitamin A, with the greatest impact on calcium intake in girls. The popularity of smart drinks (designer drinks, power drinks, non-alcoholic soda) is also a cause for concern as a number of smart drinks have a high caffeine content and are marketed at this age group.

Most soft drinks include a major source of energy, which may be utilised by growing teenagers. While there is little direct evidence that sucrose in soft drinks contributes to dental caries, phosphoric acid (at times added to soft drinks) is very likely to damage teeth by eroding enamel if taken in excess and may reduce the availability of calcium (Truswell and Darnton-Hill 1991). Data from the Australian National Nutrition Survey (Australian Bureau of Statistics 1995) highlighted the high consumption of non-alcoholic beverages by this age group, a contribution of 9–11 percent of total energy intake.

Fluid needs of very physically active adolescents

Very physically active adolescents need more water to replace fluids lost through perspiration. Young adolescents should be reminded to drink water. A loss of as little as 3 percent of body water could result in exhaustion and dehydration or, less dramatically, cause a person to become tired and less effective during activity. Guidelines for the prevention of heat stress in children and adolescents have been devised by the Australian Sports Medicine Federation (1989) who recommend 300–400 ml of fluid 45 minutes prior to activity and 150–200 ml each 15-20 minutes. Thirst is not generally a reliable monitor of the body's need for water during exercise. However, Meyer et al (1994) found mild dehydration during exercise increased thirst and drink desirability in children. As the level of dehydration increased so did the sensation of thirst.

Sports drinks, advertised as a way to replace water and electrolytes lost during exercise, are not generally recommended for non-endurance activities. Plain water is the most economical source of fluid. Young athletes can use sports drinks, especially if they exercise for more than 90 minutes. Although water is adequate, greater overall fluid intake may be achieved if it is flavoured (Meyer et al 1994). Some of these drinks are high in sugar, which may cause cramps, nausea and diarrhoea in some individuals. Lost electrolytes are usually replaced upon eating.

Alcohol

Alcohol dependence is of major concern. Alcohol dependence was the second most prevalent psychiatric disorder found in 18 year olds in the Dunedin Health and Development Study (Feehan et al 1994). Prevalence was greater in males, at 12.7 percent, with an overall prevalence of 10.4 percent. Estimation of its prevalence at 11 and 15 years were not available in either of these studies. These data are not nationally representative. Māori and Pacific peoples are under-represented.

Family and peer influences, rather than personality characteristics, are believed to be influential in the establishment of substance abuse in adolescence (Miller and Ware 1989). The factors that initiate alcohol consumption during adolescence are stress (Mitchell 1983), peer pressure (Pohorecky 1991), rejection of parental authority, deviant behaviour and sensation seeking (Downs and Rose 1991), ease of access to alcohol at home and working greater than 20 hours per week while studying (Resnick et al 1997). Exposure to alcohol before age six and positive parental attitudes to alcohol are also considered to increase vulnerability to frequent heavy drinking in adolescence (Fergusson et al 1994).

Individuals who drink large amounts when younger are more likely to be heavy drinkers when older (Friedman and Humphrey 1985; Barnes and Welte 1986). Other sociodemographic variables such as gender, marital status, ethnicity and education are not important mediators in drinking experience for adolescents (Casswell et al 1993; Fergusson et al 1994).

The effect of chronic alcohol abuse on nutritional status during adolescence is not known. However, a high consumption of alcohol can replace calcium intake and contribute to obesity (Truswell and Darnton-Hill 1991). Poor nutrition can result from impaired nutrient absorption and inadequate dietary intake over a period of time. A number of studies in the UK have shown that alcohol is consumed on a regular basis by over 40 percent of 17 year olds and contributes on average 2 percent of daily energy intakes (Townsend et al 1991; Crawley 1993). This is similar to the data from the Australian National Nutrition Survey (Australian Bureau of Statistics 1995), where alcohol contributed to 2 percent of the energy intake of 16–18 year olds .

Suitable fluids for adolescents

Water intake should be encouraged during adolescence. Milk, especially reduced fat milks, are also recommended.

Carbonated drinks should be restricted. Plain water instead of soft drinks with a meal is recommended. It is also recommended to dilute fruit drinks before consumption.

While alcohol intake is not recommended for adolescents, alcohol consumption cannot be completely avoided. Advice for adolescent consumers is:

- limit intake of alcohol
- discourage binge drinking
- eat some food when you drink
- dilute alcoholic beverages and keep count of the number of drinks consumed
- do not drink alcoholic beverages if you intend to drive a car or operate machinery or undertake difficult tasks.

Supplementation

The best nutrition strategy for promoting optimal health and reducing risk of chronic disease is by obtaining adequate nutrients from a wide variety of foods as recommended in the *Food and Nutrition Guidelines*. Vitamin and mineral supplementation is only appropriate in specific circumstances. Examples of when supplementation may be appropriate during adolescence are as follows:

- adolescents with an appropriately diagnosed milk allergy may require a calcium supplement
- vegans require vitamin B12 supplementation
- pregnant adolescents require folate supplements four weeks prior to conception and 12 weeks after conception
- pregnant adolescents may require iron supplementation

Supplements are not generally recommended for adolescents. Reasons for this include:

- concerns about the adverse effects related to the continued use of large numbers of certain vitamins or minerals (American Dietetic Association 1996)
- possible unknown benefits of food, due to incomplete identification of all components within the food (American Dietetic Association 1996)
- interactions among minerals and trace elements, which may mean that large supplemental intakes of one nutrient could result in deficiencies of another (Sandstead 1981)
- considerable expenditure on supplements, reducing money available for purchasing food
- reliance on dietary supplements may be associated with a false sense of security about nutrient adequacy, thus potentially impairing the adequacy of food intake.

There are no data available on supplement usage patterns in New Zealand adolescents. The National Nutrition Survey should provide some current information on supplement usage patterns of New Zealanders over 15 years of age.

Fortification

Nutrients are added to improve the quality of food or to improve the nutritional status of a population. The addition of nutrients to foods is specified in the New Zealand Food Regulations 1984.

In July 1996, the joint food standards setting system between Australia and New Zealand was introduced. Until a single set of food standards is developed for both countries, New Zealand allows food products to comply either with the New Zealand Food Regulations 1984 or with the Australian Food Standards Code.

The Regulations list which foods can be fortified, what nutrients can be added and the quantities of nutrients which can be added to the food. Food standards need to be reviewed regularly in response to a population's changing nutritional needs and to any emerging health risk which may arise from foods (Ministry of Health 1995). It is reported that there are no known safety concerns in the UK resulting from the consumption of foods with added nutrients (Brady 1996).

Vegetarian Diets

Vegetarian diets in the context of ecological, environmental, philosophical and health concerns provide a ready focus for adolescents. Studies by Worsley et al (1996) in South Australia reveal that teenage vegetarianism is primarily a female phenomenon with 8–10 percent of female adolescents being full vegetarians and up to 32–37 percent restricting their meat intake. This study and others highlight the strong association between vegetarianism and restrained eating behaviour and suggests that dieting and vegetarianism are closely associated among young women (Nelson et al 1993).

It is possible to obtain all essential nutrients without eating animal products. Eating a wide variety of different foods will ensure a good balance of nutrients. A considerable body of scientific data suggest positive relationships between vegetarian lifestyles and risk reduction for several chronic degenerative diseases such as obesity, coronary artery disease, hypertension, diabetes mellitus, colon cancer, osteoporosis and others (Halva and Dwyer 1988).

The term vegetarianism encompasses a wide range of dietary practices that can be divided into a number of sub-groups. Lacto-ovo-vegetarians (LOV) exclude meat, fish and poultry from their diet but they do consume dairy products and eggs. Lacto-vegetarians eat no meat, fish, poultry or eggs but they do include milk and milk products (butter, cheese) in their diet. Vegans adopt the strictest form of vegetarianism, as they exclude all animal-derived food from their diet (Whitney and Hamilton 1990).

The UK is considering developing separate nutrient recommendations for vegetarians.

Nutritional adequacy of lacto-ovo-vegetarian diets

LOV diets which contain milk products and eggs are generally satisfactory for children and adolescents. They also conform closely with adolescent recommendations for promoting health and reducing the risk of chronic degenerative diseases (Jacobs and Dwyer 1988).

A six-month delay in menarche has been reported in LOV (Johnston and Haddad 1996). Sabate et al (1991) studied a group of Seventh Day Adventist children (6–18 years) and found that mean height was lower in pre-adolescent school girls consuming a LOV diet or eating meat less than once a day compared to omnivore controls (Sabate et al 1991). However, LOV girls were taller than their omnivore counterparts later in adolescence, suggesting that the lower height represents delayed onset of the pre-pubertal growth spurt (Sabate et al 1991).

Nutritional adequacy of vegan diets

Vegans who exclude all animal-derived foods from their diet need to plan carefully to meet the RDIs for energy, protein, calcium, iron, zinc, riboflavin, vitamins B12 and D, and n-3 fatty acid intakes (Nutrition Standing Committee of the British Paediatric Association 1988; Sanders 1995).

Follow-up data from studies of Dutch macrobiotic (similar to a vegan diet) children suggest that the low dietary calcium intake consumed early in life negatively influences bone mass at 9–15 years which may hold important implications for fracture risk later in life (Parsons et al 1997). Ideally, the growth of vegan children and adolescents should be monitored because significant depressed growth may indicate less than optimal development (Network of the Federal/Provincial/Territorial Group on Nutrition and National Institute of Nutrition 1989). When milk is not taken, other drinks such as soy beverages which are fortified with calcium and vitamin B12 should be given.

Nutrients to monitor and practical suggestions

It is essential to plan vegetarian or vegan diets for adolescents carefully. As food intake becomes more restricted, there is a greater risk of nutrient deficiencies and an inadequate level of energy intake. The following factors need to be considered: energy, protein, minerals, omega-3 fatty acids and vitamins.

A vegetarian and vegan diet tends to be low in energy, particularly if large amounts of fruits and vegetables are consumed. The bulky nature of the vegetarian diet may mean that adolescents may have difficulty consuming sufficient nutrients and energy. Therefore, serving frequent meals and snacks is especially important. Cereals, nuts, pulses, legumes, root vegetables (potato, kumara) and dairy products are more energy dense than fruits.

It is possible for adolescents on a limited vegetarian or vegan diet to have an inadequate protein intake. Protein quality may be compromised by limited variety or improper combination of plant sources of protein. Care must be taken to offer the vegan adolescent ample sources of protein and to ensure that energy intakes are adequate. It is important that vegetarians and vegans consume protein from a variety of sources. For vegan diets, it is necessary to consume both grains – which are high in methionine and threonine and low in lysine – and legumes – which are foods high in lysine but low in sulphur-containing amino acids. This will ensure all essential amino acids are provided.

Foods commonly consumed in a vegetarian and vegan diet contain large amounts of fibre, phytate and oxalate. These substances are known to bind minerals such as calcium, iron and zinc and reduce their bioavailability (Freeland-Graves 1988). There is no evidence that this binding will cause deficiency syndromes in an otherwise adequate diet.

- *Iron* – LOV and vegan adolescents should consume wholegrain and fortified cereals, nuts, seeds, dried fruits, legumes and dark green vegetables, as these have a high non-haem iron content. Fruits and vegetables are important foods in the vegetarian diet, as they contribute a large quantity of vitamin C.
- *Calcium* – Calcium intake is not affected in LOVs as they consume milk and dairy products. Absence of milk products may influence peak bone mass acquisition in adolescents because of inadequate intakes of dietary vitamin D, calcium and phosphorus (Parsons et al 1997). Sources of calcium in vegan diets include legumes, tofu, oranges, almonds, figs and some leafy vegetables. Calcium-fortified soy beverages is recommended.
- *Zinc* – Zinc is needed for growth and development and the maintenance of body tissues. LOV and vegan diets can be low in zinc due to the dietary exclusion of meats, poultry and seafood, and the binding of zinc by fibre, phytate and oxalate. Another factor influencing zinc quality in LOV and vegan diets may be the extensive use of soy products as meat substitutes. Sources of zinc in LOV and vegan diets include legumes, nuts, miso and tofu, but the availability is questionable.

  LOV diets are usually sufficient in vitamin B12, vitamin D and riboflavin, as the main source of riboflavin is milk. Eggs and milk both supply vitamin B12. The vitamins most likely to be deficient in vegan diets are vitamin B12, vitamin D and riboflavin.
- *Vitamin B12* – Vitamin B12 is found exclusively in animal meat and dairy products (Whitney and Hamilton 1990). Strict vegans are thus theoretically at great risk of vitamin B12 deficiency (Browne 1991). Vitamin B12 deficiency produces an inadequacy in the production of myelin synthesis which results in neurological damage (Dwyer 1991). A vitamin B12 supplement or injection is recommended in vegan children.
- *Vitamin D* – When adequate exposure to sunlight is not possible, vegans who avoid all meat and dairy products are at greater risk of developing a vitamin D deficiency than LOVs or omnivores (Dwyer 1991). Inadequate exposure to sunlight should not be the case in New Zealand.
- *Riboflavin* – Milk and milk products are the major sources of riboflavin. Because vegans avoid consuming these foods, the risk of developing a riboflavin deficiency is increased (Dwyer 1991).
- Docosahexaenoic acid (22:6n-3; DHA) appears to play an important role in the retina and central nervous system. DHA is not found in foods of plant origin, but DHA can be synthesised, to a limited extent, from linolenic acid (18:3n-3) which is found in plant foods. Due to competitive inhibition from linoleic acid (18:2n-6), a high dietary ratio of linoleic:linolenic acid results in a decrease in DHA production. It is, therefore, suggested that vegans use soybean or canola oil, which have a lower ratio of linoleic:linolenic acid than sunflower, safflower or corn oils, which have a high ratio (Sanders 1995).

Body Image, Dieting and Eating Disorders

Body image

Developing adolescents, especially females, are particularly concerned about their body image and excessive weight (either real or perceived) and are under constant pressure to enhance their body image. It has been reported that concerns and dissatisfaction with one's body has become so prevalent that 'it can be considered to be a normal part of the female experience' (Heinberg et al 1996).

Currently, researchers tend to identify three separate components that comprise body image: perception of body size (accuracy of perceptions regarding one's size), a subjective component (satisfaction with one's body size, anxiety, and concern regarding one's body size and/or specific body parts) and a behavioural aspect (avoidance of situations that may cause body-image anxiety or dissatisfaction) (Heinberg et al 1996). Adolescence is thought to be the period during which distortions of body image may be initiated. Therefore adolescence is a critical time for the development of a realistic body image (Welsh et al 1992; Morava 1992; Hill et al 1992). There is a correlation between weight and dissatisfaction with body image in females (Heinberg et al 1996). Most female adolescents tend to associate weight with fatness, which is considered undesirable, while male adolescents tend to associate weight with muscle and bone, which is desirable (Morava 1992).

The Life in New Zealand survey (Hillary Commission 1991) reported that 'appearance' is the chief motivator for young people to modify their diet. While the survey found the food choices of women reflect a greater concern for health, the issue may be a greater concern with body weight and appearance. Qualitative research conducted for the Agencies for Nutrition Action (ANA) to determine young peoples' attitudes towards diet, exercise and body image reported that young people became aware of their body image at 12–13 years of age. It was thought for both sexes that the ideal and healthy body shape should be the same. However, the majority of females admitted that they were not happy with their bodies, and that most females felt some social pressure, and consequently compared themselves to the 'ideal' body image (Agencies for Nutrition Action 1994).

Exercise and weight control

One study has shown that there is a possibility of a causal relationship between regular participation in a fitness programme and excessive concern with dieting and weight, especially in people with bulimia nervosa (Davis et al 1990; Taub and Blinde 1992). Further evidence suggests that exercise could serve as a contributing factor, to body image concerns, in two ways:

- initial weight loss due to increased energy expenditure may elicit positive social reinforcement
- depression of appetite due to increased endorphin levels (Epling et al 1983; Epling and Pierce 1988).

Because the adolescent population should be encouraged to participate in physical activity, it is very important to encourage and ensure adequate food intake in the exercising adolescent population.

Eating disorders

The increasing prevalence of eating disorders and their development at a young age is alarming. A variety of psychological factors play an important role in eating disorder development (Kreipe and Higgins 1996).

Eating disorders may include a variety of conditions but in particular the clinical syndromes of anorexia nervosa and bulimia nervosa. Anorexia nervosa is a potentially life-threatening illness. Sufferers exhibit an extreme psycho-physiological aversion to food. The disease is characterised by an obsessive compulsion to keep body weight below 85 percent of what would be expected based on age and height.

Bulimia nervosa is characterised by repeated binge and purge sessions. After bingeing on food, an overwhelming sense of guilt develops and vomiting, laxative or diuretics are used to purge in order that weight gain is not achieved. Individuals with bulimia nervosa tend not to be as physically ill as individuals with anorexia nervosa (Whitney and Hamilton 1990; Edwards 1993).

Twenty percent of young women may be at risk of developing an eating disorder, and the prevalence of both anorexia nervosa and bulimia nervosa between the ages of 11 to 25 years is increasing. Anorexia occurs 15 times more frequently in females than in males (Saxelby 1993). A study of eating attitudes in 1514 Auckland schoolgirls (13–17 year olds) found that 14 percent of this population demonstrated behaviours that were indicative of potential eating disorders (Lowe et al 1985).

Risk factors for the development of eating disorders

Increased fat laid down during puberty is negatively viewed by most girls, and as puberty progresses the desire to be thinner increases (Killen et al 1992).

Preoccupation with dieting is higher in girls than in boys and increases with age (Sasson et al 1995). There is a strong association between the dietary concerns of girls and those of their mothers (Hill et al 1990). An overseas report shows that dieting is being undertaken by nine-year-olds is alarming and undesirable. This is especially so as many of these children, particularly girls, are not overweight (Hill et al 1992).

Parental beliefs and behaviours are likely to be major influences on a child's and adolescent's view of their own body size (Wardle et al 1995). It is important that parents, significant others, and the media do not promote inappropriate body size and shape values.

Several overseas studies show that many girls aspire to attain a body shape which is thinner than their current shape (Maloney et al 1989; Sasson et al 1995; Wardle et al 1995). Body shape satisfaction (or the point at which preferred shape is equal to current shape) for girls was met at 11 percent below their mean weight. Boys desire a more athletic and muscular build and have a body shape satisfaction at 12 percent above their mean weight (Wardle et al 1995). A small study based in Hamilton showed that approximately half of the female adolescents sampled had a preoccupation with weight and most desired a reduction in their weight to 'feel better about themselves' (Jordan 1991). In this study, more than half of those sampled had dieted at some time. Increased awareness of the health hazards associated with being overweight, the pursuit of thinness or distortions in body image perceptions were contributors to the high statistics of dieting (Jordan 1991).

Stereotypes shape future behaviours where the overweight stereotype drives the stereotype of thinness. People work to attain thinness not just because they desire to be thin but also because they reject fatness and what it represents (Hill and Silver 1995).

Nutritional effects of eating disorders

The major nutritional problem in these disorders is the lack of food consumption. Energy, vitamins, and mineral intakes are inadequate and malnutrition develops. Therefore development of eating disorders during the adolescent years is nutritionally and psychologically devastating. Pre-adolescence is the period when the body lays down fat reserves for the following growth spurt of adolescence. During adolescence there is a dramatic increase in nutrient requirements to sustain growth and maturation. Therefore, children and adolescents who self-impose energy restriction have a retarded growth rate and puberty is usually delayed (Davies et al 1978; Pugliese et al 1983).

Treatment

Anorexia nervosa and bulimia nervosa are complex disorders that are multifactorial in aetiology and pathology. The cluster of symptoms and signs often begins in adolescence. Clinicians, health care providers and teachers should be well informed and sensitive to early detection and intervention. Treatment of eating disorders is usually a long-term, complex process and is best provided by a psychiatrist and dietitian with specialist training and experience in this area.

Pregnancy

The nutritional recommendations for the pregnant adolescent need to take into account both the health of the mother and the infant. The pregnant adolescent is at risk if she has not completed her growth. Because of the increased nutritional needs of her own growth, as well as foetal growth, the nutritional requirements are higher than for adult women. The younger the adolescent, and the lower her gynaecologic age, the higher her nutrient requirements (Webb et al 1991). It is the position of the American Dietetic Association that pregnant adolescents as a group are nutritionally at risk and require nutrition intervention early and throughout the duration of their pregnancies (American Dietetic Association 1989).

Weight gain is very important during pregnancy, since inadequate weight gain of the mother is associated with low birth-weight in the infant (Stevens-Simon and Andrews 1996). The incidence of low birth-weight infants is higher for adolescents than adult women (Scholl et al 1994). Since body image is important to adolescent females and many initially deny a pregnancy, nutritional counselling may be required to assist in the process of gaining appropriate weight. Several studies in the US have focused on the dietary habits of pregnant adolescents and indicate that intakes of some nutrients may be below recommendations, particularly intake of iron, zinc, calcium, magnesium, folate, vitamin B6 and vitamin A (Skinner and Carruth 1991; Skinner et al 1992). It does appear that adolescents may make some appropriate dietary changes during pregnancy, skip fewer meals and substitute fewer snacks for meals. However, nutrition education should aim to improve adolescents' knowledge on how to increase their intakes of nutrient-rich foods instead of snacking on less nutritionally valuable foods (Schneck et al 1990).

Unfortunately for many pregnant adolescents, pregnancy is a time of great stress and there is usually a complex mix of social, emotional and physical factors complicating the situation. It is necessary that adequate emotional support be given to the adolescent and close contact be maintained to ensure adequate nutrition. Regular assessment of nutritional status is also important. This should include assessment of maternal weight gain, dietary intake and assessment of iron status. Strategies for promoting nutritional health of pregnant adolescents can be categorised into three broad areas:

- improve nutritional knowledge and skills of adolescents, and health care providers
- improve programmes including access to prenatal care and developing effective nutrition interventions
- direct research efforts to better understand barriers to behaviour change and conduct scientifically rigorous programme evaluations of nutrition interventions (Story 1997).

The overall dietary needs can be best met by consumption of nutrient-rich foods, regular meals and snacking on nutrient-rich foods such as dairy products, cereals and sandwiches.

Refer to *Food and Nutrition Guidelines for Healthy Pregnant Women* (Ministry of Health 1997).

Physical Activity Guidelines for Adolescents

Background

The benefits of regular moderate-intensity physical activity for adults are well established. Physical activity has numerous benefits for the cardiovascular and musculoskeletal systems as well as the functioning of the metabolic, endocrine and immune systems. The health benefits of physical activity include a reduced risk of cardiovascular disease, hypertension, some cancers, obesity and diabetes. Physical activity also improves mental health, by improving mood and reducing depression and anxiety (US Department of Health and Human Services 1996). The greatest health benefit occurs in shifting those who are sedentary into performing at least some activity (Haskell 1994). Physical activity should be part of adolescents' routine in everyday life at school, at home and in the wider community.

There is increasing evidence that habitual physical activity in adolescents has both short-term and long-term benefits. Physical activity can benefit children and adolescents by reducing body fat in obese children, improving lipoprotein profiles and lowering resting blood pressure in hypertensive children (Health Education Authority 1997). Other benefits identified by the Health Education Authority in Great Britain are:

- improving the quality of life by promoting mental wellbeing
- moderating weight in obese adolescents
- reducing the risk of osteoporosis by enhancing bone development (Health Education Authority 1997).

There is accumulating evidence that physical activity patterns developed in childhood and adolescence continue into adulthood (Armstrong and Welsman 1997). Given the relationship between sedentary adult lifestyles and increased risk of chronic diseases like coronary heart disease and non-insulin-dependent diabetes, attention needs to be paid to enhancing active lifestyles in children and adolescents (Bauman et al 1996).

The period of adolescence is a time of rapid physical, social, cognitive and behavioural change occurring in the transition from school life to work and/or advanced study. Adolescence is also an important time for developing the values, habits and behaviours of adulthood and as such it becomes an important period for developing a habit of participation in physical activity that can be transferred into adulthood.

Recommendations

In order to maintain health benefits, the recommended level of physical activity is at least 30 minutes of moderately intense activity on most or preferably all days of the week (eg, brisk walking, playing basketball and dancing). Additional benefits will be achieved by further increases in activity. This recommendation has been made for all people of all ages (US Department of Health and Human Services 1996).

An international consensus conference on physical activity guidelines for adolescents (Sallis and Patrick 1994) established recommendations for physical activity for this age group. These guidelines are:

All adolescents should be physically active daily, or nearly every day, as part of play, games, sport, work, transportation, recreation, physical education or planned exercise, in the context of family, school and community activities.

and

Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that require moderate to vigorous levels of exertion.

The intent of the first guideline is to encourage adolescents to adopt and maintain an active lifestyle into adulthood. It also aims for adolescents to incorporate weight-bearing activities in order to enhance bone density, daily energy expenditure and to reduce the risk of obesity (Sallis and Patrick 1994; Armstrong and Welsman 1997). The international consensus conference recommended that a minimum of 30 minutes of physical activity be accumulated daily.

The second recommendation aims to maintain cardiovascular fitness in adolescents and to increase HDL cholesterol and improve psychological health (Sallis and Patrick 1994; Armstrong and Welsman 1997).

Participation levels

At present there is indirect evidence that adolescents in New Zealand meet the first international physical activity guideline of at least 30 minutes of moderate activity accumulated per day (Ross 1995). However, Wilson et al (1993) report that 17 percent of males and 24 percent of females aged 15–18 years have low levels of physical activity. Recent research on participation in organised sport by secondary school students shows an increase in participation (Hillary Commission 1998).

Ross (1995) estimates that between 44–64 percent of males and 44–54 percent of females are likely to meet the second physical activity guideline of engaging in vigorous activity lasting at least 20 minutes on at least three days per week.

There is presently little New Zealand research that follows participation in physical activity across young age groups. The Hillary Commission's 1997 Sports and Physical Activity survey will provide information on participation levels in sports and physical activity for young people aged 5–17

years. International trends are that during childhood and into adolescence, girls and boys become less active (Armstrong and Welsman 1997). Males from age six through to 17 years are estimated to be 15–25 percent more active than females (Durnin 1992). In addition, Durnin has uncovered what appears to be a secular downward trend in physical activity participation, with children in the 1930s being more active than those in the 1980s.

This information identifies the need to tailor programmes to increase physical activity participation to males and females differently. Programme designers also need to be mindful of how the lifestyle of adolescence may impede being active – for example, new technologies like the Internet, computer and video games, as well as security and safety concerns which limit walking and cycling as a means of transportation.

In Australia, guidelines to support physical activity amongst young people are being developed.

1. Provide opportunities for boys and girls to regularly participate in a variety of fun activities.
2. Where possible and safe, encourage walking or bicycle use for transport instead of motorised vehicles.
3. Ensure that the physical environment provides convenient and safe opportunities for activity for enjoyment.
4. Help children learn confidence and experience success while developing movement skills.
5. Support learning of the different types of health-related fitness (ie, strength, endurance, flexibility).
6. Encourage regular weight-bearing activity, for example walking or running (where the body weight is not supported as it is in cycling or swimming) for healthy bone development (G Egger, personal communication, 1998).

Motivation for participation in physical activity

Adolescents, particularly young women, consistently state that having fun is the major reason for participation in physical activity (Gould and Horn 1984). However, the belief that exercise is fun decreases in late adolescence (Godin and Shephard 1986).

Further motives reported include improving skills, being with friends or making new friends, experiencing thrills or excitement, attaining success and developing fitness (Godin and Shephard 1986). These motives are reflected in New Zealand research (Reid and Rewi 1992; Wilson et al 1993).

Schools in the US have successfully raised the quantity and quality of physical education through changes in policy curricula and programme development. Programmes such as Know Your Body (Resnicow cited in Bauman et al 1996) have been able to significantly increase the intensity of physical activity in physical education class time. Other school-based programmes supported by community-wide events have also produced an improvement in adolescent physical activity, particularly among young women (Bauman et al 1996).

The Centers for Disease Control and Prevention recommend that comprehensive school and community health programmes promoting physical activity among adolescents be developed. These programmes are intended to increase knowledge about physical activity, foster positive attitudes toward physical activity, and encourage physical activity outside the physical education classes (US Department of Health and Human Services 1996).

In New Zealand, the Hillary Commission has introduced the Sportfit programme, which aims to increase participation and improve skills in sport among 13–19 year olds. The resources for this programme have recently been updated, and a commitment has been made by the Commission to increase the numbers of secondary school sport co-ordinators in schools. However, sport is only one avenue of physical activity for adolescents. A wider range of participation options are required.

The draft health and physical education curriculum represents an opportunity for physical activity to be promoted in schools from a total wellbeing/hauora, socioecological and health promotion perspective. The aims of the curriculum are to develop personal health education knowledge, develop motor skills and positive attitudes towards physical activity, develop interpersonal skills and participate in creating healthy communities.

In addition, many government agencies, including the Hillary Commission, Department of Internal Affairs and Te Puni Kokiri, and non-government organisations, including Agencies for Nutrition Action, have an interest in promoting physical activity.

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Appendix 1
Recommended dietary intakes (RDIs)

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

	MALE			***FEMALE***		
Age (years)	8–11	12–15	16–18	8–11	12–15	16–18
Nutrient						
Energy (MJ)	8.7–9.1	9.2–11.8	11.7–13.5	7.7–8.2	8.1–9.8	8.8–10.0
Protein (g)	27–38	42–60	64–70	27–39	44–55	57
Iron (mg)	6–8	10-13	10–13	6–8	10–13	10–13
Calcium (mg)	800	1,200	1,000	900	1,000	800
Sodium (mg)	600–2300	920–2300	920–2300	600–2300	920–2300	920–2300
Total Folate (µg)	150	200	200	150	200	200
Zinc (mg)	9	12	12	9	12	12
Vitamin A:retinol equivalents (µg)	500	725	750	500	725	750
Vitamin C (mg)	30	30	40	30	30	30
Vitamin B6 (mg)	1.1–1.6	1.4–2.1	1.5–2.2	1.0–1.5	1.2–1.8	1.1–1.6
Vitamin B12 (µg)	1.5	2.0	2.0	1.5	2.0	2.0
Niacin equivalents (mg)	14–16	19–21	20–22	14–16	17–19	15–17
Riboflavin (mg)	1.4	1.8	1.9	1.3	1.6	1.4
Thiamin (mg)	0.9	1.2	1.2	0.8	1.0	0.9
Vitamin E (mg): a-tocopherol equivalents	8.0	10.5	11.0	8.0	9.0	8.0
Iodine (µg)	120	150	150	120	120	120
Magnesium (mg)	180	260	320	160	240	270
Potassium (mg)	1950–5460	1950–5460	1950–5460	1950–5460	1950–5460	1950–5460
Selenium (µg)	50	85	85	50	70	70
Phosphorus (mg)	800	1,200	1,100	800	1,200	1,100

Appendix 2

Recommended dietary allowances 10th edition (US RDA)

National Research Council 1989

Age	*MALE*			*FEMALE*		
	11–14	15–18	19–24	11–14	15–18	19–24
Nutrient						
Energy (MJ)	10.5	12.5	12.1	9.2	9.2	9.2
Protein (g)	45	59	58	46	44	46
Iron (mg)	12	12	10	15	15	15
Calcium (mg)	1200	1200	1200	1200	1200	1200
Total Folate (µg)	150	200	200	150	180	180
Zinc (mg)	15	15	15	12	12	12
Vitamin A:retinol equivalents (µg)	1000	1000	1000	800	800	800
Vitamin C (mg)	50	60	60	50	60	60
Vitamin B6 (mg)	1.7	2.0	2.0	1.4	1.5	1.6
Vitamin B12 (µg)	2.0	2.0	2.0	2.0	2.0	2.0
Niacin equivalents (mg)	17	20	19	15	15	15
Riboflavin (mg)	1.5	1.8	1.7	1.3	1.3	1.3
Thiamin (mg)	1.3	1.5	1.5	1.1	1.1	1.1
Vitamin E (mg): a-tocopherol equivalents	10	10	10	8	8	8
Iodine (µg)	150	150	150	150	150	150
Magnesium (mg)	270	400	350	280	300	280
Selenium (µg)	40	50	70	45	50	55
Phosphorus (mg)	1200	1200	1200	1200	1200	1200

Appendix 3

Dietary reference values for food energy and nutrients for the United Kingdom

Department of Health 1991

Age	*MALE*			*FEMALE*		
	11–14	15–18	19–50	11–14	15–18	19–50
Nutrient						
Energy (MJ)	9.27	11.51	10.60	7.92	8.83	8.10
Protein (g)	42.1	55.2	55.5	41.2	45.0	45.0
Iron (mg)	11.3	11.3	8.7	14.8	14.8	14.8
Calcium (mg)	1000	1000	700	800	800	700
Sodium (mg)	1600	1600	1600	1600	1600	1600
Total Folate (µg)	200	200	200	200	200	200
Zinc (mg)	9	9.5	9.5	9	7.0	7.0
Vitamin A:retinol equivalents (µg)	600	700	700	600	600	600
Vitamin C (mg)	35	40	40	35	40	40
Vitamin B6 (mg)	1.2	1.5	1.4	1.0	1.2	1.2
Vitamin B12 (µg)	1.2	1.5	1.5	1.2	1.5	1.5
Niacin equivalents (mg)	15	18	17	12	14	13
Riboflavin (mg)	1.2	1.3	1.3	1.1	1.1	1.1
Thiamin (mg)	0.9	1.1	1.0	0.7	0.8	0.8
Iodine (µg)	130	140	140	130	140	140
Magnesium (mg)	280	300	300	280	300	270
Potassium (mg)	3100	3500	3500	3100	3500	3500
Selenium (µg)	45	70	75	45	60	60
Phosphorus (mg)	775	775	550	625	625	550

Appendix 4

Levels of total blood cholesterol in New Zealand adolescents

AGE (years)	15–18	19–24
Male (TBC mmol/L)	4.7	5.3
Female (TBC mmol/L)	5.2	5.4

Source: Life in New Zealand Survey. Commission Report on Health. Prepared by University of Otago, Wellington. Hillary Commission for Recreation and Sport. June 1991.

Appendix 5

Adolescents – sample diet

This three-day meal plan has been analysed for major nutrients and meets the needs of a 15 year old female doing light to moderate exercise (9000 kJ/day). Young males five years of age need more energy (9–12,000 kJ/day) so will need to eat extra bread and cereals. Older males (16–18 years old) will need considerably more to meet their higher energy needs of 11–13,500 kJ/day. Very active adolescents also have higher energy needs. Extra energy is best provided by additional servings of bread, cereals, pasta, rice, potatoes, fruit and milk, eaten throughout the day. The purpose of this meal plan is to determine nutrient recommendations and serving recommendations and should not be used for individual diet plans.

Day One	Day Two	Day Three
Breakfast		
1 weetbix and trim milk	half cup muesli (not toasted) and trim milk	2 slices wholemeal toast
1 banana	half cup yoghurt	2 tsp margarine
1 slice wholemeal toast	1 slice wholemeal toast	2 tsp peanut butter
1 tsp margarine	1 tsp margarine	1 glass trim milk
1 tsp marmite	2 tsp jam	
Mid Morning		
1 currant bun	1 fruit muffin	4 cream crackers
1 tsp margarine	1 tsp margarine	1 slice cheese (20 g)
Lunch		
2 slices wholemeal bread	2 slices wholemeal toast	1 potato-top meat pie
1 tsp margarine	1 tsp margarine	1 milkshake
1 slice luncheon sausage	1 cup baked beans	1 apple
1 tomato	1 orange	
1 apple		
250 ml flavoured milk		

Mid Afternoon

2 slices wholemeal bread	1 glass trim milk	1 packet crisps
2 tsp margarine	1 cup popcorn	1 orange
2 tsp jam		
1 glass diluted fruit juice		

Dinner

three-quarters cup mince	2 slices pizza	150 g baked fish (hoki)
1 medium potato	quarter French bread stick	1½ cup cooked rice
100 g carrots	2 tsp margarine	½ cup kumara
100 g broccoli	lettuce salad with 1 tomato and 1 carrot	½ cup cabbage
1 pottle fruit-flavoured yoghurt	2 scoops vanilla ice cream	2 scoops of vanilla ice cream

Supper

2 plain biscuits	1 banana	2 slices wholemeal toast
cocoa with 100 ml trim milk		2 tsp margarine
		2 tsp honey
		cocoa with 100ml trim milk

Appendix 6

Food fantastic – eating for healthy adolescents

Eat many different kinds of food each day

Life as a teenager can be fast, furious and fun – and so can your food. Include from these four groups to get the nutrients you need to stay healthy, active and alert:

- fruits and vegetables
- breads and cereals
- milks and milk products
- lean meats, chicken, seafood, eggs, dried peas, beans and lentils.

Fruit and vegetables

- Provide carbohydrates, fibre, vitamins and minerals and are low in fat.
- Choose fresh if you can.
- Have with most meals – every day.
- Enjoy raw or lightly cooked.
- Ideal snack food.

Choose at least three servings of vegetables and two servings of fruit every day.

Serving size samples:

- 1 medium potato, kumara or similar-sized root vegetable (135 g)
- half a cup cooked vegetables, for example, puha, watercress or corn (50–80 g)
- half a cup salad (60 g)
- 1 tomato (80 g)
- 1 apple, pear, banana or orange (130 g)
- 2 small apricots or plums (100 g)
- half a cup of fresh fruit salad (120 g)
- half a cup stewed fruit (135 g)
- 1 cup fruit juice (250 ml).

Breads and cereals

- More than just bread and breakfast cereals, this also includes rice and pastas.
- Provides carbohydrates, fibre and other nutrients.
- Satisfies your hunger longer than sweet biscuits, cakes or sweets.
- A great source of energy for growth, sport and fitness.
- Ideal to meet the demands of intense physical activity.
- Try some wholegrain varieties.

Fill up on breads and cereals when hungry. They are great choice for meals and snacks.

Choose at least six servings each day, including some wholegrain. Most adolescents will need more than this – especially for young men who need even more to meet their needs for extra energy (calories).

Serving size samples:

- 1 roll (50 g)
- 1 muffin (80 g)
- 1 medium slice of bread (26 g)
- 1 cup cornflakes (30 g)
- half a cup muesli (55 g)
- half a cup cooked cereal (130 g)
- 1 cup cooked pasta (150 g)
- 1 cup cooked rice (150 g)
- 2 plain sweet biscuits (14 g).

Milks and milk products

- Includes milk, cheese, yoghurt and ice cream.
- Valuable sources of calcium and protein.
- Choose low fat milk for extra calcium.
- You need high-calcium foods to build strong bones during teenage years.
- Try milk, cheese and yoghurt as snacks.
- Keep active – regular exercise keeps bones strong in later life.

Choose at least three servings each day, preferably low fat.

Serving size samples:

- milk (250 ml)

- 1 pottle yoghurt (150 g)
- 2 slices cheese (40 g)
- 2 scoops ice cream (140 g).

Lean meats, chicken, seafood, eggs, dried beans, peas and lentils

- Valuable sources of protein, iron and other nutrients.
- Your body needs lots for growth, mental and physical activity and sports.

Iron needs for women increase when periods begin.

The iron from meat, chicken and seafood is used more easily by the body. Iron from other foods is better able to be used if eaten at the same time as foods rich in vitamin C (eg, fresh fruits and vegetables, especially oranges, kiwifruit and peppers).

Choose 1–2 servings each day.

Serving size samples

- 2 slices cooked meat (approx 100 g)
- three-quarters of a cup mince or casserole (195 g)
- 1 egg (50 g)
- I medium fillet of fish – cooked (100 g)
- 1 medium steak (120 g)
- three-quarters of a cup dried cooked beans (135 g)
- 2 drumsticks or 1 chicken leg (110 g)
- 1 medium paua (120 g)
- 3 medium mussels (30 g)
- 1 kina (100 g)

Vegetarians

If you are a vegetarian it is important to understand your body's needs and plan your meals and snacks carefully.

By not eating meat, vegetarians need foods with lots of iron, such as wholegrain cereals, dried peas, beans and lentils, dried fruits and dark green leafy vegetables. Eat vitamin C rich foods with these meals to help absorb iron.

For vegetarians who don't eat cheese, milk or eggs, mixed meal and cereals, tofu, dried peas, beans and lentils will also give protein.

Eat enough for growth and physical activity

- You need more energy (calories) now than ever before. During rapid growth, energy and nutrient needs are high, so you must eat enough food to get all the nutrients your body needs.
- Choose from the four food groups first to meet this need for extra energy.
- Snacks are needed, but limit high-fat, high-sugar foods.
- There is no exact or ideal body weight or shape. Body shapes change naturally when you are growing as proportions of fat and muscle change. If you get little exercise and choose high-calorie foods too often you may gain unneeded weight.

Physical activity

- Everyone benefits from regular physical activity.
- Try and be physically active on most if not all days of the week.
- Activity includes biking, walking, swimming, dancing and playing sport.

If you are very active you will need more to eat than most. If you are involved in heavy physical training and endurance sports events you will have special food needs. It's best to get ideas and advice from a dietitian or a sports medicine specialist.

Choose foods low in fat, sugar and salt

Establish good eating habits while young and promote good health in your adult life.

Achieve this by:

- eating foods low in fat, sugar and salt
- keeping fit by exercising often
- watching your weight
- choosing not to smoke.

Many fast foods, takeaways and snacks are high in fat, salt and/or sugar. For example, chocolate bars, muesli bars, potato chips, French fries, doughnuts, pies, sweets, fruit leathers and soft drinks.

Instead of eating these high-calorie foods every day, eat them only now and then. If you eat them too often, you may gain weight.

- Eat more bread, cereals, fruits and vegetables.
- Choose low fat varieties of milk, cheese and yoghurt.

- Spread margarine and butter thinly.
- Eat less saturated fat, eg, butter, meat fats, dripping, sausage and cream.
- Choose lean meats, trim off the fat, skim fat off stews, remove skin from chicken and eat more frilled or steamed fish.
- Keep sugary foods and drinks to mealtimes to protect your teeth from decay.
- Grill, steam, microwave, boil or bake meals without adding fat.
- Eat meals without adding extra salt.
- When shopping, read labels and look for pre-prepared foods that are lower in fat, salt and sugar.

Choose snacks well

Active teenagers need snacks. Snacks help provide the extra calories you need for growth and physical activity and will satisfy large appetites. Snacks should be low in fat, salt and sugar, for example, fruit, bread, yoghurt and low fat milk. They should provide plenty of energy as well as nutrients.

Snack ideas

- Bread, bread rolls, bagels, Māori and pita bread, French sticks. Try some wholegrain varieties.
- Muffins, crackers, fruit buns, scones, fruit bread, pancakes, popcorn – pop your own.
- Pasta and rice.
- Snack filling ideas: egg, lean meat, seafood, cheese, lots of salad, peanut butter, jam, spaghetti, baked beans, vegemite, banana or cottage cheese.
- Breakfast cereals low in fat and sugar served with low fat milk.
- Yoghurt, plain or flavoured milk and ice cream.
- Fresh fruit eaten whole or served with yoghurt, blended into a milkshake or served with a slice of cheese.
- Fresh vegetables, eaten raw, like carrots, tomatoes or coconut.
- Leftovers reheated, for example, stews, soups, vegetables such as potato, taro, pumpkin or kumara.

Drink plenty every day

- Drink at least six to eight glasses every day.

You need to drink plenty of fluid every day. Even more during hot weather and when you are very active (especially before, during and after sports events).

Great Drinks

- Water is best. It is cool, refreshing, easy to get and FREE. Keep a jug of cold water in the fridge.
- Milk is a cool drink, it's rich in calcium and makes a good snack. Low fat milks are recommended.
- Dilute fruit juice with plenty of water. Add lots of ice. Limit to meal times only because the natural sugar present can cause tooth decay.

Soft drinks are popular, but don't drink too much. They can be a source of unneeded calories.

Coffee and tea should be limited. Tea should not be drunk with meals because the tannins in tea mean you will not absorb the iron as well as you could.

Alcohol is not recommended

Alcohol is not recommended because it is a drug that affects every part of your body. If you decide to drink, limit your intake – keep it to a minimum. Alcohol supplies unnecessary calories and almost no other nutrients, so can contribute towards obesity.

If you do decide to drink alcohol:

- *be responsible*
- eat some food when you drink alcohol
- dilute alcoholic drinks with plenty of water or mixers and lots of ice
- do not binge drink
- do not drive
- if you are having a party, make sure you provide plenty of fruit juice, soft drinks and water, low alcohol drinks and plenty of food throughout.

Smoking

- Being smokefree is recommended.
- Smoking shortens your lifespan, makes you broke and doesn't help to make friends.
- Some people think smoking is an easy way to lose weight. This is not true.

For more information contact:

Dietitian at your local hospital.

Local dietitian – try the *Yellow Pages.*

Registered nutritionist.

School counsellor or health education co-ordinator.

Community health centre.

National Heart Foundation.

Doctor, doctor's nurse (practice nurse).

Nutrition Foundation, PO Box 33-1409, Takapuna, Auckland.

Cancer Society, PO Box 12 145, Wellington