

FOOD AND NUTRITION GUIDELINES  
*for*  
Healthy Infants and Toddlers  
(Aged 0-2 Years)

*A Background Paper*

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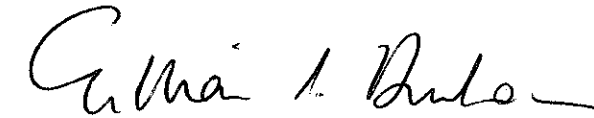
## Foreword

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This paper brings together the key areas of nutrition affecting the health of infants and toddlers at this point in time. It has provided the background material for the development of the health education booklet *Healthy Eating for Babies and Toddlers from Birth to Two Years Old*.

These guidelines support the National Nutrition Policy and are an important strategy within the *National Plan of Action for Nutrition* (PHC, 1995).

It is envisaged that this background document will provide health professionals, educators and caregivers with technical information relating to food for infants and toddlers.



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## Introduction

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This background paper has been written to complement *Food & Nutrition Guidelines for Children Aged 2-12 Years* which was published by the Department of Health in 1992 (Reid et al, 1992).

During the first two years of life infants and toddlers are entirely dependent upon their caregivers for providing them with nourishment. The first two years of life are also a time of great nutritional change for the child, from a diet consisting entirely of milk (either breast milk, infant formula, or both) to one consisting of a variety of foods. Optimal nutrition probably has greater importance during this time of life than at any other because of its effect on brain growth, development of the nervous system, overall growth and the need to meet energy requirements.

*Food and Nutrition Guidelines for Infants and Toddlers (Aged 0-2 Years)* has been written for health professionals and educators to help them to assist parents in determining appropriate feeding practices for infants and toddlers in the first two years of life. On issues where there is still some uncertainty, the authors have made this clear. References, whilst not exhaustive, have been given so the reader who wants more information on a particular topic can find it.

Topics include breastfeeding, formula feeding, solid foods including cultural foods, milk, other fluids, adverse reactions to foods, energy, fat, iron, calcium, other minerals, fibre, nutritional supplements, and specialised diets.

These definitions are used throughout:

- an infant is a child in the first 12 months of life
- a toddler is a child in the second year of life.

## Breastfeeding

Breast milk is the ideal food for infants. It is the best way to feed infants during the first six months of life. Exclusive breastfeeding is recommended until at least four months of age and if possible six months (WHO/UNICEF, 1989). From four to six months of age non-milk foods are usually introduced into the infant's diet. Provided the infant is allowed to breastfeed on demand, breast milk remains a major source of nutrients in the first year of life even after solid foods have been introduced, although after six months of age breast milk alone is insufficient for satisfactory weight gain (Ramachandran, 1987). In New Zealand 94 percent of babies are fully or partially breastfed at birth (Alison et al, 1993); nearly half are still partially or fully breastfed at six months of age (Plunket Society, unpublished data). A lactating mother can produce enough breast milk to feed twins and even triplets provided they are fed on demand (Saint et al, 1986).

### Benefits of breastfeeding

Breastfeeding has advantages for the infant and the mother. The nutritional benefits of breastfeeding for the infant are that it:

- meets the full term infant's complete nutritional needs for up to the first six months of life
- is always at the right temperature and readily available
- has low risk of bacterial contamination
- is very low cost
- has less risk of overfeeding or underfeeding.

The immunological benefits of breastfeeding are that it:

- reduces the risk of infectious diseases such as gastroenteritis, respiratory infections and ear infections because maternal antibodies are passed to the infant (Howie et al, 1990; Duncan et al, 1993)
- reduces the risk of food allergy (Chandra et al, 1993).

Other benefits of breastfeeding are that it:

- reduces the risk of sudden infant death syndrome (SIDS, or cot death) (Mitchell et al, 1991a)
- increases infant-mother attachment (Kennell, 1980; Klaus and Kennell, 1982)
- assists in jaw development (Davis and Bell, 1991).

Benefits of breastfeeding for the mother are that it:

- provides emotional and physical satisfaction
- helps her to return to her pre-pregnancy weight
- requires no preparation before the feed
- has a 98 percent contraceptive effect in the first six months after the baby's birth provided the baby is exclusively breastfed and the mother does not resume menstruation (Guillebaud, 1991; Kennedy et al 1989).
- reduces the risk of premenopausal breast cancer (Byers et al, 1985; McTiernan and Thomas, 1986)
- speeds up involution of the uterus after birth.

### Composition of breast milk

The breast milk produced during the first few days after birth is termed colostrum, which is rich in antibodies. It has a greater proportion of protein, minerals and fat soluble vitamins but less fat than mature breast milk. From four to 10 days after birth the breast produces transitional milk, which has a higher lactose, fat and energy content than colostrum. The breast then produces mature milk, in which the water and fat content increases until it reaches a plateau at about three months post partum (Lawrence, 1989).

There can be significant variations in breast milk composition between mothers and even between samples from the same mother. The fat, carbohydrate, protein, energy, vitamin, immunoglobulin and mineral levels of breast milk vary throughout lactation and during a feed. It is difficult therefore to give the precise nutritional content of breast milk although average values for mature breast milk are available (Lawrence, 1989).

When the baby suckles he or she receives foremilk followed by hindmilk. Hindmilk has a higher protein and fat content than foremilk. It is important therefore not to impose restrictions on the length of time the baby suckles nor to restrict the baby to only one breast per feed. If the baby is still hungry after feeding from one breast then the other breast should be offered. If only one breast is taken at a feed, then the other breast should be offered first at the next feed. If both breasts are used during a feed the next feed should start on the breast used last at the previous feed. Thus overall both breasts will receive equal stimulation to produce milk and be drained equally by the baby's sucking, which reduces the risk of engorgement and mastitis (Royal College of Midwives, 1991).

### Contra-indications to breastfeeding

There are very few true contra-indications to breastfeeding. These would include:

- conditions affecting the mother:
  - taking certain medications (eg, drug treatment for cancer or hyperthyroidism). Other medications may be passed to the infant through the breast milk to a lesser or greater extent, and the baby should be carefully observed. Drugs which the infant has been exposed to throughout pregnancy, such as medication for epilepsy, are unlikely to add little additional risk when ingested via breast milk (Neifert and Seacat, 1986)
  - infections (eg, HIV, or local infectious lesions affecting the skin of the breast such as herpes simplex). Mothers who are hepatitis B positive can breastfeed provided the infant has had hepatitis B immunoglobulin immediately after birth and has begun a course of hepatitis B immunisation
- conditions affecting the baby:
  - very rare metabolic conditions such as galactosaemia.

If the mother has temporarily stopped breastfeeding whilst taking a course of medicine and wants to continue breastfeeding after the medicine is finished, she should continue to express breast milk and discard it. If breastfeeding is stopped suddenly there is the risk that the mother may develop mastitis; she will need careful guidance on how to reduce her breast milk supply to avoid this.

Infants with a physical disability, such as harelip, cleft palate or cerebral palsy, may have difficulty sucking at the breast because they are unable to form an airtight seal around the breast when sucking, or have a poor sucking response. However even if they are unable to breastfeed they can still be fed expressed breast milk. Mothers of these infants may need extra support and assistance to enable them to breastfeed, either directly or with expressed breast milk.

### Storing breast milk

Breast milk can be expressed and stored in a sterile container with a lid (to lessen the risk of contamination). The recommended storage times for storing are shown in *Table 1*. Each time breast milk is expressed it should be stored in a different container rather than being added to already frozen breast milk as the newly added milk can cause some of the frozen breast milk to thaw and then refreeze which increases the risk of bacterial growth in the milk. The expressed breast milk can then be thawed and given to the baby later using either an infant feeding bottle or a small cup (Lang, 1994). The bottle or cup must be sterilised prior to use for the first three months of the infant's life and must be thoroughly cleaned thereafter. Sterilising equipment and tablets to make sterilising solution are available. The manufacturers' instructions must be

carefully followed (the process is the same as for sterilising equipment for formula feeding). If the breast milk has been frozen, it should be allowed to thaw in the refrigerator or by placing the container in warm water until thawed. It is then heated as described in *Formula Feeding*. Expressed breast milk should not be heated using a microwave oven as this can destroy some of the immunological components (Sigman et al, 1989). Microwaves can cause variations in temperature throughout the milk with local "hot spots" and the milk may continue to cook even after it has been removed from the microwave (hence manufacturers' recommendations for standing time) causing extremely high temperatures, which may cause scalding (James, 1989).

## Assistance with breastfeeding difficulties

Assistance with breastfeeding difficulties can be obtained from:

- general practitioners
- lactation consultants
- La Leche League
- midwives
- paediatricians
- Plunket Karitane Family Centres
- Plunket nurses.

Table 1: Guidelines for storage of expressed breast milk (Bernshaw, 1990)

Storage of milk	Storage time
Refrigerated breast milk	up to 5 days
Frozen breast milk - freezer box in refrigerator	2 weeks
- separate door fridge/freezer	3 to 4 months
- separate deep freeze	6 months

## Formula Feeding

Breast milk is the best food for newborn babies and all parents should be encouraged to breastfeed their babies. However, while stressing the superiority and benefits of breastfeeding, the World Health Organization (WHO) recommends that where needed, mothers and families must be given objective and consistent advice on the proper use of infant formula (WHO, 1981). In New Zealand six percent of babies are fully formula fed from birth (Alison et al, 1993). This rises to 20 percent by two months of age and continues to rise throughout the first year of life. There are other babies who are fed both breast milk and infant formula. Supplementing breastfeeding should be strongly discouraged because supplementary feeding reduces the breast milk supply by reducing sucking at the breast and diminishing maternal production of the hormone prolactin (Royal College of Midwives, 1991). Women who choose to feed their babies infant formula, either exclusively or in combination with breast milk, must be given accurate information about this method of feeding. This information should include choice of formula, how to prepare the formula and the equipment, and how to feed the baby. The WHO is concerned that breast milk substitutes are not inappropriately promoted and has written guidelines for the marketing of breast milk substitutes (WHO, 1981).

Infant formulas should be used in the first 12 months of life if an infant is not fully breastfed. Infant formulas must be nutritionally adequate to promote growth and development when used appropriately (Department of Health, 1984). They must meet the complete energy and nutritional requirements for the healthy full-term infant up to six months of age. After this age the infant should also be receiving solid food.

Infant formulas are based either on cows' milk protein or another protein, for example, soy protein or goats' milk protein. Follow-on formulas are also available for infants over six months old; these are described below. The composition of all formulas sold in New Zealand must meet WHO guidelines (FAO/WHO, 1976).

Infant formula has several disadvantages compared to breast milk:

- formula is of constant composition whereas human milk varies in composition during lactation and even during a single feed
- the bioavailability of various nutrients, such as iron, protein and calcium, is not always the same as in human milk even if the levels are the same. This may at least be partly corrected by having a different concentration of the ingredient in the formula
- many biologically active components of human milk, such as immunoglobulins, cannot be reproduced in formula or would be prohibitively expensive to do so
- in New Zealand, labelling on cans of formula is in English, which assumes a certain level of literacy
- higher risk of infection due to variable sterilisation techniques or unsafe water sources
- higher risk of undernutrition or overnutrition due to differences in preparation.

## Cows' milk-based formula

Standard cows' milk-based formulas are recommended for routine feeding of the healthy infant who is not breastfed. They may be used by those who wish to supplement breastfeeding, although it is discouraged.

## Non-cows' milk-based formulas

Approximately 13 percent of infant formula sales in New Zealand are non-cows' milk-based formulas. Non-cows' milk formulas can be given to infants with cows' milk protein intolerance or with certain inborn errors of metabolism, such as primary lactose intolerance or galactosaemia (Bahna, 1978). There is sometimes a simultaneous intolerance to the protein or another nutrient of the alternative formula. The following non-cows' milk formulas are available:

### Soy protein formula

Soy formulas differ from cows' milk-based formulas in that:

- the protein is derived from refined soy protein isolate. Since soy protein lacks sufficient of the essential amino acid methionine, the formulas must be fortified with methionine, which affects the taste
- the carbohydrate content is derived from corn syrup solids (glucose polymers) or sucrose, or a mixture of the two, so they are lactose free.

Soy formula should only be recommended for the rare situation of the infant who has primary lactose intolerance, galactosaemia, or secondary temporary lactose intolerance which can occur after gastroenteritis. Soy protein allergy can occur in infants who are fed soy formula (Australian College of Paediatrics, 1987). Some infants have both cow's milk protein allergy and soy protein allergy, and a protein hydrolysate formula must then be used (Bahna, 1978; Forsyth and McCarthy, 1985).

### Goats' milk formula

The main carbohydrate in goats' milk formula is lactose. Hence it is not suitable for infants with lactose intolerance or galactosaemia but it may be suitable for some infants with cows' milk protein intolerance.

### Protein hydrolysate formula

The overall composition of these formulas is similar to other formulas. However the protein has been broken down into peptides and amino acids. These formulas are recommended for infants hypersensitive to either cows' milk protein or soy protein and for infants with some malabsorption syndromes. They should only be used on recommendation of a dietitian and/or a paediatrician. In general the more extensive the hydrolysis of the proteins, the less likely the formula is to elicit an allergic response. These formulas are extremely expensive because of the complexity of the manufacturing process.

## Follow-on formulas

Standard infant formula is satisfactory in the second six months of life, although the infant should also be given solid foods. Follow-on formulas can be used instead of standard formulas in the second six months of life, together with solid foods. Some parents prefer follow-on formula as they see this as a sign of development of their babies. Follow-on formulas generally have higher protein, iron and mineral contents than standard infant formulas, although these vary between products. Cows' milk-based follow-on formulas, goats' milk-based follow-on formula and soy-based follow-on formula are also available in New Zealand.

## Preparation

Infant formulas are available in two forms, powder or ready to use. Powdered formulas are made up by adding formula to boiled water which has cooled. There can be wide variations in the weight of the powder measured by the scoops provided in most powdered formulas. This lack of consistency of scoop measurements has led to significant variations in the concentrations of nutrients in the reconstituted feed from 60 percent to 140 percent of the correct amount (Hitchcock, 1987; Bennett and Gibson, 1990; Lilburne et al, 1988). The scoop provided with the can of formula should be used for that formula only; the formula must be measured carefully. Prepared formula can be stored in the refrigerator but should be only kept for a maximum of 24 hours. Fresh formula should be made up every day.

Some powdered formulas are 'instantised', that is, they are instantly miscible in water. This has the advantage of having no lumps, no clogged teats and a faster preparation time. Ready-to-use formulas are convenient but are considerably more expensive. The manufacturing process of some ready-to-use formulas results in some protein degradation.

The equipment used in preparation and feeding must be sterilised before use in the first three months of the infant's life and must be cleaned thoroughly thereafter to reduce the risk of the infant contracting gastroenteritis. Sterilising equipment and tablets to make sterilising solutions are available, and manufacturers' instructions must be followed carefully (the principles are the same for feeding expressed breast milk to infants using a bottle). Sterilising solutions can be used for 24 hours before being changed.

Alternatively feeding equipment can be disinfected by boiling. The equipment should be thoroughly washed after use and then submerged in boiling water for five minutes (Rubbo and Gardner, 1965). The cost of this method and the hazards (to both the caregivers and young children) of having frequently boiling water in the kitchen should be weighed against the cost of using sterilising solutions. Microwaving does not sterilise the equipment.

Formulas should be heated gradually by placing the bottle containing the formula in hot water. The temperature of the formula should always be tested before the bottle is given to the infant. Microwaves are not recommended for heating formulas because there can be variations in temperature throughout the bottle with local "hot spots" and the milk may continue to cook even after it has been removed from the microwave (hence manufacturers' recommendations for standing time) causing extremely high temperatures, which may cause scalding (James, 1989). However, if a microwave is used to heat formula, the bottle should be shaken thoroughly and the temperature of the feed tested carefully before feeding.

## Nursing caries

Sometimes infants are placed lying down with a bottle propped up so they can continue to feed without an adult being present, and then fall asleep. This is not recommended. An infant left alone may choke if the fluid goes down the airway rather than the oesophagus. If the infant has teeth and he or she falls asleep before the contents of the bottle are finished, the teeth will continue to be bathed in carbohydrate containing fluid long after he or she has finished feeding. This can lead to so called nursing caries, in which the teeth decay and may have to be extracted (Swartz et al, 1993; Ripa, 1988).

## Changing formulas

Formulas are often blamed, without good evidence, for a variety of symptoms such as vomiting, spilling, reflux, crying, diarrhoea or constipation. However there is no evidence, for example, that iron fortified formulas lead to constipation or that casein dominant formulas are more satisfying for babies (Nelson et al, 1988; Taitz and Scholey, 1989). Babies are often changed from one formula to another for a variety of reasons including advice from health professionals (Eastham et al, 1978). This may detract from the real problem, which may require treatment, and can be expensive as parents may be left with unused cans of formula or may change to a more expensive non-standard formula.

## How much formula?

The number of feeds and the amount of formula taken at each feed varies between babies and also with time. An infant's needs will vary with activity, illness and variations in growth rate. Babies should be fed on demand as their appetite and thirst will dictate their needs. Fluid requirements must also be met; healthy babies should generally have six or more very wet nappies a day. Guidelines for quantities and frequency of feeds are printed on the side of cans of formula, which should be used as a guide.

## Weaning and Solids

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Weaning is defined as the phase during which the infant changes from a purely liquid diet of breast milk or infant formula (or both) to one which contains all the varied foods typical of that family. The infant must become accustomed (Old English *wenian*, meaning to become accustomed) to a wide range of new flavours and textures (Birkbeck, 1992).

### Age of weaning

An infant will generally signal when he or she is ready to be weaned. Either there is an increase in the frequency of demand for feeds or the appetite is clearly not satisfied after completion of the milk feed. This may be anywhere from four to six months of age or older (Wharton, 1989).

Breast milk volume reaches a maximum at about three months postpartum (Whitehead et al, 1986). However a well-nourished breastfeeding mother, or an infant formula, can provide complete nutritional requirements for most infants for six months. The signals that an infant may be ready for the introduction of non-milk foods can be influenced by other factors. For a breastfed infant, the mother's breast milk supply may decline because she is employed outside the home or the infant is in daycare and therefore the infant feeds less frequently. The fussing and crying behaviour that many infants exhibit in the first three or four months of life may be interpreted as hunger (Walker and Menahem, 1994).

Objective signals can be hard to interpret. Weight gain was often used, and the apparent slowing of growth rate compared to standard centile charts was thought to be the signal for weaning in breastfed infants. However such charts are often drawn from data including formula fed infants, in whom solids were introduced fairly early. There is no reason to assume that slower growth rates are in themselves undesirable.

The infant has to be physiologically able to deal with solids. Co-ordination of swallowing movements sufficient to deal with semi-solid foods is not completed until four to six months of age (Barness, 1990). While some digestive enzymes are fully developed at birth, pancreatic amylase levels are low before six months (Lebenthal, 1985). Thus extensive use of starchy foods may be undesirable in the first months of life.

### Which foods for weaning and how much?

The choice of first food is culturally determined. There is no "correct" first food. Iron fortified commercial cereal foods are popular. They are bland in taste and texture and hence easily accepted by the infant, especially if initially the food is diluted with breast milk or infant formula rather than water. Alternatively, finely pureed fruit or less fibrous vegetable can be used. There is no need to add extra salt or sugar to these foods, and artificial sweeteners should not be used. Even though they may taste bland to adult palates, they are attractive to infants. It is undesirable to encourage a preference for very sweet or salty foods. Foods suitable for this stage are given in *Table 2*.

A variety of foods can be gradually introduced as the taste and, more importantly, the texture are accepted. Even a pleasant tasting food will be rejected in the early phases of weaning if the texture is coarse, gritty or fibrous. Commercial baby foods have suitable texture, but this can be achieved in homemade food with a food processor. Many foods, such as banana or cooked apple, can be prepared simply with a domestic sieve and wooden spoon to push them through. Fibrous components should be removed before processing. Many foods such as fruits and green vegetables should be lightly cooked to avoid destruction of labile nutrients such as vitamin C and folate.



During the early stages of weaning, breast milk or infant formula remains the most important nutrient source and the solids must not be given in a way or in amounts which will dramatically reduce milk intake. This can be achieved at first by giving the milk feed before the solids, which are used as a 'top-up' at the end. Cereals and similar foods should never be added to the feeding bottle as this can make the feed too concentrated and the infant will not receive sufficient fluids for proper kidney function.

Gradually solids will displace milk feeds but breast milk or infant formula should remain a prominent part of the diet until at least the end of the first year of life. Unmodified cows' milk is not recommended as the primary beverage before 12 months of age because of the risk of gastrointestinal bleeding, (which can lead to anaemia especially if iron containing foods are not given), or because of the risk of developing allergy in infants with a family history of allergy. Milk products can be introduced from eight months of age in small quantities provided there is no strong family history of allergy. Foods which are suitable for infants aged seven months are shown in *Table 3*.

Certain foods should be delayed until later in the first year of life particularly if the infant has a family history of allergy. This is because of the potential of these foods to cause allergy. These foods are shown in *Tables 4 and 5*. With each new food only a small amount should be offered at one time, perhaps as little as half a teaspoon. As the variety and quantity are increased, there is no need to supplement the foods with sugar, starch or vitamin/mineral preparations. The energy, iron, protein, fibre and vitamin A, B and C content of suitable weaning foods are shown in *Table 6*.

Cooked egg yolk has been traditionally used as an early weaning food, probably because of its reputation as a good source of iron. However its high iron content (around 1mg in a large egg yolk) is countered by the iron being bound to a protein which inhibits absorption of the iron. However it is a good source of B-carotene, vitamin A, some B vitamins and calories. Despite its high protein content (around 16%), it is not especially allergenic. Egg white is highly allergenic and it should not be given to infants under one year of age.

## Foods in the first year of life (Douglas Pharmaceuticals, 1993)

*Table 2: First foods*

Baby rice, followed by other baby cereals except wheat cereal.  
Raw or cooked apple, pear, ripe banana, apricot, peach.  
Cooked and pureed potato, kumara, pumpkin, carrot, marrow, kamokamo (marrow), lentils and raw avocado.

*Table 3: Foods suitable from about 7 months of age*

Meats : chicken, lamb, liver, kidney.  
Egg yolk.  
Cooked parsnips, yams, courgettes, green beans, taro, puha, cauliflower, broccoli.  
Melon, nectarine, nashi pears, plums (all without skin or seeds).

*Table 4: Foods suitable from 8-9 months of age unless there is a strong family history of allergy*

Beef, fish.  
Soy foods, such as tofu, tempeh, soy yoghurt.  
Cooked silverbeet, spinach, peas and beans, cabbage, creamed corn and raw or cooked tomatoes.  
Orange, kiwifruit, pineapple, berryfruit.  
Bread, pasta, wheat cereal, oatmeal, semolina, rusks and crackers.  
Yoghurt, cottage cheese, grated cheese.  
Peanut butter.

*If there is a strong family history of allergy, these foods should be delayed until 12 months of age:*  
Cheese, yoghurt, ice cream.  
Fish.  
Citrus fruit, strawberries.  
Tomato.  
Chocolate.  
Wheat cereal.  
Peanut butter.

*Table 5: Foods suitable only from 12 months of age*

Plain whole milk, soy milks with calcium.  
Foods containing rye and oat cereals.  
Egg white.

*Table 6: Nutrients from suitable weaning foods*

	Energy	Protein	Fibre	Vit B1/B2	Vit C	Carotenes Vit A	Iron
Cereals, eg, rice	◆	◆	◆	◆			◆
Apple, pear, melon, nashi, orange, kiwifruit, pineapple			◆		◆		
Banana	◆		◆		◆		
Apricot, peach, nectarine, plum	◆		◆		◆	◆	
Potato, parsnip, taro	◆		◆		◆		
Kumara, pumpkin, carrot, yam	◆		◆			◆	
Puha, broccoli, silverbeet, spinach			◆		◆	◆	◆
Cauliflower, marrow, cabbage					◆		
Avocado	◆		◆		◆		
Beans, peas, lentils	◆	◆	◆				◆
Beef, fish	◆	◆					◆
Soy foods	◆	◆	◆				
Milk, yoghurt, cheese, cottage cheese	◆	◆		◆			
Egg yolk	◆					◆	◆
Whole egg	◆	◆				◆	
Liver/kidney	◆	◆		◆		◆	◆

## Introducing new foods

Persistent rejection of a food may mean that the taste or texture is not yet appreciated. It should be withdrawn and tried later. At first a new food should only be added every four to five days. Consistent rejection may mean that the infant is 'sensitive' to that food (not necessarily allergic) and it should be introduced again at a later date. The same applies if a food is consistently regurgitated or vomited. Sometimes rejection is caused by choosing an inappropriate time for a new food, such as when the infant is fretful, or at the first feed of the day or late at night. It is better to choose a time when the infant is most relaxed and happy to introduce a new food.

## Cultural aspects of diet in early childhood

Many Maori, Pakeha, Pacific Islands people and other ethnic groups living in New Zealand eat foods characteristic to their particular culture. (Nutrition Taskforce, 1991). For many Maori and Pacific Islands people traditional foods have a spiritual significance and are highly regarded. Each iwi has its own culturally significant foods depending on the geographic location. Maori kai and Pacific Islands food can be recommended for infants and toddlers when they are available and when they are suitable to be incorporated into the usual diet.

## Maori traditional foods - Ngā tino kai a te Māori

### Kumara

The kumara is a special food that is believed to offer spiritual sustenance not found in other foods. It can be offered mashed or pureed as a first food, or as a staple vegetable for older infants and toddlers.

### Kamokamo (marrow)

Kamokamo can be mashed or pureed and fed to infants as a first food, or as a staple vegetable for older infants and toddlers.

### Puha, watercress

Green leafy vegetables, such as puha and watercress, can be offered as a puree after six months of age. These foods provide an excellent source of B-carotene (provitamin A) and iron availability can be increased if a source of Vitamin C is present.

### Kai moana (seafood)

Traditional seafoods include kina, pipi, koura (crayfish), pupu, parengo, paua and eels. Fish and seafood are known to cause hypersensitivity reactions in some infants when introduced too early. These foods should not be offered before eight to nine months of age and preferably delayed until after the first birthday for infants with a strong family history of allergies. Care must be taken to avoid seafood when there is any possibility of marine biotoxin and food poisoning bacteria, to which infants are particularly sensitive.

### Rewena (bread)

As with other wheat-containing cereals, bread should not be offered before eight to nine months of age, as the early introduction of wheat cereal may cause a reaction in genetically sensitive individuals.

## Food patterns

It is important that infants and toddlers are encouraged to eat a little and often to meet requirements for growth. Healthy eating habits should be encouraged from an early age. Infants and toddlers should not be given fatty or fried foods, and the addition of cream, butter, margarine, salt and sugar to foods should be discouraged. It is important that parents and other caregivers are aware that tea is not a suitable beverage for infants or toddlers even when mixed with milk, as it inhibits the absorption of iron (Bothwell et al, 1989).

## Vegetarian weaning

Vegetarian food patterns are increasingly common in New Zealand. Non-animal foods are therefore sometimes given exclusively as weaning foods. It is important to establish what parents mean if they describe themselves as vegetarian as there are different types of vegetarianism. These can vary from exclusion from the diet of only red meat (semi-vegetarians), all meat (lacto-ovo vegetarians), eggs and meat (lactovegetarians) or all animal products (total vegetarians, or vegans). The infant should continue to receive either breast milk or infant formula for at least the first year of life. Infant formulas are available which contain no animal products.

Legumes are good sources of proteins, iron and soluble fibre. Cereals and dark green leafy vegetables can help to supply amino acids, iron and some B vitamins. Red and orange vegetables and fruit, and dark green leafy vegetables provide provitamin A from which vitamin A can be synthesised and Vitamin C to utilize non-haeme iron. Vegan diets are deficient in vitamin B12. The amount of vitamin B12 stored by the fetus is related to the mother's intake of the vitamin in pregnancy. Infants of vegan mothers therefore may be born with deficiency of vitamin B12; breastfed infants of vegans are also likely to receive vitamin B12 deficient milk (Specker, 1994). It is important therefore that these infants receive vitamin B12 supplements (British Paediatric Association, 1988). The mother may also need vitamin B12 supplements. Families should be strongly encouraged to seek advice from a dietitian to ensure that their child receives sufficient energy, protein and other nutrients.

## Fluids

A balance between fluid input and output is essential to maintain health. Fluid is lost through the urine, faeces, perspiration and breath. Children up to the age of two years are almost entirely dependent on their caregivers to provide them with fluid. From the second six months of life onwards an infant may be able to use a feeding cup but this must be placed within his or her reach and kept filled by the caregiver. Alternatively a normal cup can be used but the infant or toddler will need help to hold the cup when drinking from it.

The main source of fluids in the first year of life is milk (either breast milk or formula). Later some fluid will be derived from additional water and juice drinks and from food once solid food is introduced. The quantities infants require are shown in *Table 7*. Additional fluids will be required if the infant or toddler is feverish or the weather is hot.

*Table 7: Guidelines for calculating fluid requirements*

Age	Volume/kg/day
0-6 months	150-200ml
6-9 months	120-150ml
12 months	90-100ml
2 years	80-90ml

The child's appetite and thirst will dictate his or her fluid requirements. Infants should therefore be fed on demand, and toddlers should be offered fluids frequently. An infant or toddler who is not getting sufficient fluids will become dehydrated. The urine will become darker and stronger smelling as it becomes more concentrated. More fluid will be extracted from the intestine leaving hard pellet-like motions. Infants who are exclusively breastfed on demand usually have soft motions whereas infants who are formula fed often have firmer motions. If the infant becomes constipated it is worth checking that the formula is made up correctly and is being offered on demand. If the formula is made too concentrated, that is, if more powder is used than is recommended, the infant may be getting insufficient fluids for adequate kidney excretory function. If the formula is being made up correctly then the infant can be given more formula of the correct dilution, or extra water (see below).

Once the infant has started a weaning diet with the introduction of solids, milk (either breast milk or formula or both) remains the main source of fluid throughout the first year of life. Other clear fluids, preferably water, can be given through the day if necessary.

## Extra water

Extra water should not be given at the expense of breastfeeding or the infant's total energy intake. Infants who are healthy and exclusively breastfed on demand are unlikely to suffer from fluid depletion. Exclusively breastfed infants should be fed more often if the weather is particularly hot and the breastfeeding mother should ensure she has plenty to drink. In hot weather or if suffering from a fever, an infant or toddler may need extra water, as much as three or four 150ml bottles per day, particularly if they are formula fed. If extra water is needed, infants up to three months of age can be given tap water which has been boiled and then cooled. After this age, water from tanks, bore holes etc, should still be boiled and then cooled before being given. This is not necessary with reticulated (ie, town) supplies unless it is of poor quality in which case the water should continue to be boiled and cooled until six months of age. It is important that the container in which the fluid is given is cleaned thoroughly. Bottled waters are often bought in the belief that they are "pure" or "natural". However they have been found sometimes to contain significant amounts of contaminants and impurities (Hunter and Burge, 1987).

Bore water should be checked for its nitrite concentration (from leaching of nitrites from fertilisers into the water table and underground water sources). If the bore water has a high nitrite content, boiling will increase the concentration of nitrite. The alternatives are to use a filter which will filter out nitrite or to use water from another source which has low nitrite levels.

## Fruit juices and cordials

It is not necessary to give fruit juice or cordial to infants. Water is the preferred choice if additional fluids are required as giving sweet drinks from an early age may cause the infant to develop a preference for sweet foods (Beauchamp and Moran, 1982). If an infant is given extra fluids then this should be water via a bottle or feeding cup. If added flavouring is required, juice should be added in small quantities to the water in the container until sufficient to just colour the water. Sugar should not be added. Fruit juices and cordials all contain sugars, either intrinsically or as added sugars, despite labelling which may claim otherwise (regular cordials contain up to 15% sucrose). Fruit juices may contain up to 20 percent sugars and still be labelled 'fruit juices'. Sweetened drinks can contribute to tooth decay, either from their sugar or acid content (Sorvari and Rytomaa, 1991). An infant should not be left with a bottle of juice or milk as a way of settling him or her because the teeth are bathed in sugar (see *Formula Feeding*). Flat lemonade is sometimes given to infants as a popular remedy for various intestinal disorders such as diarrhoea or colic. This is not recommended because it is potentially dangerous. The high osmolarity of the lemonade or fruit juices may temporarily draw fluid into the intestine and cause further diarrhoea and worsen the dehydration. Excessive use of fruit juices, particularly apple juice, can cause diarrhoea because of the high concentration of sugars, particularly fructose and sorbitol, which are not absorbed (Lifshitz et al, 1992; Kneepens et al, 1989; Hoekstra et al, 1993). Some juices and cordials are advertised as containing vitamin C. Use of vitamin supplements is discussed in *Nutritional Supplements*.

## Coffee, tea, caffeine containing beverages, soya drinks and alcohol

These drinks are unsuitable for infants and toddlers. Caffeine is found in coffee, tea, cocoa and cola flavoured drinks. Coffee and tea contain about three or four times as much caffeine as an equal volume of cola flavoured drink. Caffeine is a central nervous stimulant which can cause irritability and restlessness. Coffee, tea and cola are not appropriate drinks for infants and toddlers. Tea drinking is not recommended because the tannin content of tea inhibits iron absorption from the intestine (Bothwell et al, 1989). Herbal teas can have adverse effects and are not recommended for infants and toddlers (Allen et al, 1989; Ridker, 1989). Soya drinks which are marketed for adults should not be given to infants and toddlers. These drinks provide insufficient calcium for infants and toddlers unless they have been fortified. Alcohol is also inappropriate for infants and toddlers. In metabolizing the alcohol, they may become hypoglycaemic. The blood sugar may then fall to such a low level that the child becomes unconscious and may have a convulsion or suffer brain damage.

Infants under the age of 12 months should receive either breast milk or a recognised infant formula (Wharton, 1990) as the principal fluid (see *Breastfeeding* and *Formula Feeding*). Milk, usually cows', is an important food for toddlers. However it is not an adequate source of some essential nutrients and the quantity of milk consumed must not be so much as to depress the appetite for a wide variety of other foods.

## Milk for one to two year olds

Milk is a very palatable beverage for most toddlers and there can be a tendency to consume so much that milk displaces other foods from the diet. Milk satisfies thirst, and its fat content satisfies appetite as well. A total volume of around 500 to 600 ml per day is sufficient. The nutrient value of 500 ml of whole milk in relation to recommended dietary intakes (RDIs) is shown in *Table 8*.

*Table 8: Comparison of 500 ml of whole cows' milk with the recommended dietary intakes (RDIs) for a 1 to 2 year old toddler (Burlingame et al, 1993)*

	RDI	500 ml whole milk
Energy	4.8-5.0 MJ	1.4 MJ
Protein	14-18 g	16.5 g
Calcium	700 mg	570 mg
Potassium	1.0-2.7 g	0.65 g
Riboflavin	0.8 mg	1.2 mg
Thiamin	0.5 mg	0.5 mg
Vit B12	1.0 mcg	1.75 mcg
Vit A	300 mcg	140 mcg
Zinc	4.5 mg	1.5 mg

The energy contribution of whole milk is beneficial for toddlers (see *Energy*). However milk contains very little vitamin C and folate, no dietary fibre and negligible iron. Although it is an excellent source of some essential nutrients, it is by no means a complete food. Reduced fat milk is not recommended for infants and toddlers under the age of two years because of its low energy content.

Milk and milk products which have not been heat treated (except by pasteurisation) tend to be allergenic in susceptible individuals (Jenkins et al, 1984). Unmodified milk products are therefore not recommended for infants under 12 months of age (American Academy of Pediatrics, 1992a).

The majority of infants and toddlers are not harmed by consuming milk and milk products. There is much misinformation among the public suggesting that milk is, for example, "mucus-forming" or that it is responsible for a variety of health problems. The present trend to avoid milk products on the basis of fad claims is not only unhelpful but may have adverse health consequences by depriving infants and toddlers of essential nutrients. If a true cows' milk protein hypersensitivity is present, milk and milk products must be avoided. It is estimated that between one and three percent of infants have a hypersensitivity to cows' milk protein; the proportion is much lower in older children (Bahna, 1978). Of infants with proven cows' milk allergy in the first year of life, less than 10 percent of them will have clinical problems with milk when they are five years old (Chandra et al, 1993).

Milk is a rich source of several essential nutrients, some of which are difficult to obtain from other foods in sufficient quantity. Exclusion of milk or milk products from the diet should only be undertaken with the expert assistance of a dietitian. Only by a careful choice of alternatives can nutrient requirements be met.

Reduced fat milks can be prescribed in special circumstances, such as obesity. However because of the risk of undernutrition, this should only be used following consultation with a dietitian, who will help to review the diet as a whole.

# Food Intolerance and Food Allergy

Adverse reactions to food occur more commonly in infants than in older children or adults (Chandra et al, 1993). Infants are at greater risk because their intestinal mucosa is less mature and therefore they may be more prone to absorb macromolecules than older individuals and also because their immune systems are immature. Adverse reactions to food may take the form of food intolerance, aversion or hypersensitivity. These can be difficult to detect in infants and toddlers. Health workers need to rely on parental observation and interpretation of an infant or toddler's reactions, which can be influenced by the parents' own attitudes and interpretation. During weaning normal changes which occur, such as in the character or frequency of an infant's motions, may be incorrectly thought to be abnormal and due to food intolerance. To identify whether the infant or toddler has a food allergy, withdrawal of the suspected food followed by rechallenge, preferably under double blind conditions (ie, where neither the child and his or her parents nor the observer know whether the food contains the ingredient suspected of causing the problem), is the only secure method of establishing a firm diagnosis. This should only be done in co-operation with a dietitian to ensure that all the suspected food is removed from the diet and that the infant or toddler is still receiving a nutritionally adequate diet.

## Management of food allergy and intolerance

Food allergy and intolerance should be managed jointly by a dietitian, the referring doctor and the family. Dietitians have a key role in assessing nutritional requirements and in regularly reviewing the diet and checking compliance (Wham et al, 1989). The doctor and dietitian should monitor the diet to avoid unnecessary food restriction and to monitor growth. Children may outgrow food allergy or intolerance and they should be tested regularly to ensure that diets are not prolonged unnecessarily.

## Food intolerance

A reproducible reaction to a food without antibody production is known as food intolerance because the reaction is not mediated by the immune system. The most common causes include an enzyme deficiency (eg, lactase deficiency), a histamine releasing effect (eg, sensitivity to shellfish) or the release of substances produced by the fermentation of food residues in the bowel (Royal College of Physicians, 1984).

## Food aversion

This is an adverse reaction caused by the emotion associated with a particular food or foods rather than the food itself and which does not occur when the food is given in an unrecognisable form. Food aversion may be influenced by parental behaviour and attitudes (Egger, 1991).

## Food protein hypersensitivity

Food protein hypersensitivity occurs when the body's immune system treats a food protein as an antigen. The term 'food allergy' should be used in this context only. A hypersensitivity reaction always involves antibody formation which can usually be demonstrated by skin testing or radio allergosorbent test (RAST) of the blood. Although a positive test indicates hypersensitivity, it does not indicate the clinical significance of the sensitivity, so a controlled food challenge needs to be carried out.

Hypersensitivity reactions to foods may be immediate or delayed. In both, the interaction with the antigen is immediate but the appearance of symptoms may occur within minutes or many hours later. Diagnosis of an immediate reaction is easier because symptoms correlate closely with eating of the offending food but diagnosis of delayed reactions is difficult because the symptoms may not appear until many hours after the

food is eaten. Foods that most often cause immediate reactions are nuts, eggs, milk, soy beans, wheat, peanuts, chicken, fish and shellfish (Atkins, 1983). These hypersensitivity reactions are more likely to occur in infants and toddlers with severe atopy.

## Foods causing adverse reaction in children

Reactions to milk, egg white, peanuts and soy account for the majority of reactions in infants and toddlers (Fomon and Bell, 1993). The age of introduction of these foods is discussed in *Weaning and Solids*.

### Cows' milk and dairy products

Cows' milk is the most common cause of food protein hypersensitivity in infants and toddlers (Bock et al, 1978). The incidence in New Zealand is not known but elsewhere it has been estimated to range between one percent and three percent (Bahna, 1978). Heat treatment of cows' milk denatures some of the offending proteins which may reduce their antigenicity.

### Eggs

Eggs, particularly egg white, contain a number of proteins known to cause hypersensitivity reactions.

### Legumes

Legumes include peanuts, soy beans, other beans, peas and lentils. Cross reactivity may occur between these foods. Peanuts, including peanut butter, are remarkable for their ability to cause especially severe reactions (whole peanuts are not recommended until five years of age because of the risk of inhaling peanut fragments into the lungs). Soy protein is just as likely as cows' milk protein to cause hypersensitivity (Kjellman and Johansson, 1979). Soy formulas should not be used routinely for infants considered to be at risk for developing allergies (Australian College of Paediatrics, 1987).

### Wheat

Intolerance to wheat and gluten causing coeliac disease may co-exist. In coeliac disease there is damage to the mucosa of the small intestine caused by a hypersensitivity to gliadin, a protein portion of gluten found in wheat, rye, oats and barley. Coeliac disease is usually recognised after nine months of age and is characterised by failure to gain weight and chronic diarrhoea. A gluten-free diet should not be started unless a diagnosis of coeliac disease has been confirmed by intestinal biopsy (Walker-Smith et al, 1990).

### Fish and shellfish

These may cause allergic reactions.

## Atopic eczema and allergic asthma

Most infants and toddlers with atopic eczema and allergic asthma demonstrate elevated levels of IgE antibodies in the blood, and positive skin prick tests and RAST to a variety of dietary and environmental allergens. Two-thirds or more of these infants and toddlers have a family history of eczema or asthma. Causes include exposure to aeroallergens (animal danders, dust mites, moulds), irritants (tobacco smoke) and viral infections.

## Prevention

### Breastfeeding

Prolonged exclusive breastfeeding is recommended as a protection against food allergy but it is not clear whether it postpones or prevents sensitivity (Kajosaari and Saarinen, 1983). Breast milk may contain antigens from food in the maternal diet. Although these antigens are present at low concentrations, the quantities are at times sufficient to sensitize the infant. Maternal avoidance of major food antigens during breastfeeding is recommended for infants at risk (Chandra et al, 1986) but it is important that breastfeeding women have a satisfactory diet and they should consult a dietitian before beginning an exclusion diet.

### Avoidance of cows' milk

Whole cows' milk should be avoided until 12 months of age. Infants who are not breastfed and are hypersensitive to cows' milk-based formulas should be fed a protein hydrolysate formula.

### Delayed introduction of solid foods

Introduction of solid foods in infants with a family history of food allergy should be delayed until after six months of age. Major allergens such as cows' milk, soy, eggs and peanuts should be avoided until the infant is at least one year old (see *Table 6 in Weaning and Solids*).

### Avoidance of environmental allergens

Infants at risk should have reduced exposure to dust mite, animals, tobacco smoke and infection (Chandra et al, 1993).

## Energy

We convert food which we have eaten into energy which is used for movement, growth and metabolic functions, such as breathing, heart contractions, digestion and keeping warm. Previously measured in calories and kilocalories, energy is now measured in kilojoules or megajoules. The young infant uses a considerable amount of energy for growing and most of the rest for metabolism. Relatively little is used for physical movement (Fomon, 1993).

As the child grows, these proportions change. The relative amount used in growth rapidly diminishes because the rate of growth slows during the first two years of life. The amount used in purposeful movements increases substantially as the child learns to roll around, crawl and finally walk. Since basal metabolic needs are proportional to body size, they increase as the child grows. In the first four months of life about 27 percent of energy intake is used for growth. This falls to 11 percent by six months of age and to five percent by 12 months (Fomon, 1993).

## Energy requirements

On average the full term infant has about 550 g of fat, mostly in adipose tissue, which represents about 20 MJ of energy. The fat also serves to conserve heat by insulating the deep tissues. The amount of depot fat varies markedly between babies; heavy babies can have over 25 percent of their body weight as fat. Energy needs are proportional to body size, rate of growth and degree of physical activity. Average daily energy requirements up to one year of age are shown in *Table 9*.

There may be substantial variation between energy needs in different children. The child's appetite and growth are the best guides to adequacy of energy intake. Between one and two years old there is even greater variation between toddlers due to varying levels of physical activity. Average energy requirements are 5.0 MJ per day for boys and 4.8 MJ per day for girls.

*Table 9: Daily energy requirements up to one year of age per kg body weight*

Age (months)	<1	1-2	2-3	3-4	4-5	5-6
KJ/Kg	520	485	455	430	415	405
Age (months)	6-7	7-8	8-9	9-10	10-11	11-12
KJ/Kg	395	395	415	395	420	435

## Preterm and post-term infants

These infants tend to have much less body fat than full-term babies. This means that they potentially have insufficient energy reserves to meet their demands for rapid growth and that they may develop hypoglycaemia, with the risk of brain damage. They also have problems with heat control. The fetus only stores fat in substantial amounts from 34 weeks gestation, which explains the malnourished appearance of the preterm infant. Post-term infants look emaciated probably because rapidly diminishing placental functions mean that they have to utilise energy from their depot fat stores to remain alive.

## Food energy sources

### 0 to 6 months

Human milk provides energy mainly from fat (54%) and carbohydrate (46%). Most ingested protein is used for growth and not for energy generation. Infant formulas are designed as breast milk substitutes, and therefore have the same distribution of energy sources as breast milk. Although the nature of the fatty acids is different, from the viewpoint of providing energy they can be considered equal. Infant formulas have a higher protein content than breast milk. This is partly to compensate for poorer utilisation of the protein in infant formula; more surplus amino acids will be converted into energy.

### 6 to 24 months

In the initial stages of weaning the energy contribution of solids is small and breast milk or infant formula remains the predominant energy source. Although this situation gradually reverses, in the first two years of life most infants and toddlers still obtain the majority of their energy from milk. Reduced fat milks should not be used for infants and toddlers under two years of age because of the low energy content of these milks at a time when children have high energy requirements (American Academy of Paediatrics, 1992a).

The energy density of a food is the amount of energy it contains per unit mass of food. Because infants and toddlers have relatively high energy requirements and limited stomach capacity they should eat foods which have higher energy density and lower dietary fibre than adults (see *Fibre*).

## Fat

Fat is an essential component of the diet. It provides a concentrated form of energy and contributes to the taste, texture and palatability of food. Dietary fat provides essential substrates for cell structures and a wide variety of biologically active constituents of the endocrine, coagulation and immune systems. During the first two years of life the child's high energy demands for growth and metabolism have to be met by a diet of greater energy density than for that required in adulthood. This is provided by dietary fat, initially from breast milk or infant formula.

### What is fat?

Fat comprises triglycerides which are made up of three molecules of fatty acids linked to a glycerol backbone. Both breast milk and infant formula provide approximately 50 percent of their energy from fat. Of the many biochemical and immunological differences between breast milk, cows' milk and infant formula, the differences in chemical composition of the fat are of particular importance. These comprise the differences in proportion of polyunsaturated fat (P), monounsaturated (M) and saturated (S) fats (summarised as the P:M:S ratio for a milk) and the differences in amount of omega-3 (N-3) and omega-6 (N-6) long chain polyunsaturated fatty acids.

The P:M:S ratio of the milk not only affects its immediate digestibility but the P fats in breast milk also aid the absorption of calcium. In addition this biochemical profile of the fat is reflected in the profile of the fat stored in the baby's adipose tissue and affects the composition of the fat transport vehicles (lipoproteins), which may have long term consequences on the rate of development of atherosclerosis (Fall et al, 1992).

### Why children need dietary fat

Children are more vulnerable than adults to rapid changes in nutritional intake. Acute and chronic childhood illnesses impair appetite and may cause a reduction in food intake to the point where growth falters. A proportion of infants and toddlers are fussy eaters and others may have their food intake compromised by poverty or culturally restricted diets. Recommendations for dietary modifications which aim to reduce total fat and control the energy intake of the general population are therefore inappropriate for infants and toddlers because of the potential adverse effect on their energy balance (Magarey et al, 1993). Dietary fat should contribute 35 percent or more to total food energy throughout the first two years of life.

### Recommendations for the amount of fat, and food sources, from birth to two years of age

The following recommended sources of dietary fat and the percentage contribution to total energy are similar to recommendations in Scandinavia (Social Styrelsen, 1991), Australia (NHMRC, 1994), and the United Kingdom (Department of Health (UK), 1991).

#### Age 0 to 6 months

Babies should preferably be exclusively breastfed until six months of age. Otherwise an infant formula is recommended. Fat should contribute 40 to 50 percent of the energy to the diet.

#### Age 6 to 12 months

Nearly half of mothers in New Zealand successfully breastfeed up to six months post partum. From six months of age the baby will require additional food energy to satisfy the energy requirements of growth

and weaning foods are introduced (see *Weaning and Solids*). The fat content of the diet will come predominantly from breast milk or infant formula and will be gradually supplemented with fat from animal and plant sources. Breast milk or infant formula should be added to cereal. Towards the end of the first year the fat content of the diet will gradually fall to below 40 percent but should not be below 35 percent of total food energy.

### Age 1 to 2 years

During this period the toddler gradually adds an increasing variety of foods to the diet, exploring differences in taste and texture. The diet changes from one in which half the energy is derived from fat (particularly milk) to a mixed diet in which less than 40 percent of energy is derived from fat. The implication of this change is that there is a wider range of types of fat in the diet and therefore the family's selection of food then becomes of great importance in determining the biochemical influences of fat on serum lipoproteins and cholesterol. Family food, which the toddler shares, should therefore comprise sufficient fat to contribute between 35 to 40 percent of the toddler's total energy, with no more than one third of fat being saturated (corresponding to 10 to 12 percent of total energy), no more than one third being polyunsaturated fat, and at least one third being monounsaturated fat. Fat soluble vitamins should be present in adequate amounts in the weaning food and it should not be necessary to add them as a supplement.

## Iron

Iron is an essential component of haemoglobin, myoglobin and many enzymes. Iron deficiency can cause anaemia and infants and toddlers are at risk of becoming iron deficient because of their increased needs for growth and limited food choices (Dallman et al, 1980). Preterm infants have lower iron stores at birth because the fetus only stores iron from 34 weeks gestation. These infants are at particular risk of iron deficiency.

### Prevalence of iron deficiency

Iron deficiency is a well recognised health problem amongst New Zealand children. Numerous studies over the past thirty years have documented its prevalence, particularly amongst the children of Maori and Pacific Islands people (Tonkin, 1960; Qusted, 1980; Crampton et al, 1993).

### Effects of iron deficiency

Iron deficiency in infancy which is severe enough to cause anaemia is associated with impaired mental performance and psychomotor development (Walter et al, 1983, 1989; Lozoff et al, 1987, 1991). Children with iron deficiency anaemia in infancy are at risk of long-lasting developmental impairment (Lozoff et al, 1991). Iron deficiency may also restrict linear growth (Chwang et al, 1988). Evidence for a cause and effect relationship between the prevalence of iron deficiency and the frequency of infections is controversial.

### Iron requirements

The RDIs of iron for New Zealand infants and toddlers are based on intakes required to establish an iron balance and are shown in *Table 10* (NHMRC, 1990). Absorbed iron therefore has to match losses plus requirements for growth to achieve this.

*Table 10: Daily RDI of iron depending upon feeding method and age of child*

	Iron (mg)
Breastfed infants	0.5
Bottlefed infants	3.0
Infants 7-12 months	9.0
Children 1-3 years	6-8

### Recommendations to ensure an adequate dietary iron intake

Breast milk and/or infant formula are the primary sources of nutrients during the first six months of life. They should be given to at least 12 months of age since other food sources may not provide sufficient iron in bioavailable form (Filer, 1990). The full-term infant has sufficient iron stores so that the infant's iron needs are met by breast milk or infant formula until six months of age. From six months of age weaning foods from which iron is easily absorbed should be encouraged. Iron fortified infant cereals are suitable iron-containing starter foods. At seven or eight months of age meat or chicken purees can be added. Liver and kidney are excellent sources of iron but are of little value if they are not acceptable. Dark green leafy vegetables, sieved lentils, chickpeas and peas provide a suitable alternative for vegetarian infants. Some infants and toddlers on vegetarian and vegan diets may require an iron supplement, which should be discussed with a dietitian.



## Food sources of iron

### Breast milk

Iron is present in breast milk in a low concentration (0.2 to 0.7 mg per litre) but it is highly bioavailable. About 50 percent of the iron in breast milk is absorbed compared to 10 percent from cows' milk-based infant formula (Saarinen et al, 1977). The lower calcium, phosphorus and protein content present in breast milk and the high concentration of lactose and the iron binding protein, lactoferrin, aid absorption. Compared with infants fed cows' milk, intestinal blood loss is rare in breastfed infants (Ziegler et al, 1990). Infants who receive only breast milk after six months of age need supplemental iron (Pizzaro et al, 1991).

### Infant formula

Infant formulas used in New Zealand are fortified with iron and have a higher content of iron (7 to 12 mg per litre) than breast milk. Iron fortified formulas also have added ascorbic acid which enhances iron absorption (Stekel et al, 1986). The use of iron fortified formulas is effective in the prevention of iron deficiency in full-term infants in the first six months of life (Yip et al, 1987).

### Cows' milk

Cows' milk has low concentration of iron and its absorption is poor. Feeding of cows' milk may cause gastrointestinal blood loss and subsequent iron deficiency during infancy (Ziegler et al, 1990). Feeding of whole cows' milk, particularly as the primary beverage should therefore be discouraged until 12 months of age.

### Infant cereals

Most infant cereals are fortified with iron to a level of iron between 10 and 38 mg per 100 grams of dry cereal. The bioavailability of iron from infant cereal products is not known and should not be relied upon as a sole source of iron (Fomon, 1987).

## Bioavailability of iron in food

Iron in food includes both haem and non-haem iron. Haem iron comes mainly from haemoglobin and myoglobin in meat, chicken and fish. Non-haem iron includes iron from vegetables, cereals, fruits, and eggs as well as the non-haem iron in meat, chicken and fish and from soluble iron supplements. The extent to which iron is absorbed depends on the body's iron stores and the composition of the diet as a whole. More iron is absorbed when iron stores are low.

### Enhancers of non-haem iron absorption

The absorption of non-haem iron from foods of low bioavailability is improved in the presence of beef, lamb, pork, chicken, liver and fish (Cook and Monsen, 1976). Non-haem iron absorption is also enhanced by the presence of ascorbic acid. Thus eating fruit and vegetables which contain vitamin C at the same meal will enhance the absorption of non-haem iron. Other promoters of non-haem iron absorption include citric acid, malic acid, tartaric acid and lactic acid, which are found in fruit and yoghurt.

Generally, haem iron is more highly bioavailable than non-haem iron.

## Inhibitors of non-haem iron absorption

Tannins present in tea are the major inhibitors of food iron absorption (Bothwell et al, 1989). In infants there is a highly significant association between tea drinking and anaemia. Several New Zealand studies have found tea drinking to be common amongst iron deficient children especially those children from Maori and Pacific Islands families (Questa et al, 1980; Poppe, 1993). Dietary iron bioavailability is also inhibited by phytates, which are present in cereals, soy beans, legumes, nuts, wheat bran and other sources of dietary fibre. Milk and cheese may decrease iron availability if they are taken in large amounts. Inhibition is possibly due to the presence of high levels of calcium and phosphorus (Bothwell et al, 1989). Although eggs have a high iron content, the egg yolk contains a phosphoprotein that binds iron and decreases its bioavailability.

## Calcium

Calcium is essential for the development of bone, muscle contraction, the transmission of nerve impulses and blood clotting. It is also an activator for a number of enzymes.

### Calcium requirements

Infants and toddlers require about 100 mg of calcium per day in the first two years of life (American Academy of Pediatrics, 1978). With losses of about 6 mg per day in the newborn period and of about 25 mg per day at 12 months of age, infants need to absorb about 125 mg of calcium per day (NHMRC, 1990). The RDIs of calcium for New Zealand children are based on intakes required to establish a calcium balance, and are shown in *Table 11*.

*Table 11: Daily RDI of calcium depending upon feeding method and age of child*

	Calcium (mg)
Breastfed infants	300
Bottlefed infants	500
Infants 7-12 months	500
Children 1-2 years	700

### Food sources of calcium

#### Breast milk

The mean concentration of calcium in breast milk is approximately 260 to 300 mg per litre during the first six months of breastfeeding (Fomon, 1993). The ratio of calcium to phosphorus in breast milk is approximately 2:1 compared to approximately 1.2:1 in cows' milk. The relatively low phosphorus content of breast milk may be a factor in the higher absorption of calcium from breast milk than from cows' milk. Calcium concentration in the breast milk of well nourished women is unaffected by their calcium intake (Finley, 1985).

#### Infant formulas

The Joint FAO/WHO Codex Alimentarius Commission requires that formulas contain a minimum of 12 mg of calcium per 100 KJ. The calcium to phosphorus ratio in cows' milk-based infant formulas ranges from 1.2:1 to 1.9:1. The concentration of calcium in soy-based formulas is greater than that of milk-based formulas to compensate for the presence of phytates in the soy protein isolate, which may inhibit calcium absorption.

#### Milk and milk products

Milk and milk-based foods are the major food sources of calcium and provide many other essential nutrients such as zinc, riboflavin and vitamin B12 (see *Milk*). Toddlers should be encouraged to take 500 ml of cows' milk or an equivalent each day. Yoghurt, ice cream, milk puddings and cheese are suitable substitutes.

### Non-dairy product sources of calcium

Toddlers over 12 months of age who do not consume cows' milk or milk-based foods should be encouraged to drink a calcium fortified soy milk. Suitable food alternatives include tofu, canned fish with bones, green vegetables, beans and nut pastes. For vegan infants and toddlers, cereals, pulses and vegetables should be sieved and whole grain cereals replaced by foods with a low fibre content (Dagnelie et al, 1990). The use of a calcium supplement should be considered when there is any doubt that dietary calcium requirements have not been met, but only after consultation with a dietitian and a doctor.

### Factors affecting absorption

The level of calcium in the body is regulated by parathyroid hormone, calcitonin, and metabolically active vitamin D. Vitamin D aids absorption of calcium from the digestive tract. Certain amino acids and lactose (milk sugar) may enhance absorption. Fibre, phytates and oxalates present in some cereals and vegetables may decrease absorption of calcium by forming insoluble salts (Allen, 1989). Since excess sodium in the diet can increase calcium excretion, salt should not be added to children's food and the use of salty foods should be limited. Phosphorus also influences calcium uptake and combines with calcium in forming the rigid structure of bone. The dietary phosphate to calcium ratio has to be very high (probably over 3:1) to interfere with calcium availability (Truswell et al, 1990).

### The effects of calcium deficiency

In children the failure to deposit sufficient calcium in bone causes rickets, in which there is growth retardation, bowed legs and other skeletal abnormalities. Vitamin D deficiency is the main cause of rickets (see *Nutritional Supplements*).

## Other Minerals

Essential minerals are inorganic substances needed by the body to build and maintain cell structure and as part of the chemical message system in the cell. Deficiencies of these minerals can impair normal growth and adversely affect the child's metabolism.

### Zinc

Zinc is an essential component of a large number of enzymes such as alkaline phosphatase. Since protein synthesis is dependent on a number of these zinc-containing enzymes, the effects of zinc deficiency include impaired growth. The main sources of zinc are red meat, liver, cheese and other high protein foods. The phytate and fibre present in cereals inhibit absorption of zinc by forming insoluble complexes. Fruits and vegetables other than legumes are also poor sources. Infants and toddlers on strict vegan diets are at risk of developing zinc deficiency (Dwyer et al, 1982).

### Selenium

Selenium is necessary for normal thyroid function and is a component of the enzyme glutathione peroxidase which is an essential part of the body's antioxidant defense mechanism. New Zealand soils have low levels of selenium. An adequate selenium intake is required to maintain the body's complex mechanism of scavenging free radicals which are products of oxidative reactions. Selenium deficiency has not been found to be associated with sudden infant death syndrome (SIDS, or cot death) (Mitchell et al, 1991a). The RDI for New Zealanders has yet to be established. The Australian RDI is 10 mcg per day for infants under six months, 15 mcg per day for infants aged seven to 12 months, and 25 mcg per day for toddlers aged one to two years old. New Zealand infants who are breastfed or fed infant formulas may receive less than these levels but to date there is no evidence of selenium deficiency in these infants (Williams, 1983; Dolamore et al, 1992). The concentration of selenium in foods correlates closely with the protein content. Meat, chicken, seafoods and eggs are good sources of selenium, cereals are moderately good sources, but New Zealand grown fruits and vegetables contain relatively low levels.

### Fluoride

Fluoride combines with calcium in the body to produce healthy bones and teeth. The fluoridation of drinking water is the most effective measure for prevention of dental caries. It has a proven beneficial effect on dental health. Children who have been drinking fluoridated water since infancy show the greatest benefits. Near maximal protection occurs when the fluoride concentration of drinking water is 0.5 to 1 ppm (WHO, 1994). Nowhere in New Zealand has naturally occurring water fluoride concentrations greater than 1 ppm.

The concentration of fluoride in breast milk is low irrespective of whether the mother consumes fluoridated or non-fluoridated water (Chowdhury et al, 1990). Fluoride supplementation of the maternal diet during pregnancy and lactation is not necessary for proper infant dental development. Infant formulas made in New Zealand contain negligible amounts of fluoride (although imported ones may contain variable amounts). The major source of fluoride in infant formula is from the water used to reconstitute the powdered formula provided it is fluoridated water. There is no evidence that the fluoride derived from water used to reconstitute the formula had any harmful effects in areas where the fluoride concentration is 1 ppm (Working Party, 1980). There is no association between fluoridation of water supplies and SIDS (Mitchell et al, 1991b).

Fluoride toothpaste should be used by all children from the time their first tooth erupts. A smear of toothpaste should be used on each occasion, and to avoid ingestion tooth brushing should be supervised

by an adult. Excessive fluoride intake can cause dental fluorosis which causes mottling of the teeth. Infants and toddlers are most at risk of fluorosis if they eat fluoride toothpaste (Pendry and Stamm, 1990). In non-fluoridated areas they should be given recommended doses of either fluoride tablets, which can be crushed, or fluoride drops. Dietary sources of fluoride include fish and chicken. Although tea contains significant amounts of fluoride, it is not recommended for infants and toddlers because it inhibits the absorption of iron from the diet.

### Iodine

Dietary iodine is converted to iodide in the gastrointestinal tract. Iodide is concentrated mainly by the thyroid gland, which makes two hormones, thyroxine and tri-iodothyronine, which regulate the body's metabolism. New Zealand has relatively iodine deficient soil so local foods and water are deficient in iodine. This deficiency has been partly overcome by adding iodine to salt. Most dietary iodine is derived from breast milk, infant formulas, dairy products and bakery goods. Fish and seafood provide rich sources for toddlers. Deficiency of iodine causes the cells of the thyroid gland to increase in size and number, producing a goitre. The incidence of goitre has virtually been eliminated with the increasing range of foods on the market, the use of iodine-containing foods and the supplementation of iodine in the diet.

Studies and reports referring almost entirely to adults have suggested that there are beneficial effects from eating a diet high in fibre and various diseases have been linked with inadequate fibre intake (Burkett et al, 1980).

### What is fibre?

Dietary fibre is found only in plant foods and is the undigested plant residue that passes almost intact through the small intestine (Reid et al, 1992). There are two types of fibre, soluble and insoluble. Soluble fibre is found in fruits, vegetables, legumes and some cereals such as oats. It is fermented in the large bowel by gut bacteria to produce short chain fatty acids and gas. It also delays gastric emptying and increases the viscosity of the contents of the small bowel. Insoluble fibre, which is found in cereals, grains, nuts, seeds and vegetables, absorbs water and forms softer motions, normalises bowel transit time and can reduce constipation.

### How much fibre?

There are limited data on normal intakes of fibre for infants and toddlers. A New Zealand study looking at nutritional intakes of a group of 53 healthy Auckland children aged nine to 24 months found the mean daily intake to be 8 g with a range between 1 g and 22 g (Wham, 1994).

Infants who are fed solely on breast milk or infant formula do not receive any dietary fibre. Normal bowel function in infancy is maintained by undigested compounds from milk feeds which together with gut bacteria provide the bulk for normal motions. Weaning solids such as fruit puree and commercial baby cereals, which are usually introduced at four to six months of age, are the initial sources of fibre in the infant diet. Excessive quantities of weaning solids containing fibre should not be given as diarrhoea may develop. Fibre containing foods have a low energy content relative to their volume. Infants and toddlers given large amounts of fibre containing foods may have their appetite satisfied before their energy requirements have been met (Lifshitz et al, 1989).

Dietary fibre and its contents, such as phytates found in cereal fibre, can bind with and prevent effective absorption of some minerals including calcium, copper, iron, magnesium, phosphorus and zinc (Francis, 1986). The nutritional significance of the inhibiting effect of phytate depends upon the levels at which phytate and the minerals it influences are consumed in the individual diet. Most Western diets do not contain sufficiently high amounts of phytates for infants and toddlers to be at risk of mineral deficiencies. However some sections of the population such as strict vegetarians and Asian infants and toddlers, whose diets are reliant on grains and cereals, may consume enough fibre to cause suboptimal mineral levels. In extreme cases this could cause rickets or anaemia.

Although some fibre should be encouraged in older infants' and toddlers' diets, there are no RDIs for this age group.

A nutritional supplement is a preparation containing vitamins and/or minerals. For infants these are almost always in liquid form. Some micronutrients, particularly folate and vitamin C, are quite unstable in solution which poses a problem of choosing a suitable preservative. In the past some preparations have been heavily sweetened with sugar since some constituents are unpleasant to taste. Artificial sweeteners may be used but the legal range is limited.

### Are supplements needed?

Infants fed breast milk or an infant formula do not require supplements of vitamins, minerals or other nutrients. A mother with a very poor diet can have relatively low levels of some B vitamins and vitamin C in her breast milk (Fomon and McCormick, 1993) but even in extreme cases it would normally be better to give supplements to the mother rather than to the infant. The exception to this is the administration of vitamin K at birth which is outside the terms of this review.

Once weaning is established and a variety of foods have been introduced there should normally be no need or benefit in using supplements. Commercially prepared baby foods retain their vitamin and mineral content. However home preparation of vegetables and fruits may seriously diminish the content of vitamin C and folate (Moser and Bendich, 1991). Advice should be given on methods of preparation which minimize such losses, such as gentle steaming or microwaving.

Parents are sometimes encouraged by advertising or word of mouth to provide supplements of vitamins for infants and toddlers in the belief that this may help to prevent infections or to "strengthen" the immune system. While most of these preparations are harmless, there is no evidence that their use offers any benefits provided the child is receiving appropriate food choices.

### Can supplements be hazardous?

Infants and toddlers should never be given vitamins in tablet or capsule form in case they inhale them and develop respiratory obstruction. Provided that preparations specifically designated for use in infants and toddlers are used and they are given in the correct dosage there is no risk in the use of supplements. Higher dose preparations designed for adults could cause problems. Large doses of vitamin C can cause serious diarrhoea in young children (Kubler and Gehler, 1970).

### Special indications for supplements

#### Iron

Iron supplements can be given to infants and toddlers under certain circumstances, such as when the infant is preterm. Since iron accumulation by the fetus occurs mainly after 34 weeks gestation, preterm infants usually have insufficient body iron to maintain adequate iron status by six months of age (Dallman, 1986). Iron supplements are to be given by two months of age to such infants at a dose of not greater than 2mg/kg body weight/day (American Academy of Paediatrics, 1976) usually until at least six months of age. This should be under the supervision of a paediatrician and progress should be monitored at intervals.

Iron supplements must be used with caution. This is because of the danger of poisoning should a child consume a large quantity. Containers with child resistant closures are essential and they should be stored securely (including at houses that young children visit, such as grandparents' homes). Great care must be taken to ensure that infants and toddlers cannot mistake iron tablets for sweets. If swallowed in excess,

iron can cause life-threatening acute poisoning. An excessive iron intake overwhelms the iron control systems in the body leading to high free iron levels. These act as pro-oxidants and greatly enhance the risk of infections (Barry and Reeve, 1976). Liquid iron preparations have a tendency to stain teeth and all iron forms can be irritating to the gut.

### Vitamin C and Folate

These vitamins are present in substantial amounts in various fresh fruit and vegetables. Both are easily destroyed by heating (Moser and Bendich, 1991). There may be a problem with infants fed only home-produced fruit and vegetables unless they are carefully prepared. The main problem, however, tends to occur when the range of fruit and vegetables is severely restricted, such as in families on low incomes. Supplements should only be given following a full assessment by a dietitian and if it is considered that dietary modification alone is insufficient.

### Vitamin A

Vitamin A deficiency is unusual in New Zealand infants and toddlers. The principal sources of vitamin A are from animal foods such as meats and dairy products, but it can be synthesised in the body from carotene pigments in red, yellow and dark green leafy vegetables and fruit. Excess vitamin A intake can cause anorexia and vomiting, and dry itchy skin.

### Vitamin D

Vitamin D deficiency is rare in New Zealand. It has been reported in immigrant groups, especially from southeast Asia, who have excessively shielded the infant or toddler from sunlight. The predominant source of vitamin D is from the action of sunlight on the exposed skin. Deficiency is not usually dietary in origin but due to insufficient sunlight exposure. Only 10 to 15 minutes per day of sunlight on the face, hands and arms is sufficient. To avoid burning, this should not occur at the hottest part of the day. Vitamin D supplements should only be used to treat a proven deficiency.

## Breastfed babies

Vitamins A and C should come from the mother's own diet and vitamin D from mild exposure of the infant to sunlight. There is no evidence to support the use of vitamin supplements to breastfed babies in this country.

## Prophylactic use of supplements

There is no evidence to suggest that there is any benefit from giving prophylactic nutritional supplements to infants and toddlers who are adequately fed even though the level of supplementation is modest and the cost quite low. The habit fosters the belief that one cannot achieve a satisfactory intake of micronutrients from food alone. Those who do develop vitamin deficiency have usually had a diet inadequate in quality or quantity. Therefore a change in diet is the correct course of action.

Infants are sometimes fed diluted liquid cows' milk mixtures. Such infants can have very unsatisfactory intakes of vitamins C and E, iron and other micronutrients. Health professionals may sometimes recommend supplementation in such cases. Nutritional supplements should be given only after a full assessment of the individual situation. Such infants must also be considered at risk of iron deficiency even before six months of age.

Special considerations apply in vegan and other very restrictive diets. Breastfeeding by vegan mothers can result in vitamin B12 deficiency in the infant. If the mother is not taking supplements of this vitamin and has low vitamin B12 stores, it may be necessary to assess the infant's vitamin B12 status. Vegetarian weaning practices, which can pose other nutritional concerns, are discussed in *Weaning and Solids*.

## Nutritional assessment

There are very few micronutrients for which satisfactory and accessible biochemical testing is possible. Assessment by a dietitian is the best way to make a decision about the need for supplementation of the diet. It is unwise for parents to initiate supplementation themselves. In particular, supplements should never be given to compensate for real or imagined inadequacies of the diet.

## Specialised Diets

### Cystic fibrosis (CF)

CF is a multi-organ disorder characterized by chronic pulmonary disease, pancreatic insufficiency, liver dysfunction and abnormally elevated sweat electrolytes. The energy needs for normal growth are considerably greater in infants and toddlers with CF (usually 100 to 150% of RDI). This extra requirement for energy can be very difficult to achieve and requires expert dietetic management.

CF is an autosomal recessive condition affecting approximately 1 in 3,700 live births in New Zealand [National Testing Centre Greenlane Hospital, personal communication, 1994]. The Newborn Screening Programme in New Zealand tests all newborn babies for CF (as well as several other medical conditions). Early diagnosis and treatment are very important factors in the prevention of lung disease and in the ultimate prognosis. Nutritional and medical management in CF are specialised and infants and toddlers with CF should be seen at specialised clinics, and the nutritional management supervised by a dietitian.

### Phenylketonuria (PKU)

PKU is an autosomal recessive genetic condition affecting 1 in 20,000 live births in New Zealand [National Testing Centre Greenlane Hospital, personal communication, 1994]. The Newborn Screening Programme for PKU has been operational in New Zealand since 1969. Conversion of phenylalanine (an essential amino acid) to tyrosine is impaired in PKU. The resulting high levels of phenylalanine damages the developing brain.

Management of PKU includes a low phenylalanine diet beginning in the first few days of life. Nutritional management of PKU is specialised and needs to be undertaken by a suitably qualified dietitian. Breastfeeding and the use of phenylalanine-free formula needs to be carefully supervised (Greve et al, 1994). Protein containing foods are removed from the diet and replaced with specialised amino acid supplements. Additional vitamins and minerals are required to maintain nutritional adequacy and growth. "Diet for life" is the current policy in New Zealand for treatment of PKU.

### Galactosaemia

Galactosaemia is a disorder of metabolism which results from the genetic absence of galactose-1-phosphate uridylyltransferase enzyme. Galactose, most commonly present in the diet in the form of lactose, is not metabolised. Breast milk, cows' milk-based infant formulas, goats' milk-based infant formulas and cows' milk all contain lactose as the principal carbohydrate. Screening for galactosaemia is part of the Newborn Screening Programme in New Zealand [National Testing Centre Greenlane Hospital, personal communication, 1994]. Although galactosaemia is rare, affecting one in 130,000 live births in New Zealand, it can cause mental retardation, liver damage or even death if untreated. Dietary management of galactosaemia includes a strict lactose/galactose free diet for life.

Infants with galactosaemia should not be breastfed because breast milk contains lactose. Ongoing specialised dietetic supervision is required from a paediatrician and a suitably qualified dietitian to monitor growth and development and review the diet.

### Small for gestational age infants (SGA)

By definition, SGA infants have suffered intrauterine growth retardation (IUGR). These infants require extra energy for catch up growth. If growth retardation is severe the primitive suck reflex may be impaired and continuous or intermittent enteral feeding using a nasogastric tube or gastrostomy may be necessary.

To help with catch up growth, these infants require 110 to 150 percent of RDI for energy and protein. Breastfeeding should be encouraged if possible, with fortification of breast milk with non-protein calories using glucose polymer and fat emulsion supplements under dietetic supervision. Fortifiers containing additional minerals may also be needed. If the infant is formula fed, a one and one-quarter strength cows' milk-based infant formula may be used in conjunction with additional non-protein calories as required for catch up growth. The nutritional management of SGA infants is highly specialised and requires the specialist skills of a suitably qualified dietitian and paediatrician.

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## Appendix 1

# Healthy Eating for Babies and Toddlers from Birth to Two Years Old

A baby needs enough food to grow, develop, sleep, and be happy.

Caring for a baby is very rewarding, although there is always a lot to do. Your baby depends on you for a healthy start in life.

These guidelines will help you choose healthy food for your baby and toddler:

- Breast milk is best.
- If you cannot breastfeed, use an infant formula until baby is 12 months old.
- Give babies and toddlers plenty to drink.
- Start solids with one new food at a time.
- Change variety, texture and quantity as your baby grows.
- Healthy eating habits start early.

### Breast milk is best

*Successful breastfeeding is best for babies.*

Breast milk is specially made for your baby:

- it's the perfect food for baby
- it changes with your baby's needs
- it helps protect your baby against infection
- it lowers the risk of allergies
- and it's cheap, safe, environmentally friendly and ready to use!

*Young babies need to be fed often and on demand.*

Baby's appetite, happiness, weight gain and lots of wet nappies tell you how much milk baby needs. If baby is still hungry after feeding from one breast, then offer the other breast. After feeding on both breasts, begin the next feed on the breast used last.

You can express breast milk. It will keep refrigerated in a sterilised container for up to 5 days. It can also be frozen for 3-4 months in a fridge/freezer or up to 6 months in a separate deep freeze.

Remember to put the date on the container.

Make sure bottles and teats are kept really clean.

Bowel motions are soft, a bright colour and often very frequent, but each baby is different. Breastfed babies don't usually get constipated, even though some babies only have a bowel motion every few days.

If you need advice and support ask for help from:

- your family doctor and practice nurse
- Plunket nurse and Plunket-Karitane Family Centre
- your midwife or a lactation consultant
- La Leche League.

## Formula feeding

For many reasons, some parents choose to use an infant formula. There are a lot of brands to choose from. Once you have found a formula that suits your baby it is best to keep to the same one.

- Always wash your hands before preparing bottle feeds. Keep everything you use to make up baby's feeds super clean. Be especially careful in the first three months. Ask your Plunket nurse or chemist for more information about sterilising bottles and teats.
- Make up the formula carefully using instructions on the can. It shows the amount your baby needs each day. Use the scoop provided with each can and make sure the powder is a level scoop that is not packed down.
- Formula can be heated by placing the bottle in a container of hot water. It is safer not to use a microwave oven because the milk heats unevenly in the bottle and can burn baby's mouth.
- Before feeding baby, always check the temperature of the formula by putting some on the inside of your wrist. It should feel warm.
- If baby is hungry and demands more, give more formula at each feed or add an extra feed. Do not alter the strength.
- Bowel motions will be firmer and darker in colour than those of a breastfed baby.
- Breast milk or infant formula contains everything babies need for their first 6 months. But every baby is different. Check with your nurse or doctor if your baby seems hungry.
- Continue using breast milk or formula as the main milk until baby is a year old.
- Cows' milk, goats' milk and soy milk should only be given to babies when they have been especially made into an infant formula.
- Condensed and evaporated milk should not be used for babies.
- After eight to nine months many babies like small amounts of yoghurt, custard or cheese.
- After 12 months, the main milk for toddlers can be "silver" or "blue" pasteurised or homogenised cows' milk.

If you are concerned that your baby is not thriving, talk with your doctor or nurse who sees your baby.

## Babies and toddlers need plenty to drink

Babies who are breastfed on demand don't usually need extra water to drink. Babies having formula, and toddlers, need extra water in a bottle or feeding cup. This is specially important:

- when the weather is very hot
- if baby or toddler has a temperature and is feverish
- if baby or toddler has any vomiting or has diarrhoea.

*Continue to give breast milk or formula but see your doctor if your baby continues to be unwell for 24 hours.*

- Healthy babies should generally have six or more very wet nappies a day.
- In the first three months, all water babies drink should be boiled and cooled on the day it is used.
- In cities and towns you can use water from the tap after baby is 3 months old. Water from tanks or bore holes should still be boiled and cooled for babies and toddlers until they are about 18 months old.
- Drinks containing natural or added sugar such as fruit juice, cordials and fizzy drink can damage developing teeth. If you are offering fruit juice, make sure it is very dilute - just enough to colour the water. Keep sweet drinks for treats.
- Tea, coffee and alcohol should never be given to babies and toddlers. They are stimulants which can make them very restless.
- Babies should not be left with a bottle to suck on for a long time. Milk or fruit juice will coat their teeth long after feeding is finished. This damages developing teeth and will make them rot.

## Start solids with one new food at a time

*It takes time for a baby's digestive system to fully develop.*

By about 6 months they are ready to start solids. Discuss when to start first foods with your child health nurse or doctor.

Choose a time when baby is most relaxed and happy to introduce a new food. Babies like the plain taste of milk, so first foods also need to be plain. Don't add extra salt, sugar or honey to food you make for baby.

Give the milk feed first and offer solids as a 'top up'. Try one teaspoon first and gradually increase until baby is having about three to four teaspoons at a meal.

First foods need to be soft and smooth. Use a blender or push food through a fine sieve with a wooden spoon. You can add expressed breast milk, formula or water to make the food liquid enough for baby to swallow. Cows' milk can be mixed with foods after your baby is eight months old. Extra homemade foods can be frozen in ice cube trays and used in the next three to four weeks.

Canned or bottled foods made specially for babies are nutritious and can make a quick and convenient change.

Hold baby while you feed or sit them in a baby high chair. Use a small teaspoon and put the food in the middle of their tongue.

First try plain, soft foods:

- baby rice or infant cereal
- pureed apple, pear, apricot, peach or ripe mashed banana
- pureed kumara, kamo kamo or pumpkin, potato, carrot, marrow or avocado.

Try one new food every four to five days. If they don't like it the first time, leave it for a few days and try again with a small amount.

## Give more variety as baby grows

*Change the type of food offered, how much you give and the thickness of the mixture.*

When baby is about seven months old, you can begin adding some iron-containing foods like cooked and finely minced lean lamb, chicken, liver or kidney. Offer cooked egg yolk too.

Try yams, taro, puha, courgettes, cauliflower or broccoli.

By eight to nine months you can offer solids before their milk feeds. Try finely chopped lean meat, boneless fish or tofu.

Mash or finely chop vegetables instead of puree. Offer a wider range of cooked mashed vegetables such as silverbeet, spinach, peas, beans, tomatoes, cabbage and creamed corn.

Other suggestions:

- soft fresh fruit - a few orange segments or slices of kiwifruit are easy to manage.
- white bread and plain crackers.
- fine porridge or Weetbix
- yoghurt, custard, grated cheese.

Offer your baby small pieces of food to hold, such as a small sandwich or a finger of toast. Finger foods encourage them to try to feed themselves.

If you have a strong family history of allergy, some foods should be left until baby is 12 months old. Discuss this with your doctor or child health nurse. They can arrange for you to see a dietitian if necessary.

When baby is a year old, give them small amounts of the same food your family eats. Although they still need about two cups of milk a day, toddlers can try a lot of different foods:

- bread, crackers and breakfast cereals
- vegetable and fruit
- "silver" or "blue" milk, yoghurt and cheese
- chopped lean meat, chicken, seafood, whole egg, cooked dried peas, beans or lentils.

*Babies and toddlers need small meals and snacks often. They have small stomachs and are using lots of energy.*

Some healthy snacks are:

- a small sandwich
- plain cracker with cheese
- small pieces of soft fresh fruit or vegetable (You can put pieces of hard fruit such as apple in a soft muslin cloth for them to suck on.)
- a small cup of milk
- yoghurt
- homemade rusks  
(Cut slices of bread into fingers and bake slowly in the oven. Store in an airtight jar.)

Some babies like to chew when they begin teething. Offer homemade rusks or buy teething biscuits or a teething ring.

Babies and toddlers can choke very easily. Any whole pieces of food can cause them to choke.

Always make sure babies and toddlers sit down while they eat, and that someone is with them while they are eating.

Do not give small foods such as whole nuts (especially those with skins) until children are at least five years old.

## **Meal ideas for babies eight to nine months**

### *Breakfast*

Porridge with breast milk or formula *or*  
Stewed apple with cereal *or*  
Yoghurt with soft fruit *or*  
White bread or toast with a little butter or margarine and mashed banana.

### *Lunch*

Cut up finger food - bread triangles, grated cheese, small pieces of fruit, soft pasta shapes *or*  
Canned fish mashed with potato *or*  
Grilled cheese on toast fingers.

### *Dinner*

Minced beef, lamb or chicken with:  
Mashed kumara, potato, pumpkin, taro or yam *or*  
Mushy rice and mashed vegetables

Offer drinks and snacks in between meals.

## **Meal ideas for toddlers about 15-18 months**

### *Breakfast*

Breakfast cereal and milk *or*  
1/2 banana, sliced into fruit yoghurt *or*  
Wholemeal toast with a little butter or margarine and peanut butter or honey.

### *Lunch*

Sandwich quarters with luncheon sausage or mashed egg or cheese slice *or*  
Baked beans on toast *or*  
Macaroni cheese *or*  
Scrambled egg on toast  
and  
Small piece peeled fruit.

### *Dinner*

Cut up lean meat or chicken or sliced sausage with:  
Mashed potato, kumara, taro or rice, pasta *and*  
Sliced or grated lightly cooked vegetable.

Offer drinks and snacks in between meals.

## Start healthy eating habits from an early age

### *How much food should I offer my baby?*

All babies have different individual needs. Watch for signs of being full - some babies turn their head away. As baby becomes more active, you need to offer small amounts of food often.

### *My toddler seems to eat less than she did as a baby. Is that usual?*

In their first year babies grow very quickly and they need a lot of food. They don't grow quite so quickly in the second year, so some days they may eat a bit less.

### *We use "green" milk. Is that OK for my toddler?*

"Green" low fat milks are great for children over five years and adults but babies and toddlers should have "blue" or "silver" milk.

### *My child won't eat vegetables.*

Don't worry - it's very common, especially as toddlers get older. Try offering raw vegetables or small pieces of fruit as an alternative.

### *Is it true that toddlers should not have wholegrain bread?*

Babies and toddlers get all the fibre they need from vegetables, fruit and baby cereals. White bread is better for a baby's young digestive system but by about 15 months try fine soft wholemeal breads.

### *Should baby have extra vitamins?*

Babies and toddlers can get all the vitamins they need from food. Offer fruit and vegetables often. Extra vitamins are not recommended.

### *My baby seems to like sweet foods best.*

Healthy habits begin early and we can encourage children to like fresh, plain foods. Offer water instead of sweet drinks and don't add extra sugar or honey to fruit or breakfast cereals.

### *Why does my toddler need to eat iron-rich foods?*

Iron is especially important to keep blood and brain cells healthy. Iron helps children learn. Lean meat, chicken and fish contain lots of iron, and vegetables and fruit help it to be well absorbed. Don't give tea as it contains substances which stop iron from being absorbed. Give toddlers small meals often, using lots of different foods. Two cups of milk a day is plenty for toddlers.

Go easy on fat, sugar and salt in your baby's or toddler's food.

## Further reading

Other Public Health Commission books and fact sheets available from public health units or community health services of your Crown health enterprise are:

- Breastfeeding: Giving your baby the best you've got
- Inverted nipples
- Answers to breastfeeding questions
- Expressing milk
- Sore breasts
- Sore nipples
- Eating for Healthy Pregnant Women
- Eating for Healthy Breastfeeding Women.

## For more information contact:

### *The doctor or nurse who sees your baby:*

- family doctor and practice nurse
- Plunket nurse
- midwife
- child health nurse at community clinic or Tipu Ora
- paediatrician
- lactation consultant

### *Other groups in the community:*

- La Leche League - a mother-to-mother network which provides breastfeeding support and information
- Whangai U - midwives trained to offer breastfeeding support and advice from a Maori perspective
- Plunket-Karitane Family Centres
- Kohanga Reo
- Parent Centres New Zealand
- Multiple Birth Association

### *Community health workers*

- Community health services or public health units in your local Crown health enterprise
- Dietitian in community or private practice
- Maori or Pacific Island health workers.

### *You can also get telephone help from:*

- Plunket Line freephone  
0800 10 10 67.

Source: PHC. Healthy Eating for Babies and Toddlers from Birth to Two Years Old. Wellington: Public Health Commission, 1995.