

# Vegetarianism in children and adolescents

There are many types of vegetarian eating, and the associated health benefits and nutritional risks differ greatly. A varied vegetarian diet providing adequate energy, protein, vitamins and minerals will meet all the requirements of children and adolescents for growth and development. However, other diets may place young people at risk of nutritional deficiencies, growth failure and associated problems such as eating disorders.

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Vegetarian eating is not new or unusual – in fact, many of the world's most ancient cultures have survived and flourished on traditionally vegetarian diets. In Australia, vegetarian eating has become more popular since the 1950s, with many people regularly choosing vegetarian or semi-vegetarian meals. Reasons for vegetarian eating may be:

- religious (for example, Hindus, Buddhists or Seventh Day Adventists)
- cultural (such as a preference for Mexican food)
- environmental (such as concern about land use)
- ethical (such as concern about world hunger or animal welfare)
- economic (finding vegetarian eating to be less expensive)
- health related.

**Health benefits**

The known nutritional benefits of most vegetarian diets include the low intake of fat and cholesterol in combination with a high intake of dietary fibre and antioxidants.<sup>1</sup> In addition, recent research shows that the phytoestrogens in soy products may have special benefits for menopausal women, such as reducing hot flushes. Studies of vegetarian populations, such as the Seventh Day Adventist Studies,<sup>2</sup> have reported certain benefits, including lower levels of blood cholesterol (total and LDL), and lower rates of coronary heart disease, obesity, cancer (particularly colon cancer) and noninsulin-dependent diabetes.

Vegetarians are also likely to be health conscious people who generally partake in a healthy

**IN SUMMARY**

- The quality of a vegetarian diet for adolescents usually depends on the adequacy of energy intake and provision of a good source of protein.
- Diets that are high in dietary fibre (such as vegan diets) are unsuitable for children and adolescents, who tend to feel full before they have consumed enough nutrients.
- The energy and nutrient needs of children and adolescents are high, and usually greater than those of fully grown adults. This point is largely missed by parents, who may be concerned about a child's large appetite and food intake.
- Strict vegetarian eating patterns such as fruitarian and vegan diets are likely to produce growth failure and nutritional problems in young patients. It is important that clinicians be aware of the potential problems as well as the diagnosis and treatment of young people on diets that generally amount to fads bordering on eating disorders.
- Clinicians can provide patients and their parents with sound nutritional advice about vegetarian diets. Further specialised advice may be obtained from a dietitian or counsellor in the area of eating disorders.

**Table 1. Nutritional risks from various vegetarian diets**

**Lacto-ovo vegetarian**

**Features.** The most common vegetarian diet. Does not include flesh foods but does include eggs, milk, dairy foods, fruit, vegetables, breads and cereals.

**Nutritional risk.** Very low. Needs attention to good sources of absorbable dietary iron.

**Lacto vegetarian**

**Features.** Does not include flesh foods or eggs, but includes milk, yoghurt and other dairy foods, as well as most other foods.

**Nutritional risk.** Very low. Children need attention to total energy, good sources of protein and absorbable dietary iron.

**Semi-vegetarian**

**Features.** Does not include red meats but includes most other foods and occasionally fish or other 'white' meats.

**Nutritional risk.** Low. Nutritionally adequate if diet is mixed and not prone to fads, and contains a good source of protein (milk, cheese, yoghurt, eggs, fish, chicken, nuts, peanut butter).

**New age vegetarian**

**Features.** May simply be a traditional diet with the meat from meals removed (e.g. a plateful of vegetables or rice).

**Nutritional risk.** May be high. Nutritional adequacy depends on the quality of protein. Diet will be adequate if it includes milk, dairy foods, eggs, vegetables, fruit, bread and cereals. This type of diet is often associated with eating disorders in adolescents.

**Vegan**

**Features.** Does not include any animal products and may exclude food that contains animal products such as butter, milk and honey. Vegans may avoid using cosmetics that contain animal products and wearing animal fibres such as leather and wool.

**Nutritional risk.** High, particularly for babies, children and adolescents, as well as for pregnant and lactating women. Likely to be low in calories, iron, calcium, zinc, vitamin B<sub>12</sub> and protein.

**Fruitarian**

**Features.** Does not include anything other than raw fruit, berries and some nuts. Based on a misinformed belief that humans evolved eating a natural fruitarian diet.

**Nutritional risk.** Very high. Unlike some primates, humans cannot survive on this diet. Extremely low in energy, protein, fat, iron, zinc, calcium and vitamin B<sub>12</sub>.

**Zen macrobiotic vegetarian**

**Features.** Very restricted dietary regimen based on the teachings of George Ohsawa. Includes large amounts of brown rice and small amounts of fruit, vegetables and legumes.

**Nutritional risk.** Very high. Inadequate energy, protein, zinc, iron, calcium and vitamin B<sub>12</sub>. Several deaths have been recorded.

lifestyle and do not smoke, drink alcohol or consume excessive caffeine. In combination, these factors may contribute to the better health status of vegetarians.

**Types of vegetarian diets**

Eating patterns vary with individuals' reasons for becoming vegetarian, as well as income, nutritional knowledge and the availability of foods. The various diets are outlined in Table 1. The most common is a lacto-ovo diet, which usually contains mixed and balanced amounts of breads, cereals, rice, pasta, legumes (beans, baked beans, dried peas, seeds and lentils), nuts, vegetables, fruits, peanut butter, milk, cheese, margarine, eggs, sugar and oils. A guide to healthy lacto-ovo vegetarian eating is illustrated in Figure 1.

**Vegetarianism in children and adolescents Prevalence**

In 1995, the Australian National Nutrition Survey<sup>3</sup> found that vegetarianism was more common in girls than boys, and the prevalence in the two groups to be:

- 2.3% in girls aged 2 to 11 years, 1.3% in girls aged 12 to 15 years, and 5.1% in girls aged 16 to 18 years
- 1 to 2% in boys (both children and adolescents).

A more detailed study of vegetarianism in Australian teenagers reported that 8% of girls and 3% of boys were vegetarian; in addition, 16% of girls and 6% of boys reported being semi-vegetarian.<sup>4</sup> Only 1% of the teenagers in this study said they had always been vegetarian, and 55%

reported that their mothers supported the fact that they were vegetarian.<sup>4</sup>

A study of weight control practices of Australian adolescents found that 4% of boys and 16% of girls adopt a vegetarian diet to lose weight or help control weight.<sup>5</sup>

**Growth and development**

A varied vegetarian diet providing adequate energy, protein, vitamins and minerals will meet all the requirements of children and adolescents for growth and development. Several cases of severe protein-energy malnutrition and deficiencies of iron and vitamins B<sub>12</sub> and D have been reported in infants and children who were fed inappropriate, strict vegetarian diets.<sup>6,7</sup> Growth in vegan or strict vegetarian children may be compromised,<sup>8</sup>

but growth in Seventh Day Adventist children (lacto-ovo vegetarians) has been shown to be similar to that of omnivorous children.<sup>9</sup> Catch-up growth by the age of 10 years has been found to be possible in vegan children,<sup>10</sup> but vegetarian children still tend to be lighter than those on a mixed diet.<sup>11</sup>

Older vegan children and adolescents can obtain the same energy and protein intakes as those on an omnivorous mixed diet, provided that the energy intake is adequate to prevent protein being used as an energy source and that the protein sources are of good quality.<sup>12</sup> A later age of menarche has been reported among Seventh Day Adventist vegetarian girls,<sup>13</sup> which has also been found in some studies of British and Chinese girls.<sup>11</sup>

### Nutritional requirements and risks

The energy and nutrient needs of children and adolescents are high, usually much greater than those of fully grown adults. This point is largely missed by parents, who may be concerned about a child's large appetite and food intake (Table 2).<sup>14</sup>

Problems arise when vegetarian diets are too limited in the amount of calories, variety of different food groups (vegans, semi-vegetarians and New Age vegetarians) or when the diet is restricted to only a few different foods (fruitarian, Zen macrobiotic or some New Age vegetarian diets). An example of a healthy eating

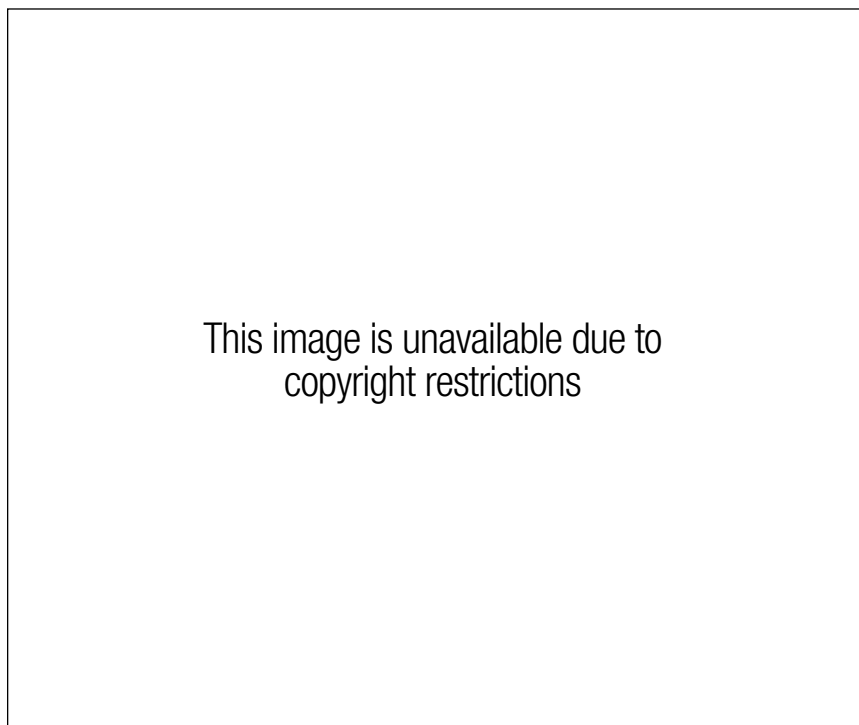


Figure 1. The healthy eating pyramid for lacto-ovo vegetarians.

pattern for a lacto-ovo vegetarian adolescent girl is shown in the box on page 34.

### Energy and protein

The high energy needs of adolescents demand large amounts of foods, and the type of food eaten must be of high nutrient density to provide sufficient calories, protein and other nutrients. Diets high in dietary fibre (such as vegan diets) are

unsuitable for children and adolescents, who tend to feel full before they have consumed enough nutrients.<sup>12</sup> The filling and quickly satisfying nature of vegetarian diets is one reason why they are advantageous for overweight adults.

Unfortunately, high intakes of breads, cereals, rice, pasta, fruits and vegetables provide low amounts of energy and are poor sources of protein, and are therefore

**Table 2. Recommended dietary intakes for adolescents and adults<sup>14</sup>**

	Females			Males		
	12 to 15 years	16 to 18 years	Adult	12 to 15 years	16 to 18 years	Adult
<b>Energy (kJ)</b> *	10,400	9200	8400	12,200	12,600	11,600
<b>Protein (g)</b> †	44 to 55	57	45	42 to 60	64 to 70	55
<b>Iron (mg)</b>	10 to 13	10 to 13	12 to 16	10 to 13	10 to 13	7
<b>Calcium (mg)</b>	1000	800	800	1200	1000	800
<b>Zinc (mg)</b>	12	12	12	12	12	12
<b>Vitamin B<sub>12</sub> (µg)</b>	2	2	2	2	2	2

\* Energy needs vary according to activity levels. † Protein needs vary according to age, stage of pubertal growth and development, and body size. Protein figures are based on 1.0 g of protein per kg of bodyweight for adolescents, and 0.75 g of protein per kg of bodyweight for adults.

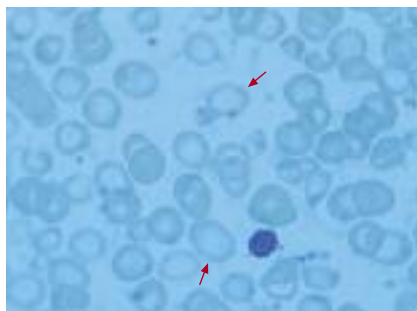
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**Table 3. Good vegetarian sources of protein**

Food	Protein (g)
Yoghurt (natural; 200 g)	11.6
Pasta (egg, boiled; 1 cup)	10.5
Rolled oats (raw; 1 cup)	10.1
Tofu, a soybean curd (½ cup)	10.0
Peanuts (¼ cup)	9.8
Milk (1 cup)	9.0
Soy drink (1 cup)	8.9
Yoghurt (fruit flavoured; 200 g)	8.6
Soybeans (can; ½ cup, drained)	8.6
Cracked wheat (bulgur; 1 cup)	8.3
Nuts (mixed; ¼ cup)	8.1
Pasta (white, cooked; 1 cup)	7.2
Peanut butter (1 tablespoon)	6.8
Baked beans (½ cup)	6.4
Red kidney beans, lentils or mixed beans (canned; ½ cup, drained)	6.4
Egg (boiled; medium size)	6.3
Avocado (half)	6.0
Rice (brown, boiled; 1 cup)	5.7
Cheese (processed, cheddar; 1 slice or 21 g)	4.5
Rice (white, boiled; 1 cup)	4.4
Tahini, a sesame seed paste (1 tablespoon)	4.3
Cheese (cheddar; 2.5 cm <sup>3</sup> )	4.1
Rolled oats (cooked; 1 cup)	4.1
Sunflower seeds (1 tablespoon)	3.4
Breakfast biscuits (wholewheat; 2 biscuits)	3.4
Bread (wholemeal; 1 slice)	3.0
Hommos (¼ cup)	3.0
Peas (green, boiled; ½ cup)	2.6
Bread (white, 1 slice)	2.4
Carrots, zucchini or broccoli (½ cup)	1.6
Fruit (banana, apple or orange; 1 piece)	1.0

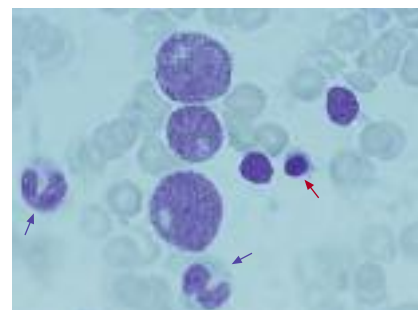
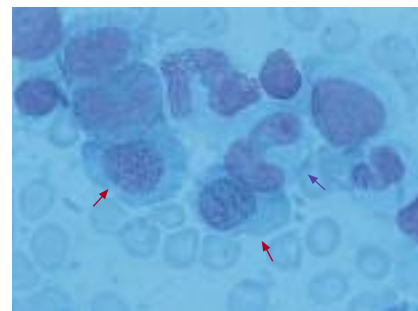
unlikely to meet the needs of children and adolescents. In addition, the higher content of phytic acid in dietary fibre has potential to interfere with micronutrient absorption by binding minerals such as iron and zinc.

Good sources of protein are listed in Table 3. Adolescents may choose low fat milk and low fat dairy foods, but these foods are not recommended for children under 5 years of age, who need the extra energy and fat-soluble vitamins provided by whole milk and full-fat dairy foods.



Figures 3a to c. Megaloblastic anaemia.

a (above). Macrocytic red blood cells in the peripheral blood film support the possibility of megaloblastic anaemia. (arrows). b (above right). In bone marrow, developing red blood cells (red arrows) are larger than normal (megaloblasts). Giant metamyelocytes are present (blue arrow). c (right). Normal bone marrow, with a nucleated red cell (red arrow) and metamyelocytes (blue arrows), is shown for comparison.



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**Fats**

Humans can manufacture all but two fatty acids – linoleic acid (omega-6) and linolenic acid (omega-3) – which are known as essential because they must be supplied in the diet. The essential fatty acids are required to build cell membranes, synthesise prostaglandins, thromboxanes and leukotrienes, and maintain normal growth and development.<sup>15</sup>

A varied and nutritious vegetarian diet containing grains, seeds, nuts, leafy green vegetables, beans and lentils (especially soybeans), vegetable oils and margarine will provide enough of the essential fatty acids to maintain health and growth. Encouraging young vegetarian patients to include the occasional fish meal will ensure the essential fatty acids are in abundance.

**Iron**

Nonhaem iron from plant foods (ferric iron) is not as well absorbed as haem iron (ferrous iron) from meats. Vegetarian adolescents need to obtain large amounts of iron (10 to 13 mg per day) to ensure growth, and females need iron to offset menstrual losses. A detailed discussion of iron deficiency in adolescent females

by these authors was presented in a previous issue of *Medicine Today*.<sup>16</sup>

Vitamin C in vegetables, juices and fruit improves absorption of nonhaem iron by reducing it to the ferrous source. Therefore, eating a variety of foods at the same meal will enhance absorption of dietary iron. Good vegetarian sources of iron are: breakfast cereals, baked beans, dried peas and beans, legumes, nuts, seeds, leafy green vegetables, dried fruits, peanut butter and tahini (sesame seed paste).

**Calcium**

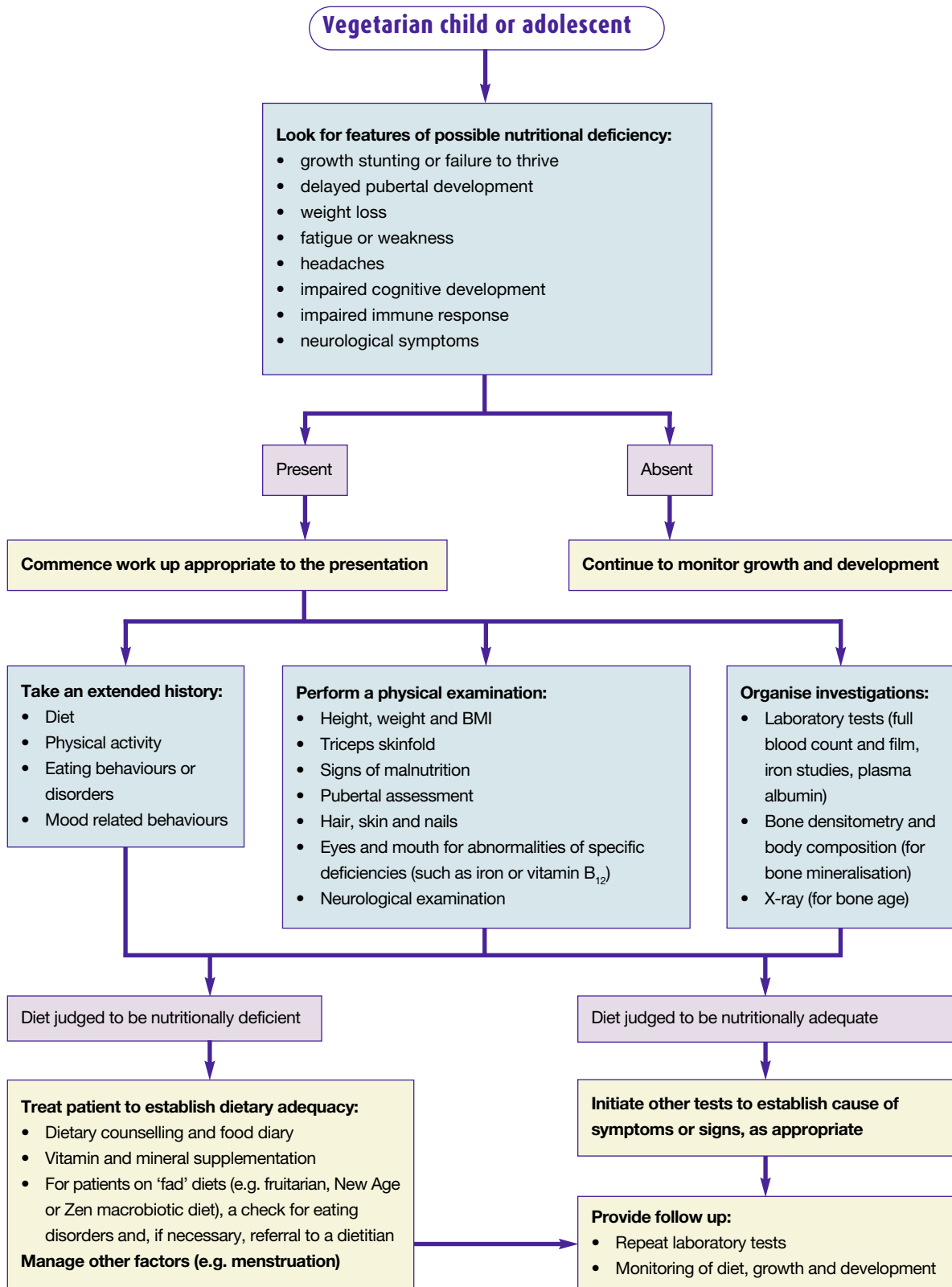
Dietary calcium is often deficient in strict vegetarian diets such as vegan and fad diets (for example, fruitarian and New Age diets). Calcium is well supplied by:

- milk, yoghurt, ice cream, hard cheeses (not soft cheeses like cottage or ricotta)
- calcium fortified soy drinks
- almonds
- tahini
- bok choy and broccoli.

**Zinc**

Zinc is important for the function of many enzymes and for growth and development. Low zinc levels in plasma

## A guide to managing vegetarian children and adolescents



continued

or hair have been found in children with growth retardation or anorexia.<sup>17</sup> The clinical signs of zinc deficiency include poor wound healing and an impaired immune response. Diarrhoea can lead to

zinc losses, and zinc deficiency can contribute to ongoing diarrhoea.<sup>18</sup>

Zinc is supplied by milk and dairy foods, and by the other foods that are good sources of protein (see Table 3).

## Vitamin B<sub>12</sub>

Deficiency of vitamin B<sub>12</sub> (cyanocobalamin) has been found among vegans (including their children and young breastfed babies) and in strict vegetarians. Even though the recommended dietary intake for vitamin B<sub>12</sub> is minute (Table 2) and deficiency takes years to develop, vitamin B<sub>12</sub> deficiency may result from diets that do not contain any animal products, or from atrophic gastritis or severe ileal malabsorption.

Vitamin B<sub>12</sub> deficiency is characterised by a smooth, sore tongue and, after exclusion of folate deficiency, by large cell anaemia (megaloblastic anaemia, see Figures 3a to c). These symptoms are accompanied by fatigue, skin hypersensitivity and neurological disturbances such as tremors. If serum vitamin B<sub>12</sub> is low, laboratory tests should be repeated, and the results of the blood test should match the clinical picture before vitamin B<sub>12</sub> supplementation is commenced.

Vegetarians who drink milk or eat dairy foods or eggs will receive enough vitamin B<sub>12</sub>, but vegans and other strict vegetarians must pay strict attention to this vitamin. Vegans should take vitamin B<sub>12</sub> supplements and not rely on spirulina, seaweed, tempeh (fermented soybeans) or other fermented foods because these sources have variable vitamin B<sub>12</sub> content, and 80 to 94% of it is inactive.<sup>12</sup>

## Vitamin D

People who follow a vegan diet have low dietary vitamin D but are able to produce vitamin D if they are exposed to sunlight. Vegans who are indoors or bedridden will need vitamin D supplementation.

## Management

A guide to managing vegetarian patients is given in the flowchart on page 33. Investigation of nutritional status should be considered if any of the following symptoms or signs are present:

- failure for progression of growth or pubertal status

## Healthy eating for lacto-ovo vegetarian adolescents

A healthy diet for a vegetarian adolescent must include a good source of protein, plus adequate calcium and iron to meet the body's requirements for growth and development. In addition, the high energy requirements for people in this age group mean that the foods eaten must be of high nutrient density to provide sufficient nutrients before an individual feels full.

The lacto-ovo diet usually contains mixed and balanced amounts of most foods except flesh foods. Although nutritional risk is low, attention to dietary iron is necessary. An example of a healthy, one-day eating plan for a 14-year-old girl weighing 50 kg is shown below.

	Energy (kJ)	Protein (g)	Iron (mg)	Calcium (mg)
<b>Breakfast</b>				
Breakfast cereal (30 g)	398	3.4	2.6	10.0
Milk (low fat; ½ cup)	585	10.8	0.1	375
Toast (wholemeal; 1 slice)	282	3.0	0.7	16.0
Butter or margarine (1 teaspoon)	269	0	0	0
Fruit juice (200 mL)	300	1.0	0	11.0
<b>Morning snack</b>				
Banana	501	2.0	0.7	7.0
Water	0	0	0	0
<b>Lunch</b>				
Bread (wholemeal; 2 slices)	564	6.0	1.4	32.0
Peanut butter (2 tablespoons)	1238	13.6	1.0	24.0
Cheese slice	291	4.5	0	131
Milo (2 tablespoons with 200 mL milk)	852	10.0	4.0	368
<b>Afternoon snack</b>				
Toast (1 slice)	282	3.0	0.7	16
Butter or margarine (1 teaspoon)	269	0	0	0
Vegemite (½ teaspoon)	18	0.7	0.1	2
Soft drink (1 can)	658	0	0	4
<b>Evening meal</b>				
Baked potato (1 medium)	306	2.9	0.6	3
Baked beans (1 cup)	785	12.7	4.4	94
Cheese (2.5 cm <sup>2</sup> )	270	4.0	0	124
Salad (lettuce, tomato and cucumber)	98	1.0	1.0	8
Yoghurt, fruit flavoured (200 g)	737	8.6	0.4	255
Chocolate bar	1090	3.3	1.0	101
Cordial (made up; 1 cup)	314	0	0	8
<b>Total</b>	<b>10,107</b>	<b>90.5</b>	<b>18.7</b>	<b>1589</b>
<b>RDI for a 50 kg, 14-year-old girl</b>	<b>10,400</b>	<b>50</b>	<b>10 to 13</b>	<b>1000</b>



## Common beliefs about vegetarian diets

### All vegetarian foods are low in fat – False

Vegetarian foods can be high in fat, such as deep fried foods, vegetarian pasties and foods containing large amounts of cream, sour cream, cheese or coconut cream. Fat reduced and low fat varieties of these foods can usually be obtained.

### Vitamin B<sub>12</sub> is produced in the gastrointestinal tract – True

Vitamin B<sub>12</sub> is produced by micro-organisms in the gastrointestinal tracts of animals and humans, as well as micro-organisms in dirt or manure on unwashed plant foods. In the human gut, however, it appears to be produced beyond the ileum,<sup>12</sup> the site for its absorption in the intestine. Hence, any vitamin B<sub>12</sub> produced in the human gut is not absorbed.

### Protein foods must carefully be matched and combined – False

It is not necessary to carefully match protein sources to provide a complete protein intake. Plant sources of protein alone can provide adequate amounts of the essential and nonessential amino acids required for growth, but the dietary sources must be varied to ensure adequate amounts. Plant sources of protein must be part of a diet providing adequate calories; otherwise, the protein will be used as a source of energy.

### Mushrooms are a good source of vitamin B<sub>12</sub> – False

Mushrooms contain no active vitamin B<sub>12</sub>, but the bacteria in soil or manure on unwashed mushrooms may produce some. Washed mushrooms are not a source of vitamin B<sub>12</sub>.

### All soy drinks are fortified with calcium – False

Not all soy drinks contain added calcium. Check the labels – a well fortified soy drink should contain approximately 120 mg of calcium per 100 mL.

- significant weight loss
- fatigue
- headaches
- impaired cognitive function
- disturbance in immune response
- neurological symptoms.

An extended history should be taken that includes food intake, activity and mood related behaviours. Physical examination should include indices of malnutrition, body composition and nutrient deficiency, such as severe weight loss, muscle wasting (Figure 4), growth failure, oedema, enlarged fatty liver, hair loss or skin changes. Laboratory measures and other investigations (for example, bone densitometry and body composition) are useful to quantify the delay in development or growth, and nutrient deficiency.

Management varies according to the degree of nutritional risk involved in the diet, and the presence of symptoms of nutritional deficiency or of growth or development failure. Emphasis should be placed on the exclusion of dieting problems or eating disorders, which are often associated with vegetarianism in teenaged girls. Clinicians can provide patients and their parents with sound nutritional advice and information about vegetarian diets and myths surrounding them (see the box on this page). Specialised advice may be obtained from a dietitian or counsellor in the area of eating disorders.

## Pregnancy and breastfeeding

Adolescents who are vegetarian and either pregnant or breastfeeding will need extra energy, protein, vitamins and minerals. The breastmilk of vegans is likely to be deficient in vitamin B<sub>12</sub>. A thorough dietary assessment will be required for pregnant adolescents, preferably with the assistance of a dietitian.

## Dieting and eating disorders

Adolescents may choose to follow a 'vegetarian' diet because it may help with weight control.<sup>5</sup> Such an eating plan will not cause problems if a variety of foods



Figure 4. Bilateral and symmetrical muscle wasting in a 12-year-old boy who has protein-energy malnutrition.

is consumed, including good sources of protein and calcium. Problems arise when the diet is very strict or limited in variety, or when vegetarianism is used as a disguise for restricted eating, resulting in weight loss or an eating disorder.

## Summary

A vegetarian diet can be very nutritious, providing all the required nutrients. However, children and adolescents who consume a vegetarian diet may be at risk for nutritional deficiencies, growth failure and associated problems such as eating disorders. Strict vegetarian eating patterns such as fruitarian and vegan diets are likely to produce growth failure and nutritional problems in young patients. It is important that clinicians be aware of the potential problems as well as the diagnosis and treatment of diets that generally amount to fads bordering on eating disorders. **MT**

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*A list of references is available on request to the editorial office.*

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