

# Dietary Guidelines

## For Children And Adolescents

**For The Healthcare Professional**



## Levels of evidence and grades of recommendation used in the Dietary Guidelines for Children & Adolescents

### Levels of Evidence

Level	Type of Evidence
Ia	Evidence obtained from meta-analysis of randomised controlled trials.
Ib	Evidence obtained from at least one randomised controlled trial.
IIa	Evidence obtained from at least one well-designed controlled study without randomisation.
IIb	Evidence obtained from at least one other type of well-designed quasi-experimental study.
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.

### Grades of Recommendation

Grade	Recommendation
A (evidence levels Ia, Ib)	Requires at least one randomised controlled trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation.
B (evidence levels IIa, IIb, III)	Requires availability of well conducted clinical studies but no randomised clinical trials on the topic of recommendation.
C (evidence level IV)	Requires evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities. Indicates absence of directly applicable clinical studies of good quality.
GPP (good practice points)	Recommended best practice based on the clinical experience of the guideline development group.

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Children And Adolescents  
For The Healthcare Professional**

**Health Promotion Board 2007**



## *Preface*

This Dietary Guidelines for Children & Adolescents aims to provide relevant, practical, and scientifically based information on how to promote and maintain health and wellbeing through healthy eating.

The important years of growth and development occur during childhood and adolescence. Thus, children and adolescents should consume foods that provide sufficient nutrients for optimal growth. Children and adolescents should also develop good dietary habits to reduce the risk of developing chronic degenerative diseases in adulthood. Evidence suggests that eating habits established in childhood are likely to carry on to adulthood.

Eating habits in Singapore are changing. There is an increase in the number of meals eaten outside the home and in the use of processed packaged foods. Providing healthy meals for children and adolescents poses a challenge to many people. This Dietary Guidelines can guide the individual, the family, and policymakers in determining ways to provide children and adolescents in Singapore with the types of foods necessary for a healthy diet.

As a move towards evidence-based recommendations, the Working Group determined the levels of evidence available, and graded the recommendations in this Dietary Guidelines for Children & Adolescents. The levels of evidence and grades of recommendations used in this Guidelines are based on that used by Ministry of Health, Singapore in their Clinical Practice Guidelines. However, the levels of evidence and grades of recommendations used in the Clinical Practice Guidelines were developed for clinical practice. It is extremely difficult for studies based on foods to reach levels evidence Ia or Ib as it is not possible to undertake a randomised controlled trial involving diet in children, as one would for a new therapeutic drug. It would not be ethical to make a group of children (e.g. the control group) forego a known nutrient or potentially beneficial non-nutritive compound for the period of the study, hence most of the recommendations in this Dietary Guidelines are based on level II or level III evidence from large, well-designed epidemiological trials.



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# ENCOURAGE AND SUPPORT EXCLUSIVE BREASTFEEDING FOR THE FIRST 6 MONTHS OF LIFE

## *Introduction*

1. Since human breastmilk is the optimum food for infants, exclusive breastfeeding is recommended for all healthy full-term infants for the first 6 months of life. The World Health Organization (WHO) defines exclusive breastfeeding as when an infant receives only breastmilk from the mother or a wet nurse, or expressed breastmilk, and no other liquids or solids with the exception of drops or syrups consisting of vitamins, mineral supplements, or medicines.<sup>1</sup> A related term is full breastfeeding. Full breastfeeding is when an infant is given only breastmilk and no other liquids or solids except a minimal amount of water or prescribed medicines.<sup>2</sup>
2. Besides providing nutrition for the growth and development of the infant, exclusive breastfeeding also contributes to the health of both mother and infant. Breastfed infants have lower incidence of infectious diseases, a lower risk of developing allergy, and a lower risk of obesity and other chronic diseases. Benefits for the mother include faster return to pre-pregnancy weight and a lower risk of developing certain types of cancer.<sup>3</sup>
3. In Singapore, the prevalence of exclusive breastfeeding up to 6 months is low compared to western countries; the most common reasons for stopping breastfeeding were the inability to produce enough breastmilk and necessity to return to work.<sup>4</sup> In order to increase the prevalence of exclusive breastfeeding in Singapore, it is necessary for healthcare professionals and employers, among others, to give mothers the support that is necessary.

## *Breastfeeding for healthy full-term infants*

4. Breastmilk provides all the nutritional requirements of healthy infants for the first 6 months of life.<sup>5,6</sup> Infants who are exclusively breastfed for 6 months have no observable deficits in growth; and there are no demonstrable benefits of introducing complementary foods at 4-6 months (Evidence level Ib).<sup>7</sup> Thus exclusive breastfeeding is recommended for the first 6 months of life (Evidence level Ia, Recommendation grade A).<sup>7-11</sup> Even after

the introduction of complementary foods, the mother should continue to breastfeed until the child is at least 12 months of age (and thereafter as long as mutually desired) (Evidence level IV, Recommendation grade C).<sup>5,10,11</sup>

5. This recommendation of exclusive breastfeeding for the first 6 months of life is made for the general population of infants. Infants must be managed individually so that insufficient growth or other adverse outcomes are not ignored.

### *Milk feeds for special groups*

6. For infants that are unable to be breastfed, caregivers should consult a paediatrician before choosing the type of formula to give the infant. Low birth weight infants should have their nutritional needs assessed by a paediatrician. If for any reason the mother is unable to breastfeed, a commercial infant formula should be given. Soy-based formulas should be given only in consultation with a paediatrician when infants cannot take dairy-based products for health, cultural, or religious reasons (e.g. infants of vegan mothers or infants with lactose intolerance or galactosaemia).<sup>12,13</sup> Hypoallergenic or protein hydrolysate formulas are for infants with allergic symptoms and they should be given only when advised by a paediatrician.<sup>14</sup>

### *Water*

7. Healthy infants do not need extra water during the period of exclusive breastfeeding, even in hot and dry environments (Evidence level IV, Recommendation grade C).<sup>11,15</sup> Infants should be fed on demand, and breastmilk or formula that is reconstituted correctly would provide all the fluids an infant needs for the first 6 months of life (Evidence level IV, Recommendation grade C).<sup>5,11</sup> Giving water may reduce milk intake.<sup>16</sup> Too much water carries a risk of water intoxication.<sup>17</sup> Nevertheless, experience in Singapore is that many mothers would be unhappy withholding water from their infants. These mothers should at least fully breastfeed their infants for the first 6 months. For infants who are ill (e.g. with fever, diarrhoea), a paediatrician should be consulted regarding the safe amount of water to provide.

## *Benefits of breastfeeding*

8. Breastfeeding has protective effects against a range of infections,<sup>3</sup> especially in the protection against diarrhoeal disease (Evidence level Ib),<sup>3,18-21</sup> respiratory tract infections (Evidence level III),<sup>3,18</sup> and otitis media (Evidence level III).<sup>3</sup>
9. Breastfeeding may have some protective effects against allergy.<sup>3</sup> It is increasingly being recognised that children who have been breastfed are less prone than their formula-fed counterparts to diseases such as asthma (Evidence level III),<sup>22-24</sup> atopic dermatitis (Evidence level Ib),<sup>20,25</sup> and rhinitis (Evidence level III),<sup>26</sup> especially if there is a family history.
10. Breastfeeding may reduce the risk of childhood obesity (Evidence level III).<sup>3,27-29</sup>
11. There is the possibility that breastfeeding may have some protective effect against childhood-onset (Evidence level III)<sup>30,31</sup> and adult-onset (Evidence level III) diabetes mellitus.<sup>32</sup>
12. Links have been reported for breastfeeding and protection against childhood onset of leukaemia, Hodgkin's disease, and cancers (Evidence level IIa).<sup>33</sup>
13. There is some evidence that breastfeeding may be associated with better performance in tests of cognition (Evidence level IIa, III).<sup>3,34-38</sup> Benefits seem to be better in premature than in full-term infants<sup>34</sup> and with long than with short duration of breastfeeding.<sup>38</sup> However, whether or how much unique nutritional factors present in breastmilk, a lower rate of illnesses among breastfed infants, psychological effects arising from the breastfeeding experience, or attitudes of breastfeeding mothers contribute to the better cognitive performance has yet to be determined.
14. The benefits of breastfeeding to children may be dose related. For instance, the greater the ratio of breastfeeding to other feedings, the lower the rates of common childhood illnesses (Evidence level III).<sup>39</sup>
15. The maternal advantages of breastfeeding<sup>3,40-41</sup> include accelerated involution of the uterus (Evidence level III), return to pre-pregnancy weight (Evidence level III), and the contraceptive effect of lactational amenorrhoea (Evidence level III). Other possible maternal benefits of breastfeeding include a reduction in the rate of breast cancer, especially premenopausal breast cancer (Evidence level IIa),<sup>42,44</sup> and perhaps in that of ovarian cancer (Evidence level IIa),<sup>3,45</sup> and hip fractures later in life (Evidence level IIa).<sup>3,46</sup>

16. The economic benefits of promoting breastfeeding have been estimated for some countries. In the USA, for example, total medical-care expenditures was 20% lower for fully breastfed infants than for never-breastfed infants.<sup>47</sup>

### *Current practices in Singapore*

17. In 2001, the Health Promotion Board conducted a National Breastfeeding Survey<sup>4</sup> among 2149 Singapore women to determine the prevalence and duration of breastfeeding and factors influencing breastfeeding. The survey showed that 95% mothers initiated breastfeeding. At 2 months, 50% were still breastfeeding but at 6 months the proportion was only 21%.
18. The breastfeeding initiation rate is higher in Singapore than in several other countries. In Hong Kong a survey<sup>48</sup> conducted among more than 1700 mothers in 2001 showed that 62% initiated breastfeeding. In similarly large national surveys in the USA,<sup>49</sup> Australia,<sup>50</sup> and the UK,<sup>51</sup> breastfeeding initiation rates were 70%, 83%, and 69%, respectively. However, the proportion of mothers in Singapore still breastfeeding at 6 months (21%) was lower than in the US (33%)<sup>49</sup> and Australia (45%)<sup>52</sup> but it was the same as that in the UK (21%).<sup>51</sup>
19. Exclusive breastfeeding was not a common practice in Singapore. Most mothers supplemented breastfeeding with formula feeds. Only 23% mothers were exclusively breastfeeding at 1 month and the rate dropped to 14% and 0% at respectively, 2 and 6 months.<sup>4</sup> In the USA the prevalence of exclusive breastfeeding at 6 months was 17%,<sup>50</sup> and in Australia it was 19%.<sup>52</sup>

### *Factors influencing breastfeeding in Singapore*

20. In the 2001 National Breastfeeding Survey<sup>4</sup> most of the mothers who initiated breastfeeding stated that they did so because breastmilk is best for the baby and/or that breastfeeding helps to foster bonding with the baby. Knowledge of the benefits of breastfeeding was thus high. This level of knowledge needs to be maintained and translated into breast feeding behaviour that can be maintained long enough to confer optimal benefits for the baby.
21. The most common reasons cited by mothers for failing to continue to breastfeed were inability to produce enough breastmilk and necessity to return to work. Similar findings were reported in studies in Hong Kong<sup>48</sup>

and the UK.<sup>51</sup> These findings have implications for the support that can be provided by healthcare providers, hospitals, and workplaces.

### *Facilitation of and support for breastfeeding*

22. Poor milk supplies are a result of partial breastfeeding. By discouraging frequent suckling, supplementary bottle-feeds could reduce milk production and subsequently lead to discontinuation of breastfeeding. In Singapore most mothers attempted breastfeeding after delivery, so breastfeeding support provided during the hospital stay is particularly critical since lactation is established during the first few weeks after birth. Supportive hospital management helps to establish successful breastfeeding (Evidence level Ia).<sup>53,54</sup> Success factors include access to lactation-management support provided by trained healthcare professionals, encouragement of 24 hour rooming-in of infants soon after delivery, and communication of breastfeeding policy to all healthcare staff.
23. Since most hospitals discharge mothers 24-48 hours after delivery, health professionals in polyclinics, obstetric and gynaecology clinics, or paediatric clinics and breastfeeding-support group have an important part to play in helping mothers overcome transient problems with lactation and to motivate them to continue to breastfeed. As healthcare professionals play an important role in the promotion and support of breastfeeding, those who are directly involved with lactating mothers may find it useful to continually upgrade their knowledge of the practical aspects of breastfeeding.
24. For mothers returning to work, supportive worksite policies are required to provide education for both employers and employees and to facilitate continuation of breastfeeding – for e.g. through provision of facilities such as a “mothers’ room” or benefits such as subsidy for purchase of breast pumps. The Association of Breastfeeding Advocacy in Singapore, which includes representatives from hospitals, government bodies, academia, and professional groups, is involved in advocating breastfeeding-friendly workplaces in Singapore.
25. To protect breastfeeding the Health Promotion Board appointed a committee (Sale of Infant Foods Ethics Committee of Singapore) to produce a code providing guidelines for infant formula marketing to ensure that it does not interfere with the establishment of breastfeeding.

Adherence to the code is obligatory by the entire infant food industry. SIFECs administers the code, and compliance has generally been good.

26. The Health Promotion Board (HPB) also undertakes and facilitates public-education programmes to raise breastfeeding awareness, as well as training of healthcare professionals to help mothers in their breastfeeding efforts. HPB recognises the need for a national strategic plan to protect and support breastfeeding in different settings, and will work with the Association of Breastfeeding Advocacy in Singapore to develop and operationalise a blueprint for action.

### *Key recommendations*

1. For healthy full-term infants, feed only breastmilk for the first 6 months of life (Evidence level Ib, Recommendation grade A).
2. Healthy infants do not need extra water during the period of exclusive breastfeeding (Evidence level IV, Recommendation grade C).
3. After introduction of complementary feeds, continue breastfeeding till the child is 12 months old and thereafter as long as mutually desired (Evidence level IV, Recommendation grade C).
4. Breastfeeding-support policies and measures should be implemented in hospitals (Evidence level Ia, Recommendation grade A) and in the community.

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## ENJOY A VARIETY OF NUTRITIOUS FOODS

### *Importance of variety*

1. No single food can provide all the nutrients in the amounts that a child needs each day. Eating a variety of foods is important during childhood and adolescence since these are periods of growth and development, and periods during which future eating habits might be established. Variety refers to a selection of different foods from all the food groups, as well as within each food group.
2. Including different types of food in a diet increases the likelihood of consuming adequate amounts of any particular nutrient or non-nutrient substance beneficial to health, for example phytochemicals. Diets narrow in variety are associated with decreased nutritional adequacy, whereas diets wider in variety are associated with improved nutritional adequacy (Evidence level III).<sup>1-5</sup>
3. Confining dietary variety to within certain food groups can be associated with increased body fatness, possibly because of increased energy density of foods in those groups (Evidence level III).<sup>6,7</sup> Reducing dietary variety within energy-dense food groups and increasing dietary diversity within the vegetable food group might be related to weight loss (Evidence level III).<sup>1,8</sup>

### *Planning a nutritionally balanced diet*

4. The nutritional quality of a diet is often assessed against the Recommended Dietary Allowances (RDA), a dietary standard that lists the average daily levels of energy and nutrients that meet the needs of most individuals. Being nutrient-based, the RDA is difficult to use for choosing foods and planning meals that provide a nutritionally balanced diet. Moreover, food provides not only nutrients but also a combination of other components that are protective against chronic degenerative diseases. A daily food guide helps to translate recommendations on nutrient intake into recommended number of servings of food to be consumed daily from the various types of food.
5. Since 1995, the Healthy Diet Pyramid (Appendix 1, page 21) has been used as a food guide for Singaporeans aged 2 years and above – i.e. for

both children and adults. Individuals are encouraged to include 5-7 servings of Rice and Alternatives; 2-3 servings of Meat and Alternatives; 2 servings of Fruit; and 2 servings of Vegetables in the diet every day. The larger number of servings is for individuals with higher nutrient and calorie needs – for e.g. adolescents and active adults. For children aged 2-11 years the number of servings recommended is from the lower end of the range.

6. Since energy and nutrient requirements vary from infancy through pre-school and school-going age, the Health Promotion Board proposes a food guide specifically for children, to address these changing needs.

## ***A daily food guide for children and adolescents***

### ***Age – groupings***

7. Complementary foods offered before 6 months of age tend to displace breastmilk and do not confer any growth advantage over exclusive breastfeeding (Evidence level IV).<sup>9</sup> However, beyond age 6 months breastmilk alone cannot meet all nutritional requirements; complementary foods should be introduced to supplement breastfeeding (Evidence level IV, Recommendation grade C).<sup>10</sup>
8. The Health Promotion Board proposes the following food guide for infants aged 7 through 12 months, toddlers aged 1 through 2 years, pre-schoolers aged 3 through 6 years, school-going children aged 7 through 12 years and adolescents aged 13 through 18 years (Table 1, page 13). Since these age-groupings correspond with the ages of children attending child-care centres and kindergartens, and primary and secondary schools in Singapore, the food guide would facilitate communication and implementation in these settings.

### ***Number of servings and serving sizes, and food consistency***

9. The number of servings are intended to meet recommended energy and nutrient allowances. The number of complementary meals should be increased as the child grows older to ensure that the recommended number of servings are taken daily. The serving sizes for the different foods are listed in Appendix 2 (page 22). The Health Promotion Board proposes to retain the same serving sizes as those used in the adult food guide.

10. Food consistency and variety should be gradually increased so that by about 12 months, the child can eat the same type of foods consumed by the rest of the family.<sup>10</sup>

**Table 1 : Proposed daily food guide for children and adolescents**

Food group	Recommended number of servings				
	7-12 months <sup>e</sup>	1-2 years <sup>f</sup>	3-6 years	7-12 years	13-18 years
Rice and Alternatives <sup>a</sup>	1-2	2-3	3-4	5-6	6-7
- whole grains	-	½	½-1	1	1
Fruit <sup>b</sup>	½	½-1	1	2	2
Vegetables <sup>b</sup>	½	½	1	2	2
Meat and Alternatives <sup>c</sup>	½	½	1	2	2
Milk <sup>d</sup>	750 ml	750 ml	500 ml	250-500ml	250-500ml

<sup>a</sup> Include at least one daily serving of wholegrain products such as brown rice or wholemeal bread. For infants aged 7 through 12 months, it is advisable to introduce iron-enriched infant rice cereal as the first solid food.<sup>11-15</sup>

<sup>b</sup> Include a variety of fruit and vegetables, especially brightly-coloured and dark green, leafy vegetables.

<sup>c</sup> Half of the recommended number of servings should come from alternatives such as beans and bean products (e.g. tofu).

<sup>d</sup> Full-cream milk is not recommended for infants less than 1 year of age and low-fat milk should not be given to children less than 2 years of age (refer to section on Milk consumption).

<sup>e</sup> No salt or sugar should be added to foods introduced to infants.

<sup>f</sup> Fat constitutes an important source of energy for children below the age of 2 years. There is no need to restrict fat in the diet of children below the age of 2 years.<sup>11-15</sup>

### **Milk consumption**

11. For infants aged below 7 months, exclusive breastfeeding is recommended (see chapter on Breastfeeding, page 1). In the event that mothers are unable or choose not to breastfeed, infant milk formula can be given as an alternative. In light of the uncertainty about the safety of soy infant formula, it should be given only in consultation with a paediatrician.<sup>17,18</sup> Hypoallergenic or protein hydrolysate formulas are for infants who are intolerant of cow's milk protein and soy protein.<sup>19</sup> This type of formula should be used only when advised by a paediatrician. Goat's milk, evaporated milk, and other "milks" not formulated to meet the infant's nutritional requirements are not recommended for use during the first 12 months of life.<sup>19</sup> For infants aged 7 through 12 months, mothers can continue with breastmilk or infant milk formula or switch to follow-on milk.

12. Breastmilk continues to provide substantial amounts of key nutrients beyond the first year of life,<sup>9</sup> and can be offered to babies (children) as long as mutually desired by mother and child.
13. Full-cream milk should be introduced only after one year of age (Evidence level IV, Recommendation grade C).<sup>11-15</sup> Full-cream milk is a poor source of iron and its early introduction predisposes infants to iron deficiency.<sup>20,21</sup> Feeding infants full-cream milk may also lead to intestinal blood loss (Evidence level IIb),<sup>22</sup> which aggravates the problem of iron deficiency. In addition the higher levels of protein and minerals in full-cream milk have been associated with an increase in renal solute load in young infants (Evidence level III).<sup>23</sup> Since young children require proportionately more fat in their diet than older children, reduced-fat milk should not be introduced until after 25 months (Evidence level IV, Recommendation grade C).<sup>11-15</sup> The fat content from milk becomes less important with age as other foods that contribute fat are increasingly eaten.
14. Milk remains an important source of nutrients, particularly calcium for children and adolescents. We recommend that children 1 through 2 years be provided three glasses (750ml) of milk a day, and those aged 3 through 6 years be provided at least two glasses (500ml) of milk a day. Children and adolescents 7 to 18 years should be encouraged to consume one to two cups (250-500ml) of milk a day. These recommended milk intakes are on top of, and not part of, the servings recommended for the Meat and Alternatives food group.
15. Healthy infants being fed solely on milk do not need extra water; breastmilk or infant formula provides all the fluids an infant needs (see chapter on Breastfeeding, page 1). Once the infant has started on solid foods, water can be given through the day as necessary. Sufficient hydration is important, and since children may not be able to indicate when they are thirsty, water should be offered frequently to toddlers and young children.<sup>12</sup> Children should aim to drink the equivalent of 6-8 glasses of water daily;<sup>13</sup> while adolescents should aim for up to 8-10 glasses a day.<sup>24</sup> If the child exercises, more water should be drunk.

### *Nutrient adequacy of proposed daily food guide*

16. Since food intake data for children are not available, data from the 1998 National Nutrition Survey conducted among adults to calculate the nutrient profile of a “composite serving” for each of the four food groups for children were used. For example, a “composite serving” of the Rice and

Alternatives food group is made up of 33% noodles, 31% rice, 15% potatoes, 8% bread, 5% biscuits, 4% roti prata, 2% chapatti, and 2% cereal, based on the consumption pattern of these foods by adults in the 2004 National Nutrition Survey. The nutrient profile of a food group thus reflects the nutrient content of the “composite serving” of that group.

17. Appendix 3 (pages 23-28) shows the proposed number of food servings (based on the composite servings) and their energy and nutrient content for the various age-groups. For infants and children less than 3 years of age, the proposed number of servings of food to be consumed from the four food groups meet most of their energy requirements. For children above 3 years of age, the proposed food guide would be able to provide at least 60% of daily energy needs. The foods analysed are in their lowest fat form with no added sugar. The diet of children aged above 3 years is expected to include more foods with added fat and sugar. For all age-groups, the proposed food guide more than meets the RDA for essential nutrients such as protein, calcium, iron, folic acid, and vitamins A and C.

### *Supplementation*

18. Supplements are generally not necessary for healthy, growing children who consume a varied and balanced diet as recommended in the daily food guide.<sup>12,19</sup> Supplementation may be appropriate only in specific circumstances – for e.g. when the individual is anorexic or strictly vegetarian. In the assessment of need for supplementation, dietary intake should be evaluated, in consultation with a doctor or a dietitian.

### *Vegetarian diets*

19. Vegetarian diets tend to be bulky and low in caloric density. This may be a problem for infants and toddlers who have limited stomach capacity and high nutrient needs per unit weight.<sup>11,14,19</sup> Older children and adolescents on vegetarian diets are at less risk of growth failure compared to younger children.<sup>19</sup> However, vegan diets pose a risk if the diet is not properly planned to provide adequate energy, vitamin B12, protein and iron.<sup>11,14,19</sup>
20. Parents who are vegetarian are strongly encouraged to seek advice from a dietitian to help plan meals that can provide the infant or toddler with sufficient energy and nutrients. As adolescents become more responsible for their own food choices, they must be educated on the basic principles of food selection. A sound vegetarian diet should contain a variety of

foods, including whole-grains, fruit, vegetables, legumes (peas, lentils, beans and bean products), nuts and seeds, as well as dairy products and eggs if permitted, to help meet the nutrient requirements of vegetarians.<sup>25</sup> A doctor should also be consulted regarding the need for supplementation, particularly vitamin B12.

## *Food allergies*

21. Food allergy is more likely to occur in infants and children with a strong (bi-parental, parental, or sibling) family history<sup>26</sup> of allergy, or a personal history of other allergic problems, such as eczema, asthma, or allergic rhinitis. The prevalence of food allergy among schoolchildren in Singapore is estimated to be 4-5%. Common foods that most often trigger allergic reactions in Singaporean children are crustacean seafood (e.g. prawns, crabs), eggs, and cow's milk, though any food may trigger an allergic reaction.<sup>27</sup>
22. Symptoms of food allergy may vary from mild to life-threatening. Allergic symptoms start within minutes and at most within a few hours of exposure to the food trigger. The symptoms may include rashes (hives), swelling of lips and face, vomiting, abdominal cramps, breathing difficulty, and wheezing.
23. Food allergy should be diagnosed only by a doctor through physical examination and allergy testing. Only in certain circumstances is a controlled food challenge required. A confirmed food allergy should be jointly managed by a dietitian, the referring doctor, and the family. Children may outgrow food allergy and they should be tested when advised to do so by a doctor to ensure that dietary modifications are not prolonged unnecessarily.
24. Strategies for the prevention of food allergy in high-risk infants include:
  - Exclusive breastfeeding for the first 6 months of life (Evidence level IV);<sup>26</sup> or the use of an extensively hydrolyzed hypoallergenic formula (Evidence level Ia).<sup>28-30</sup>
  - Delaying introduction of dairy products until 1 year of age (Evidence level IV).<sup>31</sup>
  - Delay introducing hen's eggs until 2 years of age (Evidence level IV).<sup>31</sup>

## Alcohol

25. Over-consumption of alcohol in adults is associated with increased rates of accident-related injury and death, malnutrition, and in the long-term, increased rates of chronic diseases such as liver cirrhosis and oropharyngeal, oesophageal, and liver cancers (Evidence level III).<sup>32</sup> Moderate regular consumption of alcohol has been shown to reduce the risk of coronary heart disease, but this benefit is found mainly among older adults (i.e. aged 40 years and above). Moreover, the relationship between alcohol consumption and mortality from coronary heart disease is J-shaped, with one to four drinks daily reducing and five or more daily increasing the risk (Evidence level III).<sup>33</sup> Alcohol consumption in adolescence has been associated with impaired intellectual development (Evidence level III),<sup>34</sup> as well as an increased risk of binge and harmful drinking in adulthood (Evidence level III).<sup>35</sup> Factors that protect against underage alcohol consumption include knowledge of the consequences of alcohol consumption and parental teaching of responsible alcohol consumption (which can be measured as parental provision of alcohol and drinking with a parent) (Evidence level III),<sup>36</sup> whereas a factor that increases drinking among adolescents and young adults is exposure to alcohol advertising (Evidence level III).<sup>37</sup>
26. In Singapore, alcoholic drinks are defined as any liquor containing more than 0.5% (v/v) alcohol at 20°C,<sup>38</sup> and the legal drinking age is 18 years. Persons under 18 years of age are not allowed to buy alcoholic drinks. They are also not allowed to be given or to consume alcoholic drinks on licensed premises.<sup>39</sup> The Advertising Standards Agency of Singapore, the self-regulatory body of the advertising industry, oversees the advertising of alcoholic drinks in Singapore through the Singapore Code of Advertising Practice. The Code provides general guidelines covering advertising for alcoholic drinks and it also forbids alcoholic drink advertisements directed at young people or that in any way encourage young people to start drinking.<sup>40</sup>
27. Alcohol is not recommended for children and adolescents. Caregivers at home should educate adolescents on the effects of alcohol consumption, closely monitor any alcohol consumption, and encourage adolescents to avoid harmful alcohol use. Educating adolescents is important since drinking behaviour in adolescence tracks to young adulthood, and alcohol consumption patterns among young adult Singaporeans aged 18-29 years is an issue of some concern. The number of young adults who consumed alcohol regularly or who are binge drinkers doubled between 1998 and 2004.<sup>41</sup>

## *Key recommendations*

1. Eat a variety of foods from among and within food groups (Evidence level III, Recommendation grade B).
2. Introduce complementary foods at 7 months of age while continuing to breastfeed (Evidence level IV, Recommendation grade C).
3. Full-cream milk should be introduced only after 1 year of age (Evidence level IV, Recommendation grade C).
4. Reduced-fat milk should not be introduced before 2 years of age (Evidence level IV, Recommendation grade C).
5. For infants at high risk of allergy, consider allergen-avoidance measures (Evidence levels Ia-IV, Recommendation grades A-C).

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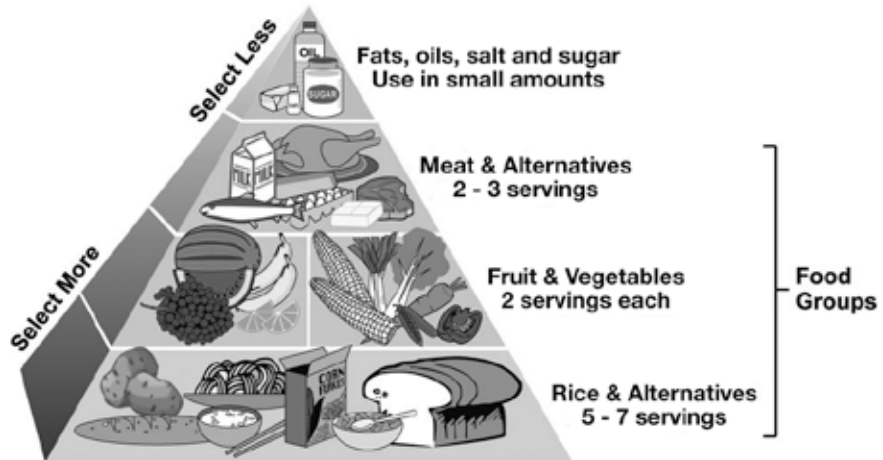
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## Appendix 1

### The Healthy Diet Pyramid For Adults



The Healthy Diet Pyramid is a food guide for the average healthy Singaporean aged 2 years and above. The Pyramid categorises food into 4 groups:

- (i) Rice and Alternatives
- (ii) Fruit
- (iii) Vegetables
- (iv) Meat and Alternatives

Children aged 2-11 years are recommended to consume the number of servings from the lower end of the range. Adolescents (12 years and above) are encouraged to aim for the greater number of servings.

## Appendix 2

### Definition of *one serving*\*

#### Rice & Alternatives

- 2 slices bread (60g)
- ½ bowl\*\* rice (100g)
- ½ bowl noodles, beehoon or spaghetti (100g)
- 4 plain biscuits (40g)
- 1 thosai (60g)
- 2 chapatis (60g)
- 1 large potato (180g)
- 1½ cups plain cornflakes (40g)

#### Fruit

- 1 small apple, orange, pear or mango (130g)
- 1 wedge papaya, pineapple or watermelon (130g)
- 10 grapes or longans (50g)
- 1 medium banana
- ¼ cup dried fruit (40g)
- 1 cup pure fruit juice (250ml)

#### Vegetables

- 150g raw leafy vegetables
- 100g raw non-leafy vegetables
- ¾ mug\*\*\* cooked leafy vegetables (100g)
- ¾ mug cooked non-leafy vegetables (100g)
- ¼ round plate+

#### Meat & Alternatives

- 1 palm-size piece meat, fish or poultry (90g)
- 2 small blocks soft bean curd (170g)
- ¾ cup\*\*\*\* cooked pulses (peas, beans, lentils) (120g)

#### NOTE

\* All weights listed are for edible portions only

\*\* rice bowl

\*\*\* 250ml mug

\*\*\*\* 250ml cup

+ 10inch plate

### Appendix 3

**Infants 7 through 12 months** - Comparison of the recommended number of servings<sup>^</sup> from the food groups with the RDAs\*

	Energy (kcal)	Protein (g)	Fats (g)	Calcium (mg)	Iron (mg)	VitA (mcg)	Vit C (mg)
1 serving of rice and alternatives	162	4	1	16	2	3	2
$\frac{1}{4}$ serving of animal based protein <sup>#</sup>	37	6	2	9	0	12	0
$\frac{1}{4}$ serving of plant-based protein	72	4	3	23	0	1	0
Infant formula	510	11	27	428	9	563	46
$\frac{1}{4}$ serving of dark green and brightly coloured vegetables	9	1	0	26	1	198	12
$\frac{1}{4}$ serving of pale green leafy and other vegetables	7	1	0	9	0	3	8
$\frac{1}{4}$ serving of orange/ red/ yellow fruit	4	0	0	2	0	10	3
$\frac{1}{4}$ serving of other fruit	13	0	0	2	0	2	4
<b>Total</b>	<b>814</b>	<b>26</b>	<b>33</b>	<b>514</b>	<b>13</b>	<b>792</b>	<b>76</b>
RDA	950	18	42	400	7	300	40
<b>% RDA met</b>	<b>86</b>	<b>142</b>	<b>78</b>	<b>129</b>	<b>179</b>	<b>264</b>	<b>190</b>

<sup>^</sup> The lower number of the recommended servings is used

\* RDA shown is for infants aged 9-<12 months

# Not including milk or other dairy products

**Children 1 to less than 2 years** - Comparison of the recommended number of servings<sup>^</sup> from the food groups with the RDAs\*

	Energy (kcal)	Protein (g)	Fats (g)	Calcium (mg)	Iron (mg)	VitA (mcg)	Vit C (mg)
<sup>1</sup> / <sub>2</sub> servings of rice and alternatives	243	5	2	24	3	4	3
<sup>1</sup> / <sub>2</sub> serving of whole-grains	72	3	1	40	1	3	0
<sup>1</sup> / <sub>4</sub> serving of animal-based protein <sup>#</sup>	37	6	2	9	0	12	0
<sup>1</sup> / <sub>4</sub> serving of plant-based protein	72	4	3	23	0	1	0
Full cream milk (750ml)	495	25	29	900	1	225	8
<sup>1</sup> / <sub>4</sub> serving of dark green and brightly coloured vegetables	9	1	0	26	1	198	12
<sup>1</sup> / <sub>4</sub> serving of pale green leafy and other vegetables	7	1	0	9	0	3	8
<sup>1</sup> / <sub>4</sub> serving of orange/ red / yellow fruit	4	0	0	2	0	10	3
<sup>1</sup> / <sub>4</sub> serving of other fruit	13	0	0	2	0	2	4
<b>Total</b>	<b>952</b>	<b>45</b>	<b>35</b>	<b>1034</b>	<b>6</b>	<b>458</b>	<b>38</b>
RDA	1150	19	45	500	7	250	35
<b>% RDA met</b>	<b>83</b>	<b>236</b>	<b>79</b>	<b>207</b>	<b>90</b>	<b>183</b>	<b>110</b>

<sup>^</sup> The lower number of the recommended servings is used

\* RDA shown is for infants aged 1-2 years

<sup>#</sup> Not including milk or other dairy products

**Children 2 to less than 3 years - Comparison of the recommended number of servings<sup>^</sup> from the food groups with the RDAs\***

	Energy (kcal)	Protein (g)	Fats (g)	Calcium (mg)	Iron (mg)	VitA (mcg)	Vit C (mg)
$\frac{1}{12}$ servings of rice and alternatives	243	5	2	24	3	4	3
$\frac{1}{2}$ serving of whole-grains	72	3	1	40	1	3	0
$\frac{1}{4}$ serving of animal-based protein <sup>#</sup>	37	6	2	9	0	12	0
$\frac{1}{4}$ serving of plant-based protein	72	4	3	23	0	1	0
Full cream milk (500ml)	330	17	19	600	1	150	5
$\frac{1}{2}$ serving of low-fat dairy products	96	8	3	282	0	26	0
$\frac{1}{4}$ serving of dark green and brightly coloured vegetables	9	1	0	26	1	198	12
$\frac{1}{4}$ serving of pale green leafy and other vegetables	7	1	0	9	0	3	8
$\frac{1}{4}$ serving of orange/ red/ yellow fruit	4	0	0	2	0	10	3
$\frac{1}{4}$ serving of other fruit	13	0	0	2	0	2	4
<b>Total</b>	<b>882</b>	<b>44</b>	<b>29</b>	<b>1016</b>	<b>6</b>	<b>409</b>	<b>36</b>
RDA	1350	22	45	500	7	250	35
<b>% RDA met</b>	<b>65</b>	<b>201</b>	<b>64</b>	<b>203</b>	<b>90</b>	<b>163</b>	<b>103</b>

<sup>^</sup> The lower number of the recommended servings is used

\* RDA shown is for infants aged 2-<3 years

# Not including milk or other dairy products

**Children 3 through 6 years** - Comparison of the recommended number of servings<sup>^</sup> from the food groups with the RDAs\*

	Energy (kcal)	Protein (g)	Fats (g)	Calcium (mg)	Iron (mg)	VitA (mcg)	Vit C (mg)
<sup>1</sup> / <sub>2</sub> servings of rice and alternatives	404	9	3	40	4	7	4
<sup>1</sup> / <sub>2</sub> serving of whole-grains	72	3	1	40	1	3	0
<sup>1</sup> / <sub>2</sub> serving of animal-based protein <sup>#</sup>	73	11	3	17	1	23	0
<sup>1</sup> / <sub>2</sub> serving of plant-based protein	143	8	5	47	1	2	0
1 serving of low-fat dairy products	192	15	6	564	0	51	0
<sup>1</sup> / <sub>2</sub> serving of dark green and brightly coloured vegetables	18	1	0	51	1	397	25
<sup>1</sup> / <sub>2</sub> serving of pale green leafy and other vegetables	15	1	0	18	0	6	16
<sup>1</sup> / <sub>2</sub> serving of orange/ red / yellow fruit	8	0	0	3	0	21	7
<sup>1</sup> / <sub>2</sub> serving of other fruit	27	0	0	4	0	3	9
<b>Total</b>	<b>952</b>	<b>50</b>	<b>19</b>	<b>785</b>	<b>10</b>	<b>513</b>	<b>61</b>
RDA	1850	30	62	600	7	300	40
<b>% RDA met</b>	<b>51</b>	<b>166</b>	<b>30</b>	<b>131</b>	<b>136</b>	<b>171</b>	<b>153</b>

\* RDA shown is for boys aged 5-<7 years

<sup>^</sup> The lower number of the recommended servings is used

<sup>#</sup> Not including milk or other dairy products

**Children 7 through 12 years** - Comparison of the recommended number of servings<sup>^</sup> from the food groups with the RDAs\*

	Energy (kcal)	Protein (g)	Fats (g)	Calcium (mg)	Iron (mg)	VitA (mcg)	Vit C (mg)
4 servings of rice and alternatives	647	14	4	64	7	10	7
1 serving of whole-grains	143	7	2	79	2	6	0
1 serving of animal-based protein <sup>#</sup>	147	22	6	35	1	46	0
1 serving of plant-based protein	286	16	11	94	2	4	0
<sup>1</sup> / <sub>2</sub> serving of low-fat dairy products	96	8	3	282	0	26	0
1 serving of dark green and brightly coloured vegetables	36	3	0	102	3	794	49
1 serving of pale green leafy and other vegetables	30	2	0	36	1	12	33
1 serving of orange/ red /yellow fruit	16	0	0	7	0	42	13
1 serving of other fruit	54	1	0	8	0	6	18
<b>Total</b>	<b>1455</b>	<b>73</b>	<b>27</b>	<b>707</b>	<b>17</b>	<b>947</b>	<b>120</b>
RDA	2200	49	73	1000	7	575	70
<b>% RDA met</b>	<b>66</b>	<b>149</b>	<b>37</b>	<b>71</b>	<b>237</b>	<b>165</b>	<b>172</b>

\* RDA shown is for boys aged 10-<12 years

<sup>^</sup> The lower number of the recommended servings is used

<sup>#</sup> Not including milk or other dairy products

**Children 13 through 18 years** - Comparison of the recommended number of servings<sup>^</sup> from the food groups with the RDAs\*

	Energy (kcal)	Protein (g)	Fats (g)	Calcium (mg)	Iron (mg)	VitA (mcg)	Vit C (mg)
5 servings of rice and alternatives	809	18	5	81	8	13	9
1 serving of whole-grains	143	7	2	79	2	6	0
1 serving of animal-based protein <sup>#</sup>	147	22	6	35	1	46	0
1 serving of plant-based protein	286	16	11	94	2	4	0
$\frac{1}{2}$ serving of low-fat dairy products	96	8	3	282	0	26	0
1 serving of dark green and brightly coloured vegetables	36	3	0	102	3	794	49
1 serving of pale green leafy and other vegetables	30	2	0	36	1	12	33
1 serving of orange/ red /yellow fruit	16	0	0	7	0	42	13
1 serving of other fruit	54	1	0	8	0	6	18
<b>Total</b>	<b>1617</b>	<b>77</b>	<b>28</b>	<b>723</b>	<b>18</b>	<b>949</b>	<b>122</b>
RDA	2850	80	95	1000	19	750	90
<b>% RDA met</b>	<b>57</b>	<b>96</b>	<b>30</b>	<b>72</b>	<b>96</b>	<b>127</b>	<b>136</b>

\* RDA shown is for boys aged 16-<18 years (except iron, where the RDA for girls aged 16-<18 years were used)

<sup>^</sup> The lower number of the recommended servings is used

<sup>#</sup> Not including milk or other dairy products

## ESTABLISH SENSIBLE EATING HABITS AND ENCOURAGE PHYSICAL ACTIVITY

### *Introduction*

1. An adequate diet is essential for child and adolescent growth but exactly how much an individual needs varies with size and build, growth rate, and level of physical activity. Exact requirements for an individual are difficult to specify, so growth is an important indicator of nutritional adequacy (Evidence level IV).<sup>1</sup>
2. Children should be monitored not only for underweight and failure to thrive but also for obesity. Childhood obesity tends to persist into adulthood,<sup>2-5</sup> and it might be associated with increased risk of health problems (see section on Childhood Overweight and Obesity, page 32).<sup>6-8</sup>
3. Physical activity promotes physical growth. It is also an important means of balancing energy intake and output. Hence it is an important factor in maintaining normal growth or tackling obesity.<sup>9</sup>

### *Assessment of growth*

4. In Singapore, two sets of height and weight charts are used to determine the state of growth of individual children in relation to population growth profiles. For pre-schoolers aged below 7 years, growth is assessed by use of charts of Body Mass Index (BMI) for age. For school going children aged 7-18 years, weight-for-height charts are being used. The feasibility of using BMI-for-age charts is being explored.

### *Factors influencing dietary intake*

#### *Growth rate*

5. The rate of growth, which varies throughout the childhood years, determines to a large extent the energy and nutrient needs and appetites of the child. Changes in the rate of growth are most rapid during the first 2 years of life, with the rapid growth in the first few months generally being followed by a period of catch-down growth, during which the child's size settles to that appropriate for his or her genetic make-up.<sup>10,11</sup> Growth stabilises during the pre-school years, before picking up again

during the adolescent growth spurt at ages 10-11 years for girls and 12-13 years for boys.

6. Catch-down growth may account for the seemingly paradoxical decline in a child's appetite at a time when the appetite would otherwise be expected to increase when the child's activity increases as he or she becomes a toddler.<sup>10</sup>

### **Food preferences**

7. Infants seem to have an innate preference for sweet taste.<sup>12</sup> However, this preference can be modified early in life.<sup>12</sup> If totally denied sweetened drinks in the newborn period, the child can lose this preference and gradually decline to accept such drinks.
8. Most food preferences are learned and acquired early in life (Evidence level Ib).<sup>13</sup> Willingness to taste a novel food can be increased by flavouring it with a familiar flavour (Evidence level Ib).<sup>14</sup> Liking for an unfamiliar food can be encouraged by increasing exposure to the food.<sup>15,16</sup>
9. Attempts to externally control a child's intake may lead the child to rely on external cues such as the amount of food remaining on the plate, rather than the internal cues of hunger and satiety, to regulate food intake (Evidence level Ib).<sup>13,18,19</sup>
10. Food should not be offered as a reward or withheld as a punishment. Offering food (usually something sweet and of low nutritional value) as a reward commonly enhances preference for that food (Evidence level Ib),<sup>20</sup> with implications for the development of eating patterns later on in life – for e.g. a child may turn to these foods for comfort during times of negative emotions. Restricting access to palatable foods that are thought to be unhealthy for the child increases the desire to gain and consume those foods (Evidence level Ib).<sup>21</sup> Conversely, excessive attention to a child's refusal of certain foods may decrease preference for these foods (Evidence level Ib).<sup>22</sup>
11. Mealtime companionship is important to young children.<sup>18,22</sup> By offering such companionship, the family can also provide the appropriate role models and reinforcements that are most likely to bring about desired food habits.<sup>22,23</sup>
12. Since parents, caregivers, and teachers play an important role in shaping the food preferences of children, it is important that they know their food facts and values. Parental knowledge of nutrition and their involvement in

nutritional programmes at their children's primary school has been related to quality of the children's diet (Evidence level III).<sup>24,25</sup>

### **Television advertising**

13. A joint World Health Organization and Food and Agriculture Organization (WHO/FAO) Expert Consultation in 2002 concluded that the heavy marketing of fast food and energy-dense, micronutrient-poor foods and beverages is a "probable" causal factor in weight gain and obesity.<sup>26</sup> The following year, a review (Evidence level III, Recommendation grade C) commissioned by the UK Food Standards Agency concluded that food advertising influences children's food choices and dietary habits.<sup>27</sup> In its Global Strategy for Diet, Physical Activity and Health, which was approved in May 2004, WHO advocates the development of multi-sectoral approaches to deal with the marketing of food to children.<sup>28</sup>
14. A survey of 13 countries found that the number of food advertisements shown on television per hour was 12 in Australia, 11 in the USA and 10 in the UK.<sup>29</sup> Such exposure is a concern since the foods most frequently advertised tend to be high in fat, sugar, or salt, and of low nutritional value.<sup>30</sup> Comparable figures on exposure to television food advertisements are not available for Singapore. However a survey by the Singapore Sports Council has found that only 32% of children are engaged in sports but 92% watch television during their leisure time.<sup>31</sup> Moreover, on average watching television takes up 50% and sports 10% of leisure time. With there being an average of 4.58 leisure hours per day, 2.3 hours are spent on watching television per day.
15. A WHO review in 2004 of regulations from 73 countries on the marketing of food to children<sup>32</sup> found that 85% had some form of regulation on television advertising to children and 44% had specific restrictions on both the timing and content of television advertisements directed at children. Two countries have banned television advertising to children.
16. In Singapore, the Media Development Authority's TV Advertising Code does not consider food as a separate category or restrict advertising during children's programmes.<sup>33</sup> There is a general requirement (in accordance with the international norm) that there should be no more than 14 minutes of advertisements per hour. Clauses on advertising to children (defined as children aged under 14) do not refer to timing of advertisements and the restrictions are stated in only very general terms – for e.g. advertisements should not contain "any visuals, effects or words

that might result in harm to them morally or psychologically” and “should not show them doing acts which might endanger themselves or others”.

17. Globally, the regulatory environment is evolving. New regulations are being proposed, consumer and public health groups are making new demands and the industry is embarking on self-regulation. The Australian Coalition on Food Advertising to Children, a national advocacy group formed in 2002, is calling for a ban on all television food advertising during programmes for which children aged 0-12 years make up a substantial proportion of the viewing audience.<sup>34</sup> In addition, some food companies are adopting self regulation. In 2003, at least four of the world’s largest food and drinks companies developed internal guidelines on marketing, including that directed at children. For example, Kraft Foods declared that their advertisements will not promote “overconsumption,”<sup>35</sup> and Coca-Cola reaffirmed its policy of prohibiting marketing to children under the age the 12 years.<sup>36</sup>

## *Childhood overweight and obesity*

### *Health consequences*

18. There is a consistent body of evidence that childhood obesity is associated with most of the major cardiovascular risk factors.<sup>2</sup> Childhood obesity is likely to persist into adulthood with its associated health risks.<sup>2,7</sup> Obesity is more likely to persist when it first manifests in childhood or adolescence than in the pre-school years, and when obesity is severe.<sup>7,10</sup>
19. A less well recognised ill-effect of childhood obesity is its psychosocial consequences. Obese children and adolescents often encounter social isolation and discrimination.<sup>37</sup> They are also likely to have poor self-esteem and adopt high-risk behaviours, such as smoking and binge drinking.<sup>38</sup>

### *Prevalence*

20. There is a rising trend in most developed countries. In USA, the prevalence of overweight and obesity has increased by 80% in children and doubled in adolescents over the past two decades.<sup>39,40</sup> In UK, the rates of overweight in children have doubled over a similar period.<sup>41</sup> Australia is also seeing increasingly more overweight children, and the increase in BMI is most marked at the heavier end of the distribution.<sup>42</sup>
21. In contrast, the prevalence of overweight and obesity among Singapore school children has decreased from 14% in 1992 to 9.5% in 2007.<sup>43</sup>

### **Possible factors influencing prevalence of obesity**

22. Eating patterns are changing among children.<sup>44</sup> These include increased number of meals eaten in schools and outside the home, larger portion sizes, shifts in beverage consumption from milk-based drinks to sweetened drinks, changing meal patterns and frequency, with declining breakfast consumption and increase in snacking. In the USA, low-nutrient-density but energy-dense foods (e.g. sweetened drinks, high-fat snacks, fast foods) contributes about 30% of the total energy intake in the USA.<sup>45</sup>
23. Whether increases in energy intake have contributed directly to the rising trend in childhood obesity is not clear. Some surveys in the USA (e.g. those cited by the American Dietetic Association<sup>46</sup>) have indicated that children's total energy intakes have been rising over the past quarter century. However, data from the Bogalusa Heart Study<sup>47</sup> showed that total caloric intake among 10-year-olds remained quite stable between 1973 and 1988, and a study based on the US National Health and Nutrition Examination surveys found that between 1971 and 2000, mean energy intake increased among adults but changed little among those aged 1-19 years, except for adolescent females, whose energy intake increased.<sup>48</sup> The methodological difficulties of dietary surveys could complicate interpretation of dietary trends.
24. The relation between the obesity epidemic and a decline in physical activity is also not clear. Some cross-sectional surveys have shown correlations between prevalence of obesity and television viewing,<sup>49-51</sup> and a television in the bedroom has been associated with obesity.<sup>52</sup> In addition, a randomised trial has shown that limiting media use without promoting more active behaviour resulted in lower BMI among the intervention than the control group after a year (Evidence level Ib).<sup>53</sup> In Singapore, which is probably the only country in Asia and perhaps in the world, where since 1992, all schoolchildren who are overweight or obese undergo a Trim and Fit (TAF) programme that emphasises physical activity and good eating habits. It would be tempting to attribute the decline in prevalence of overweight and obesity among children to this programme. However, there are arguments<sup>54</sup> to support the view that a decrease in physical activity seems to follow rather than precede the development of obesity and that the association between obesity and television viewing might be accounted for by the possibility that watching television could be an independent predictor of fatness or that it might be associated with changes in eating patterns.

## ***Prevention and management***

25. Despite controversies over reasons for the trends in obesity, the general view is that attention to both diet and physical activity is the approach to the prevention and management of obesity (Evidence level IV, Recommendation grade C)<sup>7,28,55</sup> Management of obesity, especially in young growing children (below the age of 7 years), should focus on weight maintenance rather than weight reduction. As the child grows taller, the effect of weight maintenance in earlier years would be the attainment of normal weight.

## ***Eating disorders***

26. Anorexia nervosa, bulimia, and binge-eating disorder are the three most recognised eating disorders. These eating disorders have been reported to affect 1-3% of adolescent girls in the Western countries.<sup>56</sup> Anorexia nervosa and bulimia are together the third most common medical disorder in adolescents after asthma and depression.<sup>56</sup>
27. There is no data on the prevalence of eating disorders in Singapore. A recent review of eating disorders in Singapore estimated the local prevalence to be comparable to that of more industrialised Asian countries such as Hong Kong, Korea and Japan.<sup>56</sup> These countries are seeing the greatest increase in reports of eating disorders in this region.
28. The rates of eating disorders in Asian countries are generally lower than those reported in Western countries.<sup>57</sup> However, the rates of body dissatisfaction and dieting in Asian countries are similar to those in Western countries. In Singapore, body dissatisfaction is prevalent among Chinese schoolgirls and female undergraduates.<sup>58</sup> Body dissatisfaction and dieting behaviour are important predictors for the development of eating disorders. It would appear that although only a small proportion of the population develops clinical eating disorders, many more are at risk.<sup>59</sup>
29. The peak age of onset for eating disorders is during adolescence and young adulthood but children as young as 12 years old have been found to exhibit some characteristics of eating disorders and concerns about body weight.<sup>60</sup> This coupled with the observation that eating disorders are likely to become increasingly prevalent in Asia suggests that preventive measures such as public education, early detection and treatment should be instituted to avert a growing problem.<sup>56</sup>

## *Physical activity*

### *Benefits*

30. Physical activity plays an important part in promoting physical growth. Physical activity increases energy requirement and thus influences nutrient intake. Nutrient needs are more likely to be met if sufficient energy is consumed.
31. Apart from building up lean muscle mass and reducing body fat, regular physical activity during childhood and adolescence has some beneficial effect on bone mass (Evidence level Ib),<sup>61</sup> which has implications on future risk of osteoporosis.<sup>62</sup> Activity patterns and fitness in childhood and adolescence show modest correlations with activity levels in adults and the associated health outcomes (Evidence level III).<sup>63</sup> Physical activity may improve self-esteem in children and adolescents (Evidence level Ia).<sup>64</sup> Participation in sports programmes can also introduce young people to skills such as teamwork, self-discipline, leadership, and socialisation.

### *Physical activity recommendations of other countries*

32. In 1994, the International Consensus Conference on Physical Activity Guidelines for Adolescents recommended that adolescents should engage in three or more sessions per week of activities that require moderate to vigorous levels of exertion that last 20 minutes or more each time.<sup>65</sup> The UK Department of Health<sup>66</sup> and the Australian Department of Health & Aging<sup>67</sup> have recommended at least 60 minutes of moderate-intensity physical activity each day, and the US Surgeon General<sup>68</sup> and the USDA<sup>69</sup> have recommended 60 minutes of moderate-intensity physical activity most days of the week.
33. More recently, other organisations have recommended more than 60 minutes of physical activity a day. The National Association for Sports & Physical Education<sup>70</sup> in the USA states that toddlers should accumulate at least 30 minutes and preschoolers should accumulate at least 60 minutes of structured physical activity per day, while toddlers and preschoolers should engage in at least 60 minutes and up to several hours per day of daily unstructured physical activity and should not be sedentary for more than 60 minutes at a time except when sleeping. The Canadian Public Health Agency<sup>71</sup> recommends that children and adolescents increase physical activity and reduce sedentary activity, and over a period of several months, they should increase their level of physical activity to at least 90 minutes per day, and decrease by at least 90

minutes per day the amount of time spent on non-active activities such as watching videos and sitting at the computer.

34. An expert panel convened by the US Centres for Disease Control and Prevention (CDC) published a report that recommended that school-age youth should participate every day in 60 minutes or more of moderate to vigorous physical activity that is enjoyable and developmentally appropriate.<sup>72</sup> However, there is emerging evidence to suggest that young people need to accumulate at least 90 minutes of moderate-intensity physical activity daily to prevent insulin resistance, which seems to be the central feature for clustering of cardiovascular disease risk factors (Evidence level III).<sup>73</sup> This is the first time a physical activity recommendation has been based on accelerometry, an objective measure of physical activity and multiple health outcomes, in this case the clustering of cardiovascular disease risk factors. This is in contrast with many other studies on physical activity, which have been based on self-reported data and have used single risk factors as outcomes.

#### ***Physical activity patterns among Singapore children and adolescents***

35. Studies done in Singapore<sup>74</sup> and other developed countries<sup>75-77</sup> have found that regular physical activity declines as children move from primary to secondary school. One study conducted in Singapore among 240 students (120 primary and 120 secondary students) aged 10 to 15 years found that primary students accumulated 14 minutes of moderate-intensity physical activity on a weekday, while secondary students spent 5 minutes at similar intensity activity on a weekday.<sup>74</sup> Students were significantly more sedentary on a weekend day, spending 5 minutes or less at moderate-intensity physical activity. Data from the Student Health Survey<sup>78</sup> on 6800 students found that students aged between 12-18 years, the median time spent on physical activity of moderate-intensity or greater each day was 24 minutes, and that 18% of individuals surveyed met the existing recommendation for physical activity, which is at least 30 minutes of physical activity of at least moderate-intensity on at least 5 days a week. The data also showed that 11% of individuals surveyed had 60 minutes or more physical activity of at least moderate-intensity on at least 5 days a week.
36. Another local study conducted among 500 adolescents found that they spend on average 4 hours, watching television or playing computer games.<sup>79</sup> Increasing use of multimedia technology (television, video games, and computer) has been suggested as a cause of physical

inactivity among young people.<sup>80,81</sup> Increased television viewing has also been associated with increased snacking on high fat and high sugar foods. Recently, the American Academy of Paediatrics issued a policy statement that recommends limiting television and video time to a maximum of 2 hours per day.<sup>6</sup>

37. The Health Promotion Board recommends that children and adolescents accumulate at least 60 minutes of moderate-intensity physical activity on 5 or more days a week, though there is emerging evidence that children and adolescents require 90 minutes of physical activity every day to provide health benefits. The recommended levels of physical activity may be accumulated from both structured and unstructured physical activity. In addition, toddlers and preschool children should not be allowed long stretches of sedentary activity. Caregivers should encourage toddlers and preschool children to accumulate 60 minutes of both structured and unstructured physical activities daily in a safe and supervised (by caregivers) environment.

### ***Foetal (Developmental) origins of chronic adult disease***

38. The foetal (developmental) origins of chronic adult disease hypothesis is that chronic diseases in adults originate from developmental plasticity in response to undernutrition during foetal life and infancy.<sup>82</sup> The original form of the hypothesis was that low birth weight was associated with an increased rate of coronary heart disease and related disorders.<sup>83</sup> More recently, it was observed that individuals who later developed coronary heart disease remained small in infancy but had accelerated gain in weight and Body Mass Index (BMI) during childhood compared to their peers.<sup>84</sup> These observations led to a refinement of the hypothesis to include impaired growth in infancy and subsequent rapid childhood weight gain as contributors to the development of chronic diseases in adults.
39. Developmental plasticity is the ability of the human body to alter its development in response to signals about its environment. The foetal origins hypothesis is that *in utero*, the foetus responds to undernutrition by adapting itself to the expected harsh environment by reducing its body size and altering its metabolism. It is thought that these adaptations, combined with rapid growth in childhood, may predispose individuals to chronic diseases in adults.<sup>85</sup> One such adaptation is to conserve energy for brain development, at the expense of other organs. Individuals who were small at birth have a reduced number of glomeruli

in their kidney,<sup>86</sup> which leads to increased blood flow through each glomerulus. Increased use of each glomerulus may cause a more rapid loss of glomeruli and lead to a self-perpetuating cycle of rising blood pressure and glomerular loss. Another example is the development of a “thrifty” metabolism. Insulin resistance is associated with low birth weight and may be a residual foetal adaptation to maintain blood glucose concentrations for brain development.<sup>87</sup> Rapid childhood weight gain in individuals born small is thought to exacerbate the ill effects of foetal undernutrition. A larger body size may increase the demands on organs that have a reduced capacity, such as glomeruli in the kidney. In addition, individuals born small have less muscle and if they develop a high BMI later in life it is likely to contain a higher proportion of fat mass, which leads to insulin resistance.<sup>88</sup>

40. Evidence is emerging in support of the foetal origins hypothesis, but it is as yet unproven. Moreover, there have been studies that suggest that adult lifestyle and biological risk markers are more important than early life factors in determining cardiovascular health.<sup>89</sup> As the foetal origins hypothesis does have long-term implications for adult health, it is important to continue to monitor developments in this area and review recommendations as necessary. Meanwhile, it seems prudent to continue with measures to prevent the development of childhood obesity and excessive fat gain in all children regardless of birth weight. Information on the prevention of obesity in childhood is mentioned in page 32.

### *Key recommendations*

1. Monitor growth of children and adolescents, as an indicator of dietary intake and nutritional status (Evidence level IV, Recommendation grade C).
2. Train children to eat sensibly by shaping their food preferences and eating patterns. Parents and caregivers should expose and familiarise their children to nutritious foods and be judicious in the use of food as rewards. Do not pay undue attention to food that children dislike, instead provide them with companionship during mealtimes, be role models of sensible eating and continue with the child’s nutrition education (Evidence levels Ib-III, Recommendation grades A, B).
3. The relevant authorities should regulate television advertising of food to children (Evidence level III, Recommendation grade C).

4. Prevent obesity in children and adolescents by promoting sensible eating and encouraging physical activity (Evidence level IV, Recommendation grade C).
5. Children and adolescents should accumulate at least 60 minutes of moderate-intensity physical activity on 5 or more days a week. This includes both structured and unstructured physical activity (Evidence level IV, Recommendation grade C).

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## LIMIT SATURATED FAT AND MODERATE TOTAL FAT INTAKE FOR CHILDREN AGED 2 YEARS AND OLDER

### *Dietary fat for children below 2 years of age*

1. Adults are advised to limit dietary fat intake to 25-30% of energy intake, saturated fat to 10% of energy intake, and cholesterol to 300 mg/day, to guard against obesity and cardiovascular disease.<sup>1,2</sup> Although there is concern that in children a high-fat diet is related to adiposity and the development of overweight and obesity, even when energy intake is not excessive,<sup>3</sup> the guideline on moderating fat intake for the adult population is not suitable for infants and toddlers below 2 years of age.
2. Fat is the nutrient that provides the most concentrated source of energy. During the first 2 years of life, a diet that is proportionately high in fat is best able to meet the child's high energy demands for rapid growth and development, especially when the small stomach volume limits food intake. In the first three months of life, growth and tissue replacement make up 35% of energy requirements, falling to 5% at twelve months, 3% in the second year of life and 1-2% until mid-adolescence and then negligible in late teens and onwards.<sup>4</sup>
3. Fat is also an essential source of fat-soluble vitamins (vitamins A, D, E, & K) and essential fatty acids (-6 or linoleic acid & -3 or -linolenic acid). Essential fatty acids are important for cell structure and function and for neurological development<sup>5</sup> which is particularly rapid during the first 2 years of life. The human body is unable to synthesise essential fatty acids, so these must be obtained through the diet.
4. Restriction of fat intake in children aged up to 2 years is not advisable because it may interfere with optimal energy intake and reduce the supply of essential nutrients, adversely affecting growth and development. Fat is also important for the myelination of the central nervous system, which is completed within the first few years of life. After the second year, a high-fat and energy-dense diet becomes less necessary as the growth rate slows down.

## ***Recommended fat intakes for children below 2 years of age (<25 months)***

5. The following recommendations are for children under 2 years of age:

### **Age 0 through 6 months**

In the first 6 months of life, fat should contribute about 50% of energy in the diet (Evidence level IV, Recommendation grade C). This recommendation is based on the fat content of breastmilk which contains approximately 50% of energy from fat.

### **Age 7 through 12 months**

After 6 months, the fat content of the diet should still come predominantly from milk (breastmilk, infant formula or follow-on milk). As other foods are introduced, a target of 40-50% dietary energy from fat is recommended (Evidence level IV, Recommendation grade C).

### **Age 1 through 2 years (<25 months)**

Growth rate slows after the first year of life. Since the toddler will be eating an increasing variety of foods, the recommended fat intake can be reduced to 35-40% of dietary energy (Evidence level IV, Recommendation grade C). The main sources of fat should continue to be milk and milk products because these are good sources of nutrients. Full-cream milk can be introduced after the first year of age (see chapter on Variety of Nutritious Foods, page 11). It is advisable not to introduce reduced-fat milk before 2 years of age.

6. No recommendation is made for saturated fat and cholesterol intake for children aged up to 2 years since the child's diet consists predominantly of milk, and the family's food selection and preparation do not contribute significantly to the saturated fat intake of the child.

## ***Dietary fat for children aged 2 years and above***

7. There is no data on the prevalence of overweight and obesity among Singaporean preschoolers, but the prevalence of obesity among children between 6-7 years of age has increased over the years (Ministry of Education, Singapore, unpublished). There are also no data on fat intake and disease-risk profiles of Singaporean children and adolescents but these would probably be largely similar to those of their Western counterparts, among whom there is a high prevalence of raised blood cholesterol concentrations, overweight and obesity.<sup>6-9</sup> National dietary studies conducted in developed countries such as the USA,<sup>10</sup> Canada,<sup>11</sup>

UK,<sup>12</sup> Australia,<sup>13</sup> and New Zealand<sup>14</sup> have found that children and adolescents aged 2-18 years obtain 33-37% of dietary energy from fat and 12-16% energy from saturated fat.

8. A high-fat diet is energy-dense and tends to increase total energy intake. Obese children are twice as likely as non-obese children to be obese adults.<sup>6</sup> In adults, obesity is a risk factor for ischaemic heart disease. So is a high intake of saturated fat, a high serum total cholesterol and low-density-lipid cholesterol. In adults, lowering of serum cholesterol level reduces the risk of ischaemic heart disease (Evidence level Ia).<sup>6,15-17</sup> Although dietary modification in childhood to reduce fat, saturated fat, and cholesterol intakes can improve children's serum cholesterol profiles to some extent,<sup>18-20</sup> there are no studies showing that a low-fat diet in childhood or adolescence, or that lowering of serum cholesterol during this time, reduces the risk of cardiovascular disease in adulthood.
9. However, since there is little doubt that the atherosclerotic process starts in childhood<sup>21-24</sup> it seems prudent to minimise the known risk factors for ischaemic heart disease in adults as early as possible. In addition, since dietary habits and food preferences are formed early in life, modification of fat intake in childhood might be maintained in adulthood.
10. Dietary modification in childhood becomes even more justified if the modifications produce no adverse effects. There have been concerns that a low-fat diet might cause some nutritional inadequacy and growth retardation,<sup>25</sup> or that it might have potential psychological effects, due to an association between depression and an increased number of deaths in some cholesterol-lowering trials in adults.<sup>26</sup> However, the Special Turku Coronary Risk Factor Intervention Project for Babies (STRIP) study,<sup>19</sup> which introduced a low-fat diet to babies from age 7 months until the first few years of life, and Dietary Intervention Study in Children (DISC),<sup>27,28</sup> which restricted fat in children aged 8-10 years over a period of 3 years, found that adequate growth, iron stores, nutritional adequacy, and psychological well-being were maintained during the critical growth period (Evidence level Ib).
11. These trends have prompted Australia, for example, to recommend that fat intake be reduced from 35-40% of dietary energy to 30% for children aged 2-14 years (from the previous level of 35-40% for those aged 2-5 and from 35% for those aged 5-14).<sup>29</sup> Other developed countries, such as the USA,<sup>9</sup> Canada,<sup>30</sup> UK,<sup>31</sup> and New Zealand<sup>32</sup> have also recommended reductions in fat intake to 30% or 30-35 % for individuals aged 2 years onwards.

12. For saturated fat, the USA,<sup>9</sup> Australia,<sup>29</sup> and Canada,<sup>30</sup> recommend a restriction to no more than 10% of total calories from the age of 2 years, but the UK<sup>31</sup> and New Zealand<sup>32</sup> recommend a restriction from the age of 1 year and 5 years, respectively.

## ***Recommended fat intakes for Singaporean children aged 2 years and above***

### **Total fat**

13. From the age of 2 years, the child should gradually adopt a diet with a fat content as that recommended for adults – for e.g. 25-30% of dietary energy (Evidence level IV, Recommendation grade C). A lower limit is set to guard against the danger of overzealousness in reducing fat intake. At the 15-20% range of fat intake, there should be no deficiencies of the fat-associated nutritional factors.<sup>33</sup>

### **Fat subtypes**

14. Less than 10% of total calories should come from saturated fat, less than 1% from trans fat, up to 10% from polyunsaturated fat, and the rest from monounsaturated fat (Evidence level IV, grade C). Trans fat tends to behave like saturated fat in the body, raising total blood and LDL cholesterol, and reducing HDL cholesterol. Polyunsaturated fat tends to lower total, LDL-, and HDL-cholesterols, whereas monounsaturated fat tends to reduce total and LDL-cholesterols but increases HDL-cholesterol.

### **Cholesterol**

15. Dietary cholesterol is not essential for growth and development since the human body is capable of synthesising sufficient cholesterol for all its metabolic needs, but an excessive intake of cholesterol, especially when it is consumed as part of a diet that is high in total saturated fat will lead to high blood cholesterol levels.<sup>33</sup> Hence, as with total and saturated fat, it is advisable to limit cholesterol intake from the age of 2 years, to 300 mg/day, as for adults (Evidence level IV, Recommendation grade C).

## ***Key recommendations***

1. For children aged 0 through 6 months, fat should contribute about 50% of energy in the diet (Evidence level IV, Recommendation grade C).
2. For children aged 7 through 12 months, dietary fat should come predominantly from milk, and it should make up 40-50% of total energy (Evidence level IV, Recommendation grade C).

3. Children 1 to less than 2 years of age should have 35-40% of dietary energy from fat. The main sources of fat should continue to be milk and milk products because these are good sources of nutrients (Evidence level IV, Recommendation grade C).
4. For children aged 2 years and above, the dietary fat recommendations are the same as for adults – for e.g. dietary fat should be limited to 25-30% of total energy, with less than 10% of total calories coming from saturated fat, less than 1% from trans fat, up to 10% from polyunsaturated fat, and the rest from monounsaturated fat. Cholesterol intake should be limited to less than 300 mg/day (Evidence level IV, Recommendation grade C).

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## ENCOURAGE EATING FRUIT AND VEGETABLES EVERY DAY

### *Introduction*

1. Children are unable to eat as much food as adults, but relative to body weight, their nutritional requirements are higher than those of adults.<sup>1</sup> The transition from childhood to adolescence is usually characterised by increased consumption of high-sugar, low-nutrient foods and beverages.<sup>2</sup> Since fruit and vegetables are rich in nutrients (e.g. vitamin C, potassium, folate) and phytochemicals (e.g. carotenoids, lycopenes, isothiocyanates), they play an important role in improving the nutrient density of the diets of children and adolescents.
2. Cancer, heart disease, and stroke are principle causes of death in Singapore, accounting for almost 60% of all deaths in 2004<sup>3</sup> and research evidence is generally consistent with increased consumption of fruit and vegetables having a protective effect on these diseases.<sup>4,5</sup> The protective effect is probably mediated through a combination of mechanisms. Fruit and vegetables provide nutrients and phytochemicals that may possess anti-carcinogenic properties to reduce cellular DNA mutations or improve cardiovascular risk factors such as blood pressure and hyperlipidemia. Consumption of fruit and vegetables may also lead to a reduced intake of foods rich in refined carbohydrates, fat, saturated fat, and cholesterol.
3. Since childhood exposure to dietary factors can influence adult susceptibility to disease,<sup>6</sup> healthy eating should be encouraged in children, especially since dietary habits are formed at an early age, even below the age of 5 years.<sup>7,8</sup> In Singapore, a study of more than 700 Chinese adults showed that those who were consuming the recommended number of servings of fruit and vegetables or who were attempting to consume more fruit and vegetables were three times more likely to have cultivated a habit of eating fruit and vegetables during childhood.<sup>9</sup> Encouragement to eat fruit and vegetables should continue during adolescence as consumption of fruit and vegetables usually declines during this stage of growth.<sup>2,10</sup>
4. The vegetable food group includes all fresh, frozen and well-drained canned vegetables, with the exception of legumes (e.g. soy beans) and starchy tubers (e.g. potato, yam). The fruit food group includes fresh,

frozen, well-drained canned (in natural juice only), pureed, or dried fruit. 100% fruit juice also counts as part of the fruit group.

## *Evidence for benefits of fruit and vegetable consumption*

### *Cardiovascular disease*

5. In 1997, a systematic review of 29 studies reported protective effects of fruit and vegetable consumption for stroke and for coronary heart disease (Evidence level III).<sup>4</sup> More recently, the Women's Health Study, a large prospective cohort study, observed inverse associations between fruit and vegetable consumption and risk of cardiovascular disease in women (Evidence level III).<sup>11</sup> Other studies too have reported the benefits of consuming fruit and vegetables for cardiovascular disease. Pooled analyses of the Nurses' Health Study and the Health Professionals' Follow-up Study have indicated that consumption of fruit and vegetables can protect against coronary heart disease (Evidence level III)<sup>12</sup> and a meta-analysis of 8 cohort studies showed that increased consumption of fruit and vegetables was able to reduce the risk of stroke (Evidence level III)<sup>13</sup> in both men and women, and the DASH clinical trial showed a benefit for lowering blood pressure in both individuals with normal and elevated ranges of blood pressure (Evidence level Ib).<sup>14</sup>
6. Although there is no clear link between consumption of fruit and vegetables in childhood and heart health later in life, consumption of fruit and vegetables in childhood has some influence on the cardiovascular-health quality of the adult diet (Evidence level III).<sup>15</sup>
7. Fruit and vegetables are rich in antioxidant, phytochemicals and vitamins (e.g. beta-carotene and vitamin E), folate and potassium, factors suggested to be cardio-protective.<sup>16-19</sup> Dietary folate possibly lowers blood levels of homocysteine (a risk factor for coronary heart disease)<sup>20,21</sup> and potassium intake has been inversely linked with blood pressure in normotensive subjects.<sup>17</sup> However, trials using beta-carotene and vitamin E supplementations had found no protective effect against cardiovascular outcomes in generally healthy or high risk individuals (Evidence level Ib).<sup>22,23</sup> It is plausible that fruit and vegetables might exert their protective effect through a combination of bioactive components rather than through individual components.<sup>24</sup>

## Cancer

8. An adequate intake of fruit during childhood may have a long-term protective effect on cancer risk in adults. In a cohort study in which nearly 4000 individuals were followed-up for more than 60 years, childhood intake of fruit and vegetables were inversely associated with risk of cancer in adulthood (Evidence level III).<sup>25</sup> Reviews conducted by expert panels of the World Cancer Research Fund and American Institute for Cancer Research,<sup>26</sup> and the World Health Organization International Agency for Cancer Research on Cancer<sup>27</sup> provided key evidence that dietary protection against cancer is strongest and most consistent for diets high in fruit and vegetables. Much of this evidence is based on case-control studies<sup>5</sup> (Evidence level III) and, to a lesser extent, longitudinal studies<sup>28</sup> (Evidence level III).
9. The protective effect of fruit and vegetables has been noted especially in relation to cancers of the gastrointestinal tract (i.e. cancers of the oral cavity, oesophagus, stomach, colon and rectum) and lung. The World Health Organization expert panel has estimated that low fruit and vegetable intake contributes to 5 to 12 percent of all cancers and up to 20 to 30 percent of gastrointestinal cancers that may otherwise be preventable.<sup>27</sup> In Singapore, a low intake of vegetables is associated with an increased risk of colorectal cancer in Chinese adults (Evidence level III).<sup>29</sup>
10. Proposed protective mechanisms include reduced formation and neutralisation of cancer-promoting substances and inhibition of growth of cancer cells by the phytochemical components in fruit and vegetables.<sup>5,26</sup> In addition, fruit and vegetables provide fibre which helps decrease gut transit time and bind potential carcinogenic agents such as secondary bile acids and short-chain fatty acids.<sup>26</sup>

## Weight status

11. Fruit and vegetables have a high water and fibre content, and are low in energy for a given measure of food. As these foods promote satiety and decrease energy intake, it is plausible that they might prevent weight gain and facilitate weight loss, within the context of a reduced calorie diet.
12. Available data, mainly from cross-sectional observational studies (Evidence level III) and several trials (Evidence level IIb), suggest that increased consumption of fruit and vegetables may be a useful component of programmes designed to achieve and sustain weight

loss.<sup>30</sup> However, there are limited data that increased consumption of fruit and vegetables prevents weight gain in the first place. A large prospective study assessed the effects of fruit and vegetable intake on changes in Body Mass Index (BMI) among children aged 9 to 14 years. Neither fruit nor fruit juices predicted changes in BMI. The inverse relationship between vegetable intake and BMI change was not statistically significant once adjusted for total calories suggesting that the protective effect of vegetable was mediated through reduced calorie intake.<sup>31</sup>

### **Bone health**

13. Bone Mineral Density (BMD) is an important determinant of risk of osteoporosis later in life and accrual is mostly complete by late adolescence.<sup>32</sup> High intakes of fruit were associated with increased heel BMD in 12-year-old girls (Evidence level III),<sup>33</sup> and a Canadian longitudinal study observed that girls consuming five or more servings of fruit and vegetables per day throughout adolescence gained bone mineral at a greater rate than those who consumed less, but no similar relationship was shown for boys (Evidence level III).<sup>34</sup> Results from a recent cross-sectional study also indicate a positive association between fruit and vegetable intake and bone mineral status in adolescent boys and girls aged 16-18 years.<sup>35</sup>
14. The beneficial effect of fruit and vegetables on BMD is possibly due to the alkaline-forming properties of nutrients such as potassium and magnesium.<sup>36</sup> A diet rich in alkaline salts reduces bone resorption and improves calcium balance by neutralising the acidic metabolites produced from dietary protein so that there is little need for release of alkaline calcium salts from the bone.

### **Intakes of fruit and vegetables**

15. A recent report on fruit and vegetable intakes showed a worldwide trend of children and adolescents eating less than the recommended number of daily servings.<sup>36</sup> National dietary studies conducted in the USA<sup>37</sup> and Australia<sup>38</sup> yielded similar findings. Sixty-five percent of American children and adolescents aged 2-19 years did not consume the recommended number of servings of fruit, and 77% did not consume the recommended number of servings of vegetables. Fewer than 50% of Australian children aged 2-11 years and fewer than 25% of adolescents aged 12-18 years had an adequate fruit intake, and only one-third of children and adolescents met the recommendations for vegetable intake. Data from the 2007 Student

Health Survey reported that 34% of students aged 12-18 years consumed 2 or more servings of fruit a day and 51% consumed 2 or more servings of vegetables a day. Twenty-four percent met the recommendation of 2 servings of fruit and 2 servings of vegetables per day.

### ***Recommended fruit and vegetable intakes***

16. The USA,<sup>30</sup> Canada,<sup>39</sup> and Australia<sup>40</sup> recommend that children and adolescents consume around 5-10 servings of fruit and vegetables daily. Younger children (2-7 years) should meet the lower end of the range, while adolescent boys (12-18 years) should eat around 10 servings daily. This is equivalent to 400 to 800g of fruit and vegetables per day. The UK<sup>41</sup> recommends 5 servings of fruit and vegetables for children (aged 5 years and above) and adolescents, or 400g of fruit and vegetables per day. Similarly, New Zealand<sup>1</sup> recommends 5 servings of fruit and vegetables (equivalent to at least 400g) for school-going children. For pre-schoolers, New Zealand recommends 3-4 servings or about 200-300g of fruit and vegetables. The World Health Organization recommends an intake of 400-500g of fruit and vegetables per day for the general population.<sup>42</sup>
17. In Singapore, the recommendations (Recommendation grade C) are as follows:

#### **Age 7 through 12 months**

Some fruit and vegetables can be introduced in the diet of weanlings aged 7 through 12 months. Children in this age group should gradually increase their intake of fruit and vegetables up to ½ serving of fruit and ½ serving of vegetables a day. This can be provided daily in pureed, mashed, or semi-solid form. Solid fruit and vegetables eaten by the rest of the family may be given by the age of 12 months. Foods given should be cut into small and manageable pieces and foods that may cause choking (e.g. items that have a shape and/or consistency that may cause them to become lodged in the trachea, such as whole grapes or raw carrots) should be avoided.

#### **Age 1 through 2 years**

Toddlers aged 1 through 2 years should not be given overly large quantities of fruit and vegetables. They have small stomach capacities and have high energy requirements per kilogram body weight than older children. Fruit and vegetables tend to be bulky and may prevent these children from achieving an optimum energy intake. Provide ½ to 1 serving of fruit and

½ a serving of vegetables per day to cultivate a habit of eating a variety of fruit and vegetables.

### **Age 3 through 6 years**

Children aged 3 through 6 years should gradually increase their intake to that closer to adults. It is recommended that they consume 1 serving of fruit and 1 serving of vegetables per day.

### **Age 7 through 12 years and 13 through 18 years**

Older children and adolescents should adopt the same fruit and vegetable recommendation as that for adults, which is 2 servings of fruit and 2 servings of vegetables a day.

18. The differences between recommendations in different countries are mainly due to the varying definitions for vegetables and serving sizes. In most countries, the vegetable serving sizes are generally smaller<sup>1,30,39-41</sup> than those in Singapore, and potatoes,<sup>1,39</sup> legumes,<sup>41</sup> or both<sup>30,40</sup> may be considered as vegetables.
19. Unsweetened fruit juice can be provided as an alternative to fruit. A cup of 100% fruit juice (250ml) may count as a serving of fruit. For older children, juice should not replace more than 1 serving of fruit a day<sup>43</sup> (Evidence level IV, Recommendation grade C). Fruit juice lacks fibre and may contribute to substantial energy intake if consumed in large quantities. For infants and toddlers, about 50 to 100ml of juice may be given per day to replace part of the fruit recommendation<sup>43</sup> (Evidence level IV, Recommendation grade C).

### ***Importance of including a variety of fruit and vegetables***

20. Specific types of fruit and vegetables have been associated with specific health benefits. For example, lycopene in tomato products, and cruciferous vegetables (e.g. broccoli and cabbage) have been associated with reduced risk of prostate and bladder cancer respectively,<sup>44,45</sup> while folate in green leafy vegetables and potassium in dried fruit are known to reduce the risk of cardiovascular disease.<sup>16,46</sup> More recently, it has been demonstrated that different areas of the brain, age at different rates<sup>47</sup>, and that in animal models, compounds from different fruit and vegetables appear to have varying protective effects on different parts of the brain. For example, the phenolic compounds in strawberry and blueberry exert their protective effects predominantly in the hippocampus and striatum

respectively.<sup>48</sup> Hence, consumption of a variety of fruit and vegetables is probably necessary for the maximum health promoting effect.

21. It is advisable to include half of the recommended amounts of fruit and vegetables in the form of brightly-coloured fruit and vegetables, and dark green leafy vegetables (Evidence level IV, Recommendation grade C).<sup>49</sup> These varieties of fruit and vegetables generally contain higher levels of nutrients and phytochemicals than their pale-coloured counterparts.

### *Key recommendations*

1. Children can start to consume some fruit and vegetables from the age of 7 months, and the quantity should be increased gradually so that by the age 12 years they are taking the amount as recommended for adults (Evidence level IV, Recommendation grade C).
2. 100% unsweetened fruit juice may count towards the daily servings of fruit. For infants and toddlers, about 50 to 100ml of juice may be given per day to replace part of the fruit recommendation. For older children, juice should not replace more than 1 serving of fruit a day (Evidence level IV, Recommendation grade C).
3. Brightly-coloured fruit and vegetables, and dark green leafy vegetables should contribute half of all fruit and vegetables consumed (Evidence level IV, Recommendation grade C).

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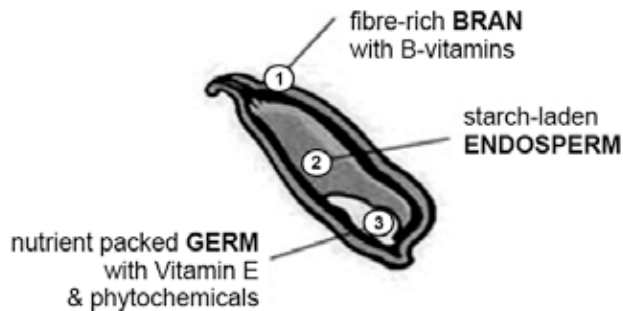
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## ENCOURAGE EATING OF WHOLE-GRAIN FOODS

### *Introduction*

1. Commonly eaten grains include rice, wheat, maize, oats, corn, and barley. Nutritionally, grains and grain products are good sources of carbohydrates (starch), dietary fibre, and are low in fat unless fat is added during processing, preparation or at the table. They are also good sources of B vitamins and vitamin E.<sup>1</sup>
2. Whole-grain consist of the entire grain seed, usually called the kernel, is made up of three components, namely the endosperm, the germ, and the bran (see diagram). During the process of refining, most of the bran and some of the germ is removed, with consequent loss of dietary fibre, vitamins, minerals, and beneficial phytochemicals. Hence, whole-grains and their products contain more vitamins, minerals, dietary fibre and phytochemicals than do refined-grain products. Examples of food rich in whole-grain include oats, brown rice, and wholemeal/whole wheat noodles, bread, and breakfast cereals.



3. Consumption of whole-grain foods is associated with reduced risk of chronic diseases such as cardiovascular disease and diabetes.<sup>2,3</sup> Constituents such as fibre, vitamin E and certain phytochemicals are believed to be beneficial,<sup>4</sup> but it appears that whole-grain consumption is protective beyond what would be predicted from the sum of its parts.<sup>5</sup>

4. Although chronic diseases are unlikely to manifest themselves in childhood, exposure to slow-acting environmental influences during childhood may influence susceptibility of adults to diseases.<sup>6</sup> Hence healthy eating should be encouraged in children, especially since dietary habits are formed at an early age, even below the age of 5 years,<sup>7</sup> and are becoming more difficult to change after the age of 11 to 18 years.<sup>8</sup>
5. Until recently, there has been little guidance on what is considered appropriate for food label statements related to “whole-grain” content. In a recently released draft guidance, the US Food and Drug Administration (FDA) clarifies that the agency considers “whole-grain” to include “cereal grains that consist of the intact, ground, cracked or flaked fruit of the grains whose principal components - the starchy endosperm, germ and bran - are present in the same relative proportions as they exist in the intact grain.”<sup>9</sup> Similar definition has been adopted by the Food Standards Australia & New Zealand.<sup>10</sup> The FDA also requires foods that claim to be a source of whole-grain to contain 51% or more whole-grain ingredients by weight per reference amount and be low in fat.<sup>11</sup>
6. In Singapore, the Food Regulations have a definition for only “wholemeal”. To be labelled “wholemeal”, the food product has to contain a specified level of fibre and have the amount of wholemeal flour in it declared.<sup>12</sup>

## *Evidence for benefits of whole-grain consumption*

### *Cardiovascular disease*

7. Epidemiological studies suggest that consumption of whole-grain foods in adults has a protective effect against coronary heart disease (CHD). In 2000, a meta-analysis of 12 prospective studies (including the Nurses’ Health Study and the Iowa Women’s Health Study) concluded that regular intake of whole-grain foods was associated with a 26% reduction in risk for CHD.<sup>13</sup> More recent reports from the Health Professionals’ Follow-up Study<sup>14</sup> and the Atherosclerosis Risk in Communities (ARIC) Study<sup>15</sup> also indicated a beneficial association between intake of whole-grain foods and CHD. Intake of whole-grain bread<sup>2</sup> and breakfast cereals with high whole-grain content<sup>16</sup> have also been associated with a reduced risk of CHD (Evidence level III).
8. The association between whole-grain intake and the risk of stroke is less clear. Data from the Nurses’ Health Study indicate that, in women, a higher intake of whole-grain foods is associated with a lower risk of ischaemic

stroke,<sup>17</sup> whereas the ARIC study did not find an association between whole-grain intake and risk of ischaemic stroke (Evidence level III).<sup>15</sup>

9. Because dietary fibre is an important component of whole-grains, a number of studies have evaluated the relationship between fibre intake and risk of CHD. Studies on dietary fibre intake show that a high intake of cereal fibre is inversely related to the risk of CHD<sup>18-20</sup> and total stroke.<sup>21</sup> Fibre from fruit or vegetables did not have the same protective effect (Evidence level III).<sup>18-21</sup>
10. In addition to dietary fibre, whole-grain foods also contain vitamin E, selenium and other bioactive compounds (e.g. lignans, phytosterols), which are known to individually reduce the risk of CHD.<sup>22</sup> The protective effect of whole-grains is difficult to differentiate from that of its constituents, but it seems that whole-grain consumption is more protective against CHD than would be expected by combining the effect of individual constituents.<sup>5</sup> It is possible that the constituents have a synergistic effect, or that some components, such as cereal bran, bran oil, or oat fibre<sup>20,23-24</sup> exert a dominant effect.

## **Cancer**

11. Case-control studies suggest that a high whole-grain intake protects against cancer in adulthood,<sup>25,26</sup> but the evidence from large prospective studies is unclear.<sup>2,3</sup> A meta-analysis of 40 case-control studies by Jacobs *et al* gave a pooled odds ratio of 0.66 for high versus low intakes of whole-grains.<sup>25</sup> Another meta-analysis, of hospital-based case-control studies from the Greater Milan area, and part of Pordenone province in Italy, showed the frequency of consumption of whole-grain foods was inversely related to cancer risk reported, most notably cancer of the upper digestive tract and the colon. The odds ratio for the highest category of intake compared with the lowest category being 0.3-0.5 for upper digestive tract, respiratory neoplasms, and colon.<sup>26</sup> Data from prospective cohort studies in the USA and Norway show that intake of whole-grain foods is inversely associated with death from all cancers, but the trend became non-significant after adjustment for other risk factors (Evidence level III).<sup>2,3</sup>
12. The evidence on dietary fibre intake and colorectal cancer is likewise inconclusive. Case-control studies<sup>25</sup> support the protective effect of dietary fibre, but evidence from prospective cohort studies is inconsistent, and randomised controlled intervention studies have not shown a positive effect.<sup>27</sup> The Nurses' Health Study and the Physician's

Follow-Up Study<sup>28</sup> did not show that dietary fibre intake has any protective effect against colorectal cancer, but this thinking was challenged by a report from the European Prospective Investigation into Cancer and Nutrition (EPIC) consortium (Evidence level III).<sup>29</sup> The EPIC study had the advantage of a much wider range of dietary fibre intakes, which increased the likelihood of detecting a protective effect.<sup>30</sup> The discrepancy in findings could also be due to the differences in measuring dietary fibre, or the possibility that dietary fibre is just a marker for intake of plant foods.<sup>30</sup> There is little established evidence that fibre intake protects against breast cancer,<sup>27</sup> but a nested case-control study from the Nurses' Health Study cohort suggests that a higher intake of fibre during adolescence is associated with a reduced risk of breast cancer in adulthood (Evidence level III).<sup>31</sup>

13. Whole-grains contain many components that have been linked to reduced risks of cancer. These components include fibre (which decreases colon transit time and aids production of short-chain fatty acids), antioxidant nutrients (which give antioxidant protection to body cells), and lignans (which act as phyto-oestrogens). In addition, intake of whole-grains is linked to a reduced risk of type 2 diabetes, and data from the Nurses' Health Study suggest that diabetes is associated with an increased risk of colorectal cancer in women.<sup>32</sup> Alternatively, whole-grain intake may simply be indicative of a reduced intake of refined grains and grain products, consumption of which has been associated with risk of several cancers.<sup>33</sup>

### **Diabetes**

14. Consumption of whole-grain foods is inversely related to the risk of type 2 diabetes in adults. Several large prospective studies show an association between a high intake of whole-grain foods and a 20-30% reduction in type 2 diabetes (Evidence level III).<sup>34-37</sup> The rate of childhood type 2 diabetes is increasing.<sup>38-41</sup> Type 2 diabetes is the leading cause of childhood diabetes in Taiwan<sup>40</sup> and is emerging as a problem in Singapore.<sup>42</sup> Obesity and insulin resistance are known risk factors for type 2 diabetes in children.<sup>39,40</sup> A high intake of whole-grain foods is known to improve insulin sensitivity in both adults<sup>43</sup> and children (Evidence level III),<sup>44</sup> possibly through the reduced Glycaemic Index (GI) of a diet high in whole-grains and the resultant decreased rate of glucose uptake.<sup>22</sup>

## Weight status

15. Several large prospective studies have revealed associations between the consumption of whole-grain foods and reduced body weight,<sup>45-46</sup> lower long-term weight gain,<sup>14</sup> and more favourable Body-Mass Index (BMI),<sup>47</sup> fat distribution<sup>46</sup> and waist-to-hip ratio<sup>47</sup> in adults. Whole-grain intake is also associated with lower BMI and waist circumference in adolescents.<sup>44</sup> Whole-grain food consumption generally improves insulin sensitivity, which provides indirect support for the role of whole-grains in body-weight regulation. McKeown *et al*<sup>47</sup> reported that whole-grain intake was inversely related to fasting insulin levels in the Framingham Offspring Study, and Fung *et al*<sup>48</sup> reported that a “prudent” diet, characterised by higher intakes of fruit, vegetables, whole-grains, and poultry, was inversely related to fasting insulin levels (a biomarker of obesity risk) in a sub-sample of the Health Professionals Follow-Up Study (Evidence level III).
16. Whole-grain foods contain dietary fibre and antioxidants that may help to regulate body weight by affecting hormonal factors, satiation and satiety.<sup>49</sup> Dietary fibre reduces the Glycaemic Index (GI) of foods.<sup>50</sup> A low-GI meal has been shown to prolong satiety and reduce caloric intake in both pre-adolescent children<sup>51</sup> and obese adolescents.<sup>52</sup> Conversely, a diet with a high GI, independent of caloric intake, lead to postprandial hyperinsulinaemia and could lead to paediatric obesity.<sup>53</sup> Dietary fibre is also known to provide bulk and reduce the energy density of a meal.<sup>54</sup> Consumption of high energy density foods is a known risk factor for the development of obesity<sup>55</sup> and low energy density meals are known to promote satiety, reduce hunger, and decrease energy intake.<sup>56</sup> In addition, whole-grain foods contain antioxidants that may also contribute to and increase in insulin sensitivity by protecting against oxidative stress,<sup>57</sup> which has been associated with reduced insulin-dependent glucose disposal and diabetic complications.<sup>58</sup>

## Intakes of grain and whole-grain foods

17. In the USA, children and adolescents eat sufficient amounts of grain foods, but consume only less than half the recommended amount of whole-grains, with ready-to-eat cereals, corn, and other chips, and yeast breads being the major sources of whole-grains.<sup>59</sup> In the UK, a national survey of children and adolescents aged 4 through 18 years showed that median intake of whole-grains was 7g a day, and that 27% of them did not consume any foods with  $\geq 10\%$  whole-grain content, while around

40% of them did not consume any foods containing  $\geq 51\%$  whole-grain content.<sup>60</sup> There are no data for the amount of grain foods eaten by children and adolescents in Singapore.

### ***Recommended grain and whole-grain food intakes***

18. The USA<sup>61</sup> recommends that children and adolescents should eat 3-6 servings of grain foods a day, while Canada<sup>62</sup> recommends 3-7 servings of grain foods a day. One US or Canadian adult-sized serving is approximately the same size as that in Singapore.<sup>63</sup>
19. The USA recommends a daily intake of 3 ounces (about 90g) of whole-grains per day.<sup>61</sup> This level of whole-grain intake can be achieved by eating half of all grain foods as whole-grain foods.<sup>61</sup> A slice of whole wheat bread contains about 15g of whole-grain, a bowl of cooked brown rice contains about 50g of whole-grain and a 30g portion of bran flakes contains about 12g of whole-grain.<sup>14</sup> According to a recent report on the Health Professionals Follow-Up Study,<sup>14</sup> the beneficial effects for whole-grain consumption are greatest for a daily whole-grain intake above approximately 30g. Canada and the US encourage people of all ages to eat half their grain products whole-grain.<sup>64,65</sup>
20. New Zealand<sup>66,67</sup> recommends that children (2-12 years of age) should eat at least four servings of grain foods every day, adolescents should eat at least six servings every day, and both should “try some whole-grain varieties”. Their serving sizes are similar to those in Singapore. Australia<sup>68</sup> recommends that children and adolescents eat 3-11 servings, with younger children (aged 4-7 years) eating a maximum of 7 servings, and adolescents up to 11 servings. These cereal foods should be “preferably whole-grain”. One Australian serving size is twice of that in Singapore.
21. In Singapore, recommendations (Recommendation grade C) are as follows:

#### **Age 7 through 12 months**

Weaning children should be given 1-2 servings of grain foods a day. Care providers can start to introduce some whole-grain foods. Grain foods should initially be given in a soft form (e.g. rice gruel), progressing to harder foods as the child matures. Iron-enriched infant rice cereal may be used as the first solid food.

#### **Age 1 through 2 years**

Toddlers aged 1 through 2 years should eat 2-3 servings of grain foods every day. The amount of whole-grain food given can be  $\frac{1}{2}$  serving a day.

### Age 3 through 6 years

Children aged 3 through 6 years should gradually increase their intake to those closer to that of adults. It is recommended that they consume 3-4 servings of grain foods every day, of which ½-1 serving should be whole-grain.

### Age 7 through 12 years and 13 through 18 years

Older children and adolescents should adopt the same grain recommendation (5-7 servings of Rice and Alternatives) as adults. Children aged 7 through 12 years should eat the lower end of the range, while adolescents aged 13 through 18 years may eat from the higher end of the range. Of these, at least 1 serving should comprise whole-grain foods.

**Table 1: Recommended servings of grain and whole-grain foods in various countries**

Country	Age Group (years)	Recommended intake of grain foods (servings)	Recommended intake of whole-grain foods (servings)	Recommended intake of whole-grains (g)	
US	2-3	3 <sup>a</sup>	1.5	45	
	4-8	4-5	2-2.5	60-75	
	9-13	M	6	3	90
	9-13	F	5	3	90
	14-18	M	7	3.5	105
	14-18	F	6	3	90
Canada	2-18	5-12 <sup>b</sup>	“Choose whole-grain and enriched products more often”	NA <sup>d</sup>	
New Zealand	2-12	≥4 <sup>a</sup>	“Try some whole-grain varieties”	NA	
	Adolescents	≥6		NA	
Australia	4-7	5-7 <sup>c</sup> 3-4	Cereal foods should “preferably be whole-grain”	NA	
	8-11	6-9 4-6		NA	
	12-18	5-11 4-7		NA	
Singapore	7-12 months	1-2	“Introduce whole-grains”	NA	
	1-2	2-3	½	15-30	
	3-6	3-4	½-1	30	
	7-12	5-7	≥1	≥30	
	13-18	5-7	≥1	≥30	

<sup>a</sup> Serving sizes are similar to those in Singapore.<sup>64,66-67</sup>

<sup>b</sup> Canada’s adult-sized servings are similar to those in Singapore, but a child-sized serving for preschool children is half an adult-sized serving.<sup>62-63</sup>

<sup>c</sup> Australian serving sizes are generally twice that in Singapore. Australian guidelines have two levels of recommendations – the top row includes a relatively large amount of cereals, while the bottom row includes less cereal servings to allow for more of the other food groups.<sup>68</sup>

<sup>d</sup>Not Available

### ***Safety concerns***

22. There are concerns that a high intake of fibre during infancy and childhood will decrease overall energy intake and reduce the bioavailability of micronutrients, leading to problems in growth.<sup>69</sup> Research so far indicates that there is no significant reduction in overall energy intake in children with a high intake of dietary fibre.<sup>70</sup> A reduction in energy intake may in fact be beneficial for children who usually consume an energy-dense diet high in refined grain foods.<sup>71</sup> A high-fibre, low-fat diet does not adversely affect energy and nutrient intakes in adolescents.<sup>72</sup> Studies on mineral absorption have concluded that an acute decrease in mineral bioavailability would result in a physiologically increased rate of absorption. The American Health Foundation has concluded that a safe range of fibre intake for children more than 2 years of age can be estimated using the formula [(age + 5) to (age + 10)] g/day.<sup>73</sup> Singapore's recommendations for fibre-rich foods are consistent with this guideline.

### ***Key recommendations***

1. Children from 7 months of age should be started on grain foods, with the amount being increased gradually such that by age 7 through 12 years, they are taking from the lower end of the range recommended for adults and at 13 through 18 years, they are taking from the higher end of the range (Evidence level IV, Recommendation grade C).
2. Whole-grain foods should be included in the diets of children aged 1 year and above (Evidence level IV, Recommendation grade C).

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## ENCOURAGE CONSUMPTION OF CALCIUM-RICH FOODS EVERY DAY

### *Introduction*

1. An adequate intake of calcium is one of several factors that have been associated with increased accumulation of bone mass during periods of growth.<sup>1</sup> Accrual of bone mass is greatest during adolescence (the maximum calcium-accretion rate of bone is estimated to occur at 12.5 years of age for girls and 14 years of age for boys<sup>2</sup>), and individuals attain their peak (maximal) bone mass before the age of 30 years, after which bone mass gradually declines.<sup>3</sup> Building a good bone mass is important as evidence suggests that having a good peak bone mass may reduce the risk of osteoporosis and related fractures later in life.<sup>4</sup> Thus, it is important that adolescents consume an adequate amount of calcium and develop habits that enable them to achieve and maintain a good peak bone mass, such as the regular consumption of calcium-rich foods.
2. The majority of studies on calcium-rich foods have focused on the intake of milk and other dairy products. Milk and other dairy products are good sources of calcium and other nutrients, including potassium, magnesium, vitamin D and vitamin A.<sup>2</sup> Consumption of milk has been associated with adequate intake of calcium as well as most micronutrients.<sup>5</sup> Encouraging the consumption of milk and other dairy products throughout childhood and adolescence is important in Singapore because milk and other dairy products are the main dietary source of calcium among adults.<sup>6</sup> In addition, milk and calcium intakes have been shown to continue from childhood to adulthood, meaning that individuals who consume milk regularly as children are more likely to do so as adults.<sup>7</sup> Continuing regular milk consumption beyond infancy into childhood is also believed to help reduce the likelihood of symptoms related to lactose intolerance.<sup>8</sup>
3. Current evidence indicates that non-dairy, calcium-rich foods are also good sources of calcium and contribute to good bone health, though the data available are less than for milk and dairy products.<sup>9</sup> Dark green leafy vegetables (e.g. *kai lan*, *chye sim*), fish with edible bones, calcium-fortified products (e.g. calcium-fortified soybean milk and cereals), and tofu (which is set with calcium) are good non-dairy sources of calcium.

## *Evidence for benefits of consuming calcium-rich foods*

### **Bone health**

4. Research, mainly on milk and dairy products, has indicated that intake of calcium-rich foods is one of several factors associated with better bone health. A review (Evidence level IV) on dairy intake and skeletal status found that in 7 of 7 randomised, controlled trials and 25 of 34 observational studies, the intake of milk and dairy products was positively related to bone mineral content or bone mineral density in one or more skeletal sites. Of the studies, 2 out of 2 randomised, controlled trials and 5 of 7 observational studies that were conducted in children and adolescents support the role of milk and dairy products in promoting bone health.<sup>10</sup> This association has also been found among Chinese adolescents (Evidence level III).<sup>11</sup> Population studies from the USA also indicate that intake of milk and dairy products during childhood and adolescence is important for bone health. Analysis of the 3<sup>rd</sup> National Health and Nutrition Examination Survey (NHANES III) showed that among white women, low milk intake in childhood and adolescence was associated with a lower hip bone mass and a greater risk of hip fractures in adulthood (Evidence level III).<sup>12</sup> However, racial differences may affect the benefits of early milk consumption on bone health as this association is not found among black women surveyed in the NHANES III (Evidence level III).<sup>13</sup>
5. Non-dairy food sources of calcium and calcium supplements appear to be suitable alternatives for milk and dairy products for maintaining good bone health. A recent study found that consuming 375ml of calcium-fortified soy milk drink over the period of 1 year helped to increase hip bone mineral density in adolescent Chinese girls (Evidence level IIb).<sup>9</sup> In the case of calcium supplements, studies comparing their effects on bone health with those of food sources of calcium (mostly milk and dairy products) indicate that calcium from both sources provided similar benefits (Evidence level IV).<sup>10</sup> However, no studies have been conducted to directly compare the effect of calcium from food sources and from supplements. Compared with calcium supplements, calcium-rich foods are likely to be more beneficial for bone health since they also provide other nutrients important for skeletal growth. In the case of milk and dairy products, intake has also been positively associated with adequate intakes of most micronutrients including potassium, magnesium, vitamin D, and vitamin A.<sup>10</sup>

6. For optimal bone health, calcium-rich foods should be consumed from childhood right through to old age. A meta-analysis of randomised controlled trials found that while increasing the calcium intake of children and adolescents (either from foods or from supplements) was able to effect an increased rate of bone mineral density gain, these benefits did not persist, except in the arm, once calcium intake returned to baseline levels (*Evidence level Ia*).<sup>14</sup> While consumption of calcium-rich foods is not able to increase bone mineral density in individuals who have attained their peak bone mass, continued consumption of calcium-rich foods is still likely to benefit bone health. There seems to be an increased risk of osteoporotic fractures when calcium intake by older men and women fall below 400-500mg per day (*Evidence level IV*), but whether the evidence applies to Singapore or not is uncertain because most studies have been done in countries with different fracture and calcium profiles from those in Singapore.<sup>15</sup> Two glasses of milk, or equivalents, should provide more than 400-500mg of calcium per day (see Appendix 1, page 87).
7. In addition to an adequate consumption of calcium, exercise also plays a role in increasing peak bone mass and has been associated with increased bone mineral density.<sup>16</sup> (See chapter on Eating Habits and Physical Activity, page 29)

### ***Other health conditions***

8. In adults, calcium supplements, whether milk-extracted or otherwise, seem to have a blood-pressure-lowering effect.<sup>17-18</sup> However, how these findings should be applied to childhood diets remain uncertain.<sup>19</sup> Whether calcium supplementation in adults has a protective effect against colon cancer is also inconclusive.<sup>20</sup> Likewise, there remains no consensus on whether there is an inverse relation between dairy intake and obesity in children and adolescents,<sup>21</sup> though consumption of dairy products has not been associated with increased body weight in adults.<sup>22</sup>

### ***Bioavailability of calcium***

9. Calcium from milk and other dairy products are well absorbed by the human body. Among non-dairy foods, absorption of calcium may be poor from foods that contain oxalic acid (e.g. spinach, sweet potatoes)<sup>23</sup> or phytic acid (e.g. seeds, nuts, whole grain products).<sup>24-25</sup> The bioavailability of calcium from different compounds used in supplements and for fortification appears to be similar to that from milk.<sup>24,26-29</sup> Despite the

differing bioavailability of calcium from different sources, the calcium content of the food is more important than the bioavailability when choosing sources of calcium, since calcium is generally well absorbed from foods.<sup>30-31</sup> For instance, calcium from calcium-fortified soy milk may have a lower bioavailability than calcium from milk, but as the fortified soy milk has more calcium overall, it will result in the same amount of absorbed calcium.<sup>32</sup>

### *Intakes of calcium-rich foods*

10. Recommendations from different countries generally recommend that younger children (approximately less than 10 years of age) consume 2 servings of milk daily, while older children consume 3 or more servings daily. One serving is equivalent to 1 cup of milk (250ml). The mean intake of milk and other dairy products among children and adolescents aged 2-19 years in the USA was 2.3 servings for boys and 1.8 servings for girls. The mean intake for girls was below the recommended intake of 2-3 servings per day for both sexes. Intake of milk and dairy products remained constant among boys as age increased, but decreased for girls, with intake particularly low among adolescent girls. Among girls aged 12-19 years, 32% were consuming  $\geq 2$  servings of dairy products daily, compared to 40% for girls aged 2-11 years and around 50% of all boys.<sup>33</sup> This trend was also seen in Australia and the UK. In Australia, only 12% of girls aged 16-18 years consumed the recommended 3 or more servings of dairy products a day.<sup>30</sup> There were no comparable data on intake of milk and other dairy products in the UK, but the trend of adolescent girls consuming less calcium was reflected in the finding that the proportion of girls aged 15-18 years who consumed less than the Lower Reference Nutrient Intake for calcium was more than double that for boys (19% versus 9%).<sup>34</sup>
11. In Singapore, there are no data on the intake of calcium among children and adolescents. Data from the 2004 National Nutrition Survey of Singaporeans aged 18-69 years showed that nearly 90% of Singaporeans aged 18-29 years consumed less than 1000mg of calcium a day.<sup>6</sup> As food choices are known to continue from adolescence to adulthood,<sup>35</sup> a low calcium intake in young adults may indicate an inadequate calcium in adolescents.

## ***Recommended intakes of calcium-rich foods***

12. Australian guidelines<sup>36</sup> recommend that children aged 4-11 years should consume 2-3 servings of dairy products daily, and adolescents aged 12-18 years should get 3-5 servings a day; Canadian guidelines<sup>37</sup> recommend that children 4-9 years have 2-3 servings of dairy products daily and older children and adolescents 10-16 years consume 3-4 servings a day. The USA<sup>38</sup> recommends that children 2-8 years of age consume 2 servings of milk daily, while older children and adolescents aged 9-18 years should consume 3 servings. One serving is around 1 cup of milk (250ml) or an equivalent amount of cheese (40g) or yoghurt (200g). The UK does not have specific recommendations on the amount of milk and other dairy products that children and adolescents should consume, but the recommended daily intake of calcium for children and adolescents is 525 mg for infants below 1 year of age, 350mg for 1-2 year olds, 450mg for 4-6 year olds, 550mg for 7-10 year olds, and 1000mg for those aged 11-18 years of age.<sup>39</sup>
13. The recommendations from the USA are based on scientific evidence that consumption of milk and other dairy products is related to overall nutrient adequacy and improving bone health. Singapore's recommendations for calcium-rich foods are similar. The levels of intake of milk and dairy foods recommended (Evidence level IV, Recommendation grade C) below for Singaporean children and adolescents contribute a significant proportion of the Recommended Daily Allowance (RDA) for calcium. See Appendix 2 (page 87) for details of the calcium RDA.

### **Age 7 through 12 months**

For infants aged 7 through 12 months, caregivers should continue giving breastmilk in addition to complementary foods. Infants not breastfed can be given infant formula or switched to a follow-on formula. The recommended amount is 750ml per day, prepared according to the manufacturer's instructions.

### **Age 1 through 2 years**

Toddlers 1 year of age should consume around 750ml (3 glasses) of full-cream milk or growing-up milk prepared according to the manufacturer's instructions per day. Children aged 2 years and above should gradually replace full-cream milk with low-fat milk. Flavoured milk may be considered as an option to increase milk acceptance by toddlers. Evidence from the USA suggests that consumption of flavoured milk is not associated with increased consumption of added sugars because flavoured milk replaces sugar-sweetened soft drinks. However, dietary patterns in Singapore differ

from those in the USA and milk is less likely to replace sugar-sweetened soft drinks; since flavoured milk contains more calories than plain milk (mostly from added sugars), it should be used sparingly to reduce the risk of the toddlers becoming overweight.

### **Age 3 through 6 years and 7 through 12 years**

Children in these age groups should include 500ml (2 glasses) of low-fat milk in their daily diet. Similarly, the recommended amount of milk may be substituted for other dairy products or calcium-fortified products equivalent in calcium content (see Appendix 1, page 87). Flavoured milk can be selected but its higher calorie content needs to be taken into consideration.

### **Age 13 through 18 years**

Adolescents should continue to include 500ml (2 glasses) of low-fat milk or equivalents in their daily diet to ensure adequate intake of calcium as adolescence is an important period of bone growth and development.

14. For children and adolescents aged 1 year and above, the recommended amount of milk may be substituted for other dairy products or calcium-fortified products with equivalent calcium content (see Appendix 1, page 87).
15. Along with calcium, vitamin D is another important nutrient involved in bone growth and development as it promotes calcium absorption.<sup>40-41</sup> In Singapore, vitamin D requirements for infants, children, and adolescents can be met by exposing the skin on the face and arms, without sunscreen, to 15 minutes of sunlight daily.<sup>42</sup> For children and adolescents who do not go out into the sun, they should include vitamin D-fortified dairy products or oily fish (e.g. sardines, mackerel, salmon) to help meet their requirements.

### **Lactose intolerance**

16. Lactose intolerance refers to symptoms such as flatulence, bloating, abdominal pain, and diarrhoea that occur after intake of too much lactose relative to the body's ability to break it down by the intestinal enzyme lactase.<sup>43</sup> In Asian children, there is an age-related decline in lactase activity, also called lactase non-persistence, which generally starts after 2-3 years of age,<sup>44</sup> possibly leading to lactose intolerance. While no data on the pattern of lactase non-persistence in Singaporean children are available, it is unlikely to differ from that in Asian children. Prevalence of lactose intolerance may be similar to that found in a study by Bolin

*et al* where prevalence of the condition in children increased with age and was reported by all children more than 10 years of age.<sup>45</sup>

17. It is possible for individuals who experience lactose intolerance to consume foods containing lactose without discomfort. A recent meta-analysis of studies involving individuals more than 4 years of age found that consuming an amount of lactose equivalent to that in 250ml of milk in one sitting was not associated with symptoms of lactose intolerance (Evidence level Ia).<sup>46</sup> In addition, prolonged exposure to lactose-containing foods can help reduce the severity of lactose intolerance symptoms (Evidence level IIb),<sup>8,47</sup> possibly because colonic bacteria are able to adapt by digesting lactose more rapidly thus reducing the potential for diarrhoea and abdominal discomfort.<sup>43</sup>
18. Despite the prevalence of lactose intolerance among children in Singapore, it is recommended that children continue to consume milk and other dairy products after breastfeeding has stopped (Evidence levels Ia-IIb, Recommendation grades A-B). Milk and other dairy products are still a good source of calcium, as people with lactose intolerance are able to absorb calcium from these foods.<sup>24</sup> In addition, a continuous consumption of milk and other dairy products may help to reduce the symptoms of lactose intolerance, while avoiding milk might cause more intolerance to future consumption as it may prevent the colonic bacteria from adapting to digest lactose more efficiently.<sup>8,47</sup> Some ways to make intake of milk and other dairy products more tolerable are to consume them during a meal, to choose fermented dairy products (e.g. yoghurt or cheese) rather than milk, or to consume the milk in small quantities (approximately ½ cup) at intervals throughout the day.<sup>43</sup>

### **Vegetarian diets**

19. Children and adolescents on vegetarian diets require similar amounts of calcium as those who consume animal products and should continue to follow RDA of calcium (see Appendix 2, page 87).<sup>48</sup> Children and adolescents on vegetarian diets who consume milk and other dairy products are advised to follow the recommendations listed on page 87 to obtain sufficient amounts of calcium from their diet. Individuals on vegetarian diets that do not include milk and other dairy products may not be consuming sufficient amounts of calcium.<sup>49</sup> Such individuals should consume non-dairy foods that are high in calcium, or calcium-fortified foods (see Appendix 1, page 87). Individuals who choose not to

include calcium-fortified foods in their diets should seek advice on the need for calcium supplements.

### **Safety concerns**

20. Calcium interacts with iron, zinc, magnesium, and phosphorus. In small children, high calcium intakes may increase the risk of zinc and iron deficiency; however, there are no data on dose-response regarding these interactions in children.<sup>41</sup> The US National Academy of Sciences has recommended a tolerable upper intake level of 2500mg calcium per day for children and adolescents 1 to 18 years of age.<sup>41</sup> There are no concerns about toxicity from calcium in Singapore. Data from the 2004 National Nutrition Survey showed that a large majority of Singaporean adults aged 18-69 years consumed less than 2500mg of calcium per day.<sup>6</sup> The recommended intakes of calcium for Singaporean children and adolescents in this guideline are lower than 2500mg per day.
21. Soybeans and soy products, such as soy milk, contain several different phytochemicals. The isoflavones, one of the groups of phytochemicals, are structurally and functionally similar to 17- $\alpha$  estradiol, a human oestrogen.<sup>50</sup> The amount of isoflavones that are obtained from a diet which contains soy products is able to modify a range of physiological processes in the human body.<sup>51</sup> As soybeans and soy products are the primary dietary source of isoflavones, there are concerns that consumption of soy products may result in adverse health outcomes, including toxicity in human infants,<sup>52</sup> an increased risk of breast cancer later in life,<sup>53</sup> and impairment of male reproductive function.<sup>54</sup>
22. Scientific evidence suggests that consumption of soy products at levels recommended in this set of guidelines is safe. Consumption of soy products consistent with an Asian diet was found not to be detrimental to breast health by a meta-analysis of 18 epidemiological studies that included both Western and Asian, pre-menopausal and post-menopausal women.<sup>53</sup> Likewise, exposure to isoflavones obtained from consuming amounts of soy products typically found in diets based on soy or containing soy products was considered safe by the authors of a literature review of studies that focused on the safety of isoflavones with regards to cancer, female reproductive health and infant development.<sup>55</sup> There are fewer studies done in men, but available data do not support concerns about effects on reproductive hormones or semen quality.<sup>54</sup> From available evidence, no firm conclusions can be made about the role of soy isoflavones on prostate cancer.<sup>56</sup> Current evidence regarding the

safety of soy-based infant formula is inconclusive.<sup>52</sup> (For more information on the use of soy-based infant formula, please refer to chapter on Variety of Nutritious Foods, page 13)

### *Key recommendations*

1. For optimal bone health, calcium-rich foods should be included from childhood and adolescence (Evidence level Ia, Recommendation grade A), and continued through to old age (Evidence level IV, Recommendation grade C).
2. Children and adolescents should consume adequate quantities of milk and dairy products since these foods contribute substantially not only to the Recommended Daily Allowance of calcium but also to overall nutrient adequacy (Evidence level IV, Recommendation grade C).
3. Children with lactose intolerance should consume milk and other dairy products after breastfeeding has stopped (Evidence levels Ia-IIb, Recommendation grades A-B), and could make these products more tolerable by consuming them during a meal, or in small quantities, or as fermented dairy products.

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### Appendix 1: Examples of calcium-rich foods

Food	Serving size	Calcium content (mg)
<b>Dairy products</b>		
High-calcium milk powder	4 scoops (25 g)	500
Low-fat milk	1 glass (250 ml)	380
Full-cream milk	1 glass (250 ml)	300
Low-fat yoghurt	1 carton (150 g)	240
Low-fat cheese*	1 slice (20 g)	200
<b>Non-dairy foods</b>		
Canned sardine (with bones)	1 fish (80 g)	270
Dried ikan bilis (with bones)	2 tablespoons (40 g)	270
Silken tofu	½ big block (150 g)	100
Tau kwa	1 small cake (90 g)	150
Dhal (raw)	¼ mug (50 g)	85
Baked beans, canned*	½ can (210 g)	110
Kai lan, cooked	¾ mug (100 g)	195
Spinach, cooked	¾ mug (100 g)	140
Chye sim, cooked	¾ mug (100 g)	140
Broccoli, cooked	¾ mug (100 g)	50
<b>Calcium-fortified products</b>		
High-calcium soybean milk	1 glass (250 ml)	450
Enriched bread	2 slices (60 g)	100
Calcium-fortified orange juice	1 serving (240 ml)	350

Note: 1 glass of milk (250ml) is equivalent to ½ a serving.

### Appendix 2: Recommended Dietary Allowance for calcium for children and adolescents

Age groups	RDA for calcium
Infants (0 - 6 months, breast-fed)	300mg
Infants (0 - 6 months, formula-fed)	400mg
Infants (7 - less than 12 months)	400mg
Children (1 - 3 years)	500mg
Children (4 - 6 years)	600mg
Children (7 - 9 years)	700mg
Adolescents (10 - 18 years)	1,000mg



## CHOOSE FOODS LOW IN SALT

### *Introduction*

1. Salt is 40% sodium and is a major contributor to sodium intake in Singapore. A high sodium intake is linked to increased blood pressure, which may lead to hypertension, a major risk factor for stroke, coronary heart disease, and kidney disease.<sup>1</sup> According to Singapore's 2004 National Health Survey, about 20% Singaporeans aged 30-69 years had hypertension,<sup>2</sup> and in recent years, cerebrovascular disease (including stroke) has been the 4<sup>th</sup> most common cause of death in Singapore,<sup>3</sup> accounting for nearly 10% of all deaths. Reducing sodium intake may help to decrease the prevalence of hypertension, and possibly that of related diseases.<sup>4</sup>
2. There has been some suggestion that infants under the age of 12 months may need some added sodium for proper growth and development. However, the evidence comes from studies that focused only on pre-term infants<sup>5</sup> and from animal studies,<sup>6</sup> so it does not apply to all infants. By 12 months of age, the renal system is fully mature, hence the sodium tolerance of children above the age of 1 year is not expected to differ from those of adults. The sodium intake of children and adolescents is tied to their energy intake. Since children and some adolescents require less energy than adults, their intake of sodium should be proportionately reduced.

### *Evidence for benefits of sodium reduction*

#### *Hypertension*

3. It is generally accepted that sodium restriction can reduce blood pressure in individuals with hypertension (Evidence level Ia),<sup>7-9</sup> but opinion<sup>10-14</sup> is still divided on the benefits of a population-wide reduction in sodium intake. Epidemiological evidence from the Intersalt study,<sup>1</sup> a cross-sectional study of 52 groups across 32 countries, shows a positive correlation between sodium consumption and blood pressure (Evidence level III). However, the Scottish Heart Study, a 7-year longitudinal study of 7354 men and women found no independent relation between sodium intake and blood pressure (Evidence level III).<sup>15</sup> Meta-analyses of clinical

trials<sup>16-18</sup> generally show that sodium restriction is able to produce only a 1-2mmHg reduction in systolic blood pressure for people without hypertension (Evidence level Ia).

4. Clinical trials of particular interest are the Dietary Approaches to Stop Hypertension (DASH) – Sodium trial<sup>19</sup> and the Trial of Hypertension Prevention, Phase II (TOHP2).<sup>20</sup> The DASH-Sodium trial studied how blood pressure is affected by sodium intake and dietary modifications. Three levels of sodium intake were investigated. Participants, who had to have a blood pressure of 120-159mmHg systolic or 80-95mmHg diastolic, were placed either on a control diet typical of intake in the USA, or on the DASH diet, which emphasises fruit, vegetables, and low-fat dairy products. The study showed that, irrespective of diet type, and irrespective of whether the group was hypertensive or not, a reduction in sodium intake significantly lowered systolic and diastolic pressure in a stepwise fashion (Evidence level Ib). The TOHP2 was designed to find out whether sodium restriction and weight loss were able, separately or in combination, to prevent incident hypertension in high-risk people, who were overweight or had diastolic blood pressures in the high end of the normal range (83-89mmHg). More than 2000 participants were followed up for 3-4 years. Sodium restriction was successful in lowering blood pressure and incidence of hypertension (Evidence level Ib).
5. The general consensus is that sodium reduction in childhood is appropriate.<sup>21</sup> Blood pressure is known to track from infancy to adulthood,<sup>22</sup> and while data from older observational studies is inconsistent,<sup>23,24</sup> a recent meta-analysis of controlled trials in children and adolescents indicates that reduction of salt intake leads to reduction in blood pressure (Evidence level Ib).<sup>25</sup> Furthermore, there is evidence suggesting that sodium consumption during infancy has an effect on future blood pressure. Hofman *et al*<sup>26</sup> randomised nearly 500 newborn infants to normal infant formula (5750mg Na/day)\* or to breastmilk (2047mg Na/day) during the first 6 months of life. After 6 months, systolic blood pressure was 2.1mmHg lower in the low-sodium group (Evidence level Ib). A 15-year follow-up of 167 participants found that blood pressure during adolescence was notably lower in participants who had been assigned to the low-sodium group as an infant, even though there was no difference in sodium consumption during adolescence (Evidence level III).<sup>27</sup>

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\* These values refer to infant formula from the 1980's. Infants fed on modern infant formula will consume around 185mg of sodium a day.

6. A suggestion is that sodium consumption during infancy influences future blood pressure by effects on renal development at that stage of life, and hence predisposes an infant to hypertension later in life.<sup>28</sup> There is a need for more long-term trials to determine whether reducing sodium consumption in infancy will have any beneficial effects on blood pressure in adulthood.<sup>29</sup>

### ***Other health conditions***

7. Increased sodium intake might have adverse effects on additional health outcomes. There is some epidemiological evidence of a link between sodium intake and cardiovascular disease. Tuomilehto et al<sup>30</sup> followed up more than 2000 men and women to find out the effect of a high sodium intake on risk of coronary heart disease (CHD) or stroke and mortality from CHD and cardiovascular events. They found that sodium intake correlated with mortality from CHD and stroke, and with risk of CHD, independent of other risk factors, including blood pressure (Evidence level III).<sup>30</sup> Risk of gastric (stomach) cancer has also been associated with increased intake of salt-preserved foods.<sup>31</sup> Other health conditions that have been associated with increased sodium intake include increased left-ventricular mass<sup>32</sup> and increased urinary calcium excretion.<sup>33</sup>

### ***Salt taste preference***

8. Infants appear to have an innate preference for salt taste, which develops around 4 months of age.<sup>34,35</sup> This preference is not dependent on exposure to salty foods in the initial 4 months of life.<sup>36</sup> However, this preference may be reduced by limiting subsequent exposure to salty food in infants and children.<sup>37,38</sup> Studies also indicate that adult salt preference can be modified by dietary exposure (Evidence level III).<sup>39</sup>

### ***Intakes of sodium***

9. The mean daily sodium intake for US children under 6 years of age is about 2115mg or 1430mg per 1000 kcal, of energy whereas children 6 years and above consume a mean of 3255-3585mg or 1540-1610mg per 1000 kcal of energy, with males consuming more than females.<sup>40</sup> A national survey in the UK showed that children and adolescents aged 4-18 years consume a mean of 2360mg of sodium a day, and this does not include salt added at the table which is believed to be in the region of 800mg.<sup>41</sup> There are no relevant data from Australia, but it is likely that

most children and adolescents consume more than the recommended level of intake.<sup>42</sup> Likewise, there are no data on Singapore, but intake is likely to be similar to that of western counterparts.

10. In western countries, salt added during cooking and at the table accounts for 15% of intake, the natural salt content of foods for 10%, and salt added by manufacturers to products for the remaining 75%.<sup>43</sup> According to the 1998 National Nutrition Survey conducted among Singaporean adults aged 18-69 years, 80% of sodium intake comes from the sauces and salt added during cooking (e.g. as part of cooked foods eaten at home and away from home), followed by 18% of sodium from processed food.

### *Recommended sodium intakes*

11. The US Dietary Reference Intakes<sup>44</sup> has set both an Adequate Intake (AI) and an Upper Limit of intake (UL) for sodium. These levels are set for apparently healthy individuals without hypertension. The AI is based on being able to obtain a nutritionally adequate diet for other nutrients and to meet the needs for sweat losses for individuals engaged in recommended levels of physical activity, while the UL is the maximum level of daily nutrient intake that is likely to pose no risk of adverse effects.
12. The AI for infants 0-6 months is 120mg per day, while that for infants 7-12 months is 370mg. There is no UL set for infants due to a lack of data regarding adverse effects of sodium in this group and concerns about an infant's ability to handle a high sodium intake. Sources of sodium should only be that naturally present in foods to prevent high levels of intake. For children 1-2 years of age the AI is 1000mg and the UL 1500mg, while for children 4-8 years of age the AI is 1200mg and the UL 1900mg. For children aged 9-13 years the AI is 1500mg and the UL 2200mg. For adolescents aged 14-18 years the AI is 1500mg and the UL 2300mg, which is the same as for adults.
13. Australia's Dietary Guidelines<sup>42</sup> for Children and Adolescents recommend that infants 0-6 months of age consume 140–280mg of sodium per day, while infants aged 7–12 months consume 320–580mg. Children 1-2 years old are recommended to consume 460–1730mg, and children 4-7 years old are recommended to consume 600–2300mg. Older children and adolescents aged 8-18 years are recommended to consume 920–2300mg per day – the same as for adults. New Zealand's guidelines<sup>46</sup> are similar to Australia's.

14. The UK<sup>45</sup> recommends that infants 0-12 months of age consume less than 400mg of sodium a day, the rationale being that their kidneys are not able to cope with larger amounts. For other age groups, maximum levels of intake have been set – 800mg for children aged 1-2 years, 1200mg for children aged 4-6 years, 2000mg for children aged 7-10 years, and 2500mg for children aged 11 years and above. Canada<sup>47,48</sup> does not have numerical recommendations on sodium intake, but encourages use of varieties of food low in sodium.
15. The recommendations of the various countries are summarised in Table 1.

**Table 1: Recommended sodium limit**

Country	Age Group (years)	Recommended intake of sodium (mg)	
US <sup>49</sup>		AI (US only)	UL (US only)
	0-6 months	120	Not determined
	7-12 months	370	Not determined
	1-2	1000	1500
	4-8	1200	1900
	9-13	1500	2200
	14-18	1500	2300
UK <sup>50</sup>	0-12 months	<400	
	1-2	<800	
	4-6	<1200	
	7-10	<2000	
	≥11	<2500	
Australia <sup>45</sup>	0-6 months	140-280	
	7-12 months	320-580	
	1-2	460-1730	
	4-7	600-2300	
	8-18	920-2300	
Singapore	0-6 months	150	
	7-12 months	≤400	
	1-2	≤800	
	3-6	≤1200	
	7-12	≤2000	
	13-18	≤2000	

16. In Singapore, the recommendations (**Recommendation grade C**) are based on those from the UK and are in line with recommendations from USA and Australia.

### **Age 0 through 6 months**

In the first 6 months of life, infants should be exclusively breastfed. Exclusively breastfed infants will get adequate amounts of sodium from breastmilk. An exclusively breastfed infant will consume around 160mg of sodium per day,<sup>42</sup> while infants who are formula fed will consume around 185mg of sodium per day.

### **Age 7 through 12 months**

Infants aged 7 through 12 months should not consume more than 400mg of sodium a day. Salt or sauces should not be added to food for infants, nor should infants eat too much food that has been seasoned for adult tastes. Processed foods with a high salt content should also be avoided.

### **Aged 1 through 2 years**

Toddlers 1 through 2 years of age should not consume more than 800mg of sodium a day. Processed foods with a high salt content should be avoided, and the amount of salt and sauces added to foods prepared for toddlers should be limited.

### **Age 3 through 6 years**

Children aged 3 through 6 years of age should restrict their daily intake of sodium to 1200mg a day. Caregivers should not give food with a high amount of added salt and sauces, so that a preference for a high salt diet is not established.

### **Age 7 through 12 years and 13 through 18 years**

Older children and adolescents should adopt the same sodium recommendation as that for adults. It is advisable that they consume no more than 2000mg of sodium a day. Children and adolescents should be encouraged to reduce the use of sauces and seasonings, and to reduce their intake of salt-preserved foods.

17. The reduced sodium intake should be accompanied by a concurrent increase in potassium intake. The recommended level of potassium intake should be 3500mg per day.<sup>49</sup>

## ***Key recommendations***

1. Children and adolescents in Singapore should limit their consumption of sodium since it is probable that, like their counterparts in other countries, they are taking more than the recommended levels of sodium (Evidence level IV, Recommendation grade C).

2. A good way of reducing sodium intake is to avoid processed foods with a high salt content, and to limit the amount of salt and sauces added to food.

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## LIMIT CONSUMPTION OF BEVERAGES & FOODS WITH ADDED SUGAR

### *Introduction*

1. The term “sugar” is used to describe both monosaccharides (e.g. glucose, galactose, and fructose) and disaccharides (e.g. sucrose, maltose, lactose). Sugar may be differentiated into “added sugar” and “naturally-occurring sugar” according to their source. Added sugar refers to sugar introduced to the food during processing or preparation, which may be in the form of sucrose, honey, or other sweeteners (e.g. condensed milk), and includes sugar added at the table. Naturally-occurring sugar describes food which contain sugar in its natural state (e.g. lactose in milk and fructose in fruits). Despite this distinction, naturally-occurring and added sugar are digested in the same way by the body.<sup>1</sup>
2. Consumption of foods containing added sugar has been associated with increased risk of overweight and obesity (Evidence level III)<sup>2</sup> and dental caries (Evidence level III).<sup>3</sup> In addition, children and adolescents who consume more than 25% of their energy from added sugar have a poorer quality of diet than whose intake of added sugar is 5-10% of energy (Evidence level III),<sup>4</sup> possibly because sugar-sweetened foods displace nutrient-dense foods.<sup>5</sup> There is some evidence that high consumption of sugar-sweetened drinks is linked to childhood obesity (Evidence level III).<sup>6</sup> Intake of sugar-sweetened drinks has been shown to remain relatively unchanged from adolescence to young adulthood (Evidence level III),<sup>7,8</sup> hence it is important to cultivate healthy eating habits in childhood and adolescence.

### *Effects of sugar consumption on health*

#### *Weight status*

3. Evidence on the association between added sugar and weight status is mixed. Cross-sectional studies have reported an association between added sugar intake and increased energy intake in children and adolescents (Evidence level III).<sup>9-10</sup> Data from the USA showed that children and adolescents (aged 2-18 years) who drank more sugar-sweetened soft drinks had higher energy intakes (Evidence level III).<sup>11</sup> Adolescents who consumed more than 26 ounces (770ml) of soft drinks

consumed a mean of 2600 calories, compared to non-consumers of soft drinks, who consumed around 2000 calories a day. Soft drinks also contributed a higher proportion of daily energy intake for overweight children and adolescents (Evidence level III) compared to those who were non-overweight.<sup>12</sup>

4. There are also studies that show an inverse relation between consumption of added sugar and either body weight or Body Mass Index (BMI) (Evidence level III).<sup>13,14</sup> A review by Hill & Prentice<sup>15</sup> concluded that there is no reason to associate high-sugar diets with obesity (Evidence level III). A more recent longitudinal study reported that in non-obese pre-menarcheal girls, overall consumption of energy-dense snack foods were not associated with percentage body fat or a higher than expected BMI (Evidence level III).<sup>16</sup>
5. Although this study did not show any association between energy-dense snack foods and weight status, there was an association between consumption of sugar-sweetened soda drinks and a higher than expected BMI (Evidence level III).<sup>16</sup> Evidence supports the association between consumption of sugar-sweetened drinks and greater overweight or obesity. In 2001, Ludwig *et al* followed 550 schoolchildren for 19 months and found that, after correction for physical activity and other variables, consumption of sugar-sweetened drinks was associated with a higher BMI (Evidence level III).<sup>6</sup> Further evidence for this association is provided by a recent systematic review. Four out of 6 prospective cohort studies reviewed were found to support the association between sugar-sweetened drink consumption and greater overweight or obesity (Evidence level III).<sup>17</sup>
6. Intervention studies indicate that decreasing consumption of sugar-sweetened beverage is able to reduce overweight and obesity in children. James *et al* found that a decrease in carbonated beverage (including sugar-sweetened beverages) consumption was associated with a decrease in overweight or obesity (Evidence level Ib).<sup>18</sup> A pilot study by Ebbeling *et al* also indicated that reducing sugar-sweetened beverage consumption in adolescents was able to reduce BMI, especially in individuals with BMI >30kg/m<sup>2</sup> (Evidence level Ib).<sup>19</sup>
7. The relation between intake of added sugar and BMI or obesity is complex. The most direct way in which added sugar would increase BMI or obesity is through an increased energy intake, although other mechanisms have been suggested. Added sugar have a high glycaemic

index, and it has been suggested that a diet with a high glycaemic index leads to postprandial hyperinsulinaemia, which changes resting energy expenditure and can lead to excessive weight gain.<sup>20</sup> Another suggestion is that people are less able to modify their total calorie intake to compensate for energy consumed from beverages; individuals with a high intake of sugar-sweetened beverages continue to consume their usual amount of energy at meals and hence have a higher overall calorie intake.<sup>21</sup> A third possibility is that foods high in added sugar promote overeating as they have a low satiety value.<sup>22</sup> However, the accuracy of these mechanisms is still debated and more research is necessary.<sup>23</sup> Possible explanations for inverse relations between intake of added sugar and BMI or obesity include a tendency for lean active people to select high-energy, high-sugar diets, and a tendency for overweight people to restrict dietary sugar.

### **Dental caries**

8. The aetiological role of sugar in cariogenicity has long been established, as has a dose-response relation between sugar and caries. Bacteria in the mouth ferment sugar to produce organic acids; the acids then dissolve the tooth surface to cause caries. This sugar-caries relation is influenced by factors such as the type and consistency of sugar-containing foods consumed, frequency of consumption of sugar-containing foods, and how quickly the acids being produced are neutralised by saliva or cleared from the tooth surface.<sup>24</sup>
9. Dental hygiene is another factor that has a substantial impact on the relation between sugar and caries.<sup>25,26</sup> In the UK, a study of predictors of dental caries among a nationally representative sample of 1450 pre-school children showed that the association between tooth brushing and caries was greater than that between intake of sugar confectionery and caries, while intakes of other sugary foods were non significant. The investigators concluded that the findings support the hypothesis that regular brushing with fluoride toothpaste may have greater impact on preventing caries in this group of children than restricting sugary foods (Evidence level III).<sup>25</sup> A systematic review of 36 studies published between 1980 and 2000 (i.e. in the era of widespread exposure to fluoride toothpaste) showed that the relation between consumption of sugar and the development of caries is only moderate to mild. Nevertheless, the investigators concluded that controlling excessive consumption of sugar remain justifiable even though it may not always be the most important measure in caries prevention (Evidence level III).<sup>26</sup>

10. In Singapore, data from the 2003 Children's Oral Health Survey supports the known relation between intake of sugar and dental caries (Evidence level III).<sup>27</sup> Twelve year olds who drank more than 2 cans of sweetened fizzy drinks every day had mean of 0.72 decayed, missing, or filled teeth (DMFT), which was significantly more than the mean of 0.52 DMFT for participants who drank less than 2 cans a day. In the same cohort, participants who drank fewer fizzy drinks were also more likely to be caries free.

### **Other health conditions**

11. There is no evidence to suggest that intake of added sugar is linked to attention deficit/hyperactivity disorder.<sup>28</sup> There is some evidence that intake of sugar-sweetened beverages in adulthood is related to the development of type 2 diabetes in adult women (Evidence level III),<sup>29</sup> but otherwise little suggest that intake of added sugar directly affects the risk of developing chronic degenerative diseases; though it is possible that intake of added sugar affects development of chronic degenerative diseases through increasing energy intake, which may lead to obesity.<sup>4</sup>

### **Nutrient adequacy**

12. Data from the USA indicates that higher intakes of sugar are linked with decreased intakes of micronutrients. Findings from the Continuing Survey of Food Intakes by Individuals (CSFII) 1994-1996 showed that individuals who had the greatest proportion of total energy from added sugar had the lowest mean intake of all micronutrients measured,<sup>30</sup> as well as poorer Healthy Eating Index scores,<sup>31</sup> a measure of diet quality (Evidence level III). This and other studies led the Institute of Medicine (IOM) to conclude that in order to ensure adequate intake of other nutrients, added sugar should make up no more than 25% of total energy.<sup>4</sup>
13. However, consumption of certain foods that contain added sugar may help improve diet quality. A review by the IOM showed that individuals who consume 5-10% of energy as added sugar have a higher micronutrient intake than those with 0-5% of energy from added sugar.<sup>4</sup> Results from the CSFII have also shown that among children and adolescents (aged 6-17 years), consumption of sugar-sweetened dairy products and pre-sweetened cereals were associated with better diet quality, while consumption of sugar-sweetened beverages, sweets, and sweetened grain products (e.g. cakes and cookies) led to poorer diet quality (Evidence level III).<sup>32</sup>

## *Intakes of sugar*

14. In the USA, data from the National Health and Nutrition Examination Survey (NHANES) 1999-2002 showed that added sugar contributed around 16% of total dietary energy daily for children 2-5 years old and around 19% of total dietary energy for children aged 6-11 years old. Among adolescents, added sugar provided around 21% of total dietary energy.<sup>33</sup> Data from earlier surveys (NHANES 1988-1994) indicate that about 75% of children aged 4-8 years old consumed more than 10% of dietary energy from sugar. This increased to around 80% for older children and adolescents.<sup>4</sup>
15. In Australia, children and adolescents aged 2-18 years old obtained 25-30% of total energy from sugar, of which 15% of total energy was from added sugar.<sup>34</sup> In the UK, non-milk extrinsic sugar (NMES; defined as sugar outside the cellular structure of a food, excluding the sugar naturally present in milk and milk products. This includes naturally-occurring sugar from fruit juice.<sup>35</sup>) contributed 18.7% of total dietary energy among young children aged 1.5-4.5 years. Only 12.5% of these children met the recommendation that NMES should contribute to less than 10% of dietary energy.<sup>36</sup> There are no data from Singapore, but intake for Singaporeans is likely to be similar to their western counterparts.
16. In the USA, intake of sugar-sweetened soft drinks increases as children progress into adolescence. Data from the Continuing Survey of Food Intakes by Individuals showed that only 18% of adolescents aged 13-18 years did not consume any soft drinks, compared to 50% of young children aged 2-5 years. Consumption of more than 9 ounces (260 ml) of soft drinks per day was 12% among young children; this increased to 32% in older children aged 6-12 years, and was more than 50% among adolescents.<sup>11</sup> Sugar-sweetened drinks were also the biggest contributor of added sugar to the diets of children and adolescents, contributing 22% of added sugar for children aged 6-11 years, increasing to 37% and 41% for adolescent females and males, respectively.<sup>37</sup> This was similar to data from Australia, where the biggest contributor of added sugar in the diet of children and adolescents was non-alcoholic beverages, which contributed nearly half of added sugar intake.<sup>34</sup>

## **Recommendation for added sugar intakes (Recommendation Grade C)**

17. The US Institute of Medicine (IOM) does not make any recommendations on daily intake of added sugar for a healthy diet because “it is not possible to determine a defined intake level [of added sugar] at which inadequate micronutrient intakes occurs.”<sup>4</sup> However, the IOM report states that on the basis of available data, no more than 25% of dietary energy should come from added sugar. The IOM does recommend consumption of micronutrient-rich foods, such as milk, dairy products, and fruit, along with a concurrent reduction in consumption of added sugar from foods and beverages that contain minimal amounts of micronutrients, such as soft drinks, fruit-flavoured drinks, and candies. New recommendations from the Beverage Guidance Panel suggest that individuals consume no more than 240ml (2/3 can) of sugar-sweetened drinks a day.<sup>38</sup>
18. Recommendations from the UK state that individuals should keep their intake of non-milk extrinsic sugar to less than 10% of total dietary energy.<sup>39</sup> The Australian Dietary Guidelines for Children and Adolescents do not give a specific recommendation on intake of added sugar, but conclude that “there is no evidence that consumption of up to 15-20% of energy as sugar [both added and naturally-occurring sugar] is incompatible with a healthy diet.”<sup>40</sup>
19. In Singapore, the recommendations are based on recommendations from UK and Australia, and the changes in consumption patterns of sugar-sweetened beverages in USA.

### **Age 7 through 12 months**

Sweeteners should not be added to foods and beverages prepared for infants aged 7 through 12 months. Limiting exposure to sweetened foods and beverages will help to modify an infant’s predisposition for sweet tastes. (see chapter on Eating Habits and Physical Activity, page 29)

### **Age 1 through 2 years and 3 through 6 years**

Added sugar should not contribute more than 10% of total dietary energy for children aged 1 through 2 years and 3 through 6 years. Children in this age group should be taught proper dental hygiene habits to prevent dental caries. Adult supervision is required to ensure proper techniques are used. Intake of sugar-sweetened drinks or foods should be restricted to mealtimes or when the children are able brush their teeth immediately afterwards. Intake of sugar-sweetened foods and beverages should be limited to maintain a preference for less-sweet tastes.

### **Age 7 through 12 years and 13 through 18 years**

Older children and adolescents should aim to get no more than 10% of dietary energy from added sugar. In addition to maintaining good dental hygiene, they should be encouraged to restrict their consumption of sugar-sweetened beverages to no more than 250ml per day. An increased intake of sugar-sweetened beverages have been linked to increased weight-gain, possibly leading to obesity.

#### ***Suggested beverages***

20. It is recommended that children aim to drink the equivalent of 6-8 glasses of fluid daily, while adolescents should aim for up to 8-10 glasses a day. Plain water and the recommended amounts of calcium-rich beverages should be the main fluids consumed. Tap water in Singapore is potable and there is no need for bottled water. (See chapter on Calcium, page 75).
21. Unsweetened 100% fruit juice may be considered as an alternative to fruit for up to ½ of the fruit servings a day. This is equivalent to ½ cup (125ml) of unsweetened 100% fruit juice per day for children less than 7 years of age, and 1 cup (250ml) of unsweetened 100% fruit juice per day for children 7 years of age and above. However, consumption of fruit juice beyond this amount is not recommended. Fruit juice lacks fibre and if consumed in large quantities contributes substantially to a high energy intake, which is linked with unhealthy weight gain and dental caries.

#### ***Key recommendations***

1. Children below 1 year of age should not be given foods or beverages containing added sugar (Evidence level IV, Recommendation grade C).
2. Limiting exposure to sweetened foods and beverages will help to modify an infant's predisposition for sweet taste (Evidence level III, Recommendation grade B).
3. Children aged 1 year and above should limit their intake of added sugar to no more than 10% of total dietary energy (Evidence level III, Recommendation grade B).

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