A young baby’s nutritional and fluid needs are entirely met by milk (Livingstone, 1997). It is universally accepted that breast milk is superior to formula milk and is almost always the milk of choice for the infant. However, it is a matter of concern that breast-feeding rates, particularly 2–3 weeks after delivery, are very low in this country (Eastwood, 1997; Barness et al, 1998).

Breast-feeding is an important and complex topic which cannot be done justice to in this article. Barness et al (1998) very adequately discuss the many advantages of breast-feeding over formula feeding, the complex reasons why we have such poor rates of breast-feeding in this country, and give practical advice on how to maximize the chances of successful breast-feeding.

This article will consider the next stage, weaning. Definitions of weaning vary, but the most commonly accepted meaning is introducing the infant to foods other than milk foods, sometimes referred to as beikost (Milla, 1986). This aspect of child care shot to public prominence recently when well-meaning but ill-informed parents gave their 2-month-old infant ‘adult food’, including a gravy rich in salt. The child became severely hypernatraemic and, tragically, died (Scowen, 1999). In weaning the infant, the carer has a number of aims (Table 1).

THE TIMING OF WEANING

The timing of weaning tends to be under the influence of fashions (Whitehead et al, 1986). During the earlier part of this century, there was a trend to start weaning very early, when the infant was just 2–3 weeks old. Indeed, parents would sometimes vie with each other, boasting about how early their child had started ‘solids’.

More recently, parents have been encouraged to delay the introduction of solids; there are a number of reasons for this. The infantile extrusion reflex needs to be absent. This reflex is present in very young infants and involves the tongue pushing out any material in the mouth not associated with suckling. The safety advantages of this are obvious, but weaning cannot be commenced until the infant has matured sufficiently for the reflex to be absent.

Another consideration is that the immature gut is particularly prone to diarrhoea and milk provides passive protection against this condition (Milla, 1986). Furthermore, the immature gut is limited in what foods it can digest and absorb, and non-

The first article in this nutrition and the life cycle series discussed nutrition in pregnancy (Vol 9(17): 1133–8). This second article will concentrate on infancy and weaning. Weaning infants is an area that causes concern for parents. Health professionals need to be well informed about this aspect of child care, as practices have changed recently. Babies should usually begin weaning between 4 and 6 months of age. Infant diets need to be high in lipid for energy, and for essential long-chain fatty acids and fat-soluble vitamins. Their diets should also be rich in the micronutrients; infants are particularly at risk of deficiency for iron and zinc. Infants should be introduced to as many tastes and textures as reasonably possible, but foods likely to cause an allergic reaction should be avoided for as long as possible. Finally, all the family should enjoy mealtimes, and the pattern laid down for a life of healthy eating. The next article in this series will review nutrition in the school-age child.
In the absence of more precise information, to commence weaning at a point midway between 4 months postgestational age and 4 months chronological age seems sensible...That said, however, many infants are given solids earlier than 4 months, sometimes much earlier. This is because there are still some cultural pressures to wean children early and, as in so many aspects of health advice, the words of friends and neighbours seem to count for more than those of health professionals.

There is a particular problem when advising parents of pre-term infants. Many of them should wait for longer than 4 months postnatally, but to wait until their compensated age would probably be to delay weaning unduly. This is an area which is under-researched, and health professionals are particularly prone to giving contradictory advice. In the absence of more precise information, to commence weaning at a point midway between 4 months postgestational age and 4 months chronological age seems sensible (Rea, 1997).

That said, however, many infants are given solids earlier than 4 months, sometimes much earlier. This is because there are still some cultural pressures to wean children early and, as in so many aspects of health advice, the words of friends and neighbours seem to count for more than those of health professionals. It is also the case that less well educated parents tend to introduce solids earlier, and bottle-fed infants tend to be weaned earlier than their breast-fed counterparts (Whitehead et al, 1986).

WEANLINGS’ NUTRITIONAL NEEDS

Infants most obvious nutritional need is for energy to enable the enormous growth of the first year and also facilitate high activity levels. They require an energy-dense diet to provide high energy, while having limited volume in their stomachs (Hardy and Kleinman, 1994).

Fat has almost twice as many joules of energy for weight than carbohydrate, 17 kJ per gram instead of 9 kJ. Some well meaning parents are reluctant to provide a diet rich in fat, as they are aware of health advice mainly aimed at adults. As a result, some children are suffering from a syndrome that has been termed ‘muesli malnutrition’ (Livingstone, 1997). Indeed, it is possible that the very high fat content of breast milk actually protects against the development of cholesterol-linked heart disease later in life (McGill et al, 1996).

Children should not normally be commenced on low fat milk, yoghurt or other foods until at least 5 years of age, and never before 2 years of age. As well as the energy component of fat in the diet, the infant requires the essential fatty acids for correct development of the nervous system. It has been suggested that the lack of essential fatty acids may explain why malnourished children consistently achieve lower intellectual levels, compared with their well nourished counterparts.

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A particular nutrient found to be lacking in the diet of young children is iron (Dallman, 1986). A neonate has limited requirements for iron for two reasons (Table 2). By 6 months, however, infants need to be eating significant amounts of iron in their diet and the evidence is that they are not all getting it (Dallman, 1986; Hurtado et al, 1999).

Initially, this can lead to iron deficiency anaemia, but can go on to be a contributory factor in the development of mild and moderate learning difficulties (Hurtado et al, 1999). This is one reason for parents who choose a vegetarian diet to be very careful if they wish their children to take this specific diet. The iron from animal sources (mostly haem) is easier to absorb than that from inorganic sources. It is also worth remembering that vitamin C will maximize absorption of iron from the gut.

Proprietary baby foods are often fortified with iron, other minerals and also vitamins. For this reason the Committee on Medical Aspect of Food Policy (COMA) report (DoH, 1994) recommended the use of some proprietary foods, whereas before parents were encouraged to use ‘family foods’ as much as possible.

However, specially prepared baby foods need to be chosen with care. A recent study reported that 40% of baby foods, 60% in the case of breakfasts, contained added sugar, and 40% contained starchy filling (Consumers’ Association, 2000). The name of the product was unhelpful. The Consumers’ Association found that one food called ‘egg custard with rice’ contained more sugar than either egg or rice and a ‘banana and rice pudding’ contained no banana, only flavouring. Some foods not specially prepared for infants, such as bread and breakfast cereals, are also fortified with iron and other nutrients.

Zinc has been found to be deficient, even in generally well nourished infants (Hambridge, 1986). One study found that at 16 months infants were taking only 49% of the recommended daily allowance (RDA) for zinc (Skinner et al, 1997). Mild deficiency can lead to dermatitis; the mucous membranes can be involved causing gingivitis (inflammation of the gums). Diarrhoea and anorexia can also occur. If the deficiency is severe and persistent, this may lead to failure to thrive and neurological changes. Meat is a useful source of zinc and so are dark green, leafy vegetables.

**WEANING DIET AND LONG-TERM HEALTH**

There are at least three aspects in which diet at this stage can contribute to health patterns in the long term (Table 3). These three areas will be considered separately.

**Feeding to lay down metabolic pathways to promote long-term health**

As has already been mentioned, lipid material is required for development. In particular, polyunsaturated long-chain fatty acids are required for development of the nervous system. They are a component of all cell membranes, but are present in particularly high concentration in the cells of the central nervous system. Arachidonic acid and docosahexanoic acid contribute to the fluidity and permeability of the membrane, and are of particular significance in development and function. They are manufactured in the liver from precursors linoleic acid and α-linolenic acid.

These precursor substances are abundant in breast milk, but rather deficient in formula milk. It is assumed that this difference explains some of the slightly improved intellectual performance of breast-fed over formula-fed infants, particularly infants born preterm (Lucas et al, 1992; Morely et al, 1988).

There is a debate as to the wisdom of fortifying formula milks with these precursor substances. There is some rather equivocal evidence that, at least in the short term, formula-fed infants receiving supplemented milks

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**Table 2. Reasons why neonates have limited iron requirements**

<table>
<thead>
<tr>
<th>Reason for limited iron requirements</th>
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<tbody>
<tr>
<td>A fetus has a much higher haematocrit than an infant, so red blood cells can be broken down and the iron stored for future use</td>
</tr>
<tr>
<td>During fetal life stores of iron are laid down that can be used slowly during the first few months of postnatal life</td>
</tr>
</tbody>
</table>

**Table 3. How diet at the weaning stage can contribute to long-term health patterns**

<table>
<thead>
<tr>
<th>Long-term health pattern</th>
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</thead>
<tbody>
<tr>
<td>The way in which intake directly affects development and growth</td>
</tr>
<tr>
<td>The possibility that avoiding allergens may help the infant avoid a lifelong problems with allergy disorders</td>
</tr>
<tr>
<td>The possibility that eating patterns now will form the basis of lifelong eating</td>
</tr>
</tbody>
</table>
have an improved cognitive development, measured by visual acuity and characteristic of novelty-seeking (Simmer, 1999).

The infants’ olfactory (smell) sense is...well developed at birth, having been exercised in utero. Neonates have a very primitive eyesight, and use the sense of smell to guide them to their food, particularly if they are breast-fed. The very early experience of taste and smell will have introduced children to the type of food that they will be reared on long before they start to eat it for themselves.

It is this second effect that will be explored now. The suggestion is that infants will grow to like those foods to which they are exposed. The implications of this are clear, in that carers should be advised to give infants healthy diets, so that, in future, they will choose such diets because they actually prefer them.

Infants have well developed chemical senses at birth (Mennella and Beauchamp, 1998). They show a marked preference for sweet tastes, actively dislike sour and bitter tastes, and are indifferent to salt (Mennella and Beauchamp, 1998). It is possible that they develop a liking for salty water at about 4 months, which reverses at about 18 months, when they develop a liking for salty foods that is similar to adults’ liking of salt, e.g. crisps.

The infants’ olfactory (smell) sense is also well developed at birth, having been exercised in utero. Neonates have a very primitive eyesight, and use the sense of smell to guide them to their food, particularly if they are breast-fed. The very early experience of taste and smell will have introduced children to the type of food that they will be reared on long before they start to eat it for themselves.

However, the infant’s food liking can also be manipulated. In a convincing study, mothers of infants who were just being introduced to beikost were provided with jars of pureed vegetable, the vegetable being either peas or green beans (Sullivan and Birch, 1994). The mothers were asked to offer this food once a day for 10 days, and after an interval of 7 days without the food, to offer it again. They found that, with increased tokens of food, intake increased by about 50% and that this increase was still present after the interval. From videotapes, adults subjectively assessed the extent to which the infant liked the food. They found a strong, positive correlation between the adults’ rating of liking and of intake. The conclusions are clear: even if infants initially reject novel foods, repeated exposure increases acceptance of the food. This occurs because the infants grow to like the food and this liking persists after a brief interval of not being exposed to the food. However, the extent to which this leads to a long-term liking of vegetable was not studied.

There were some other interesting findings from the study. Infants were offered either peas or beans, yet they also demonstrated a slight increase in intake of the vegetable they had not been offered; in other words, the increased lik-
There appears to be an epidemic of pathologies related either directly or indirectly to the unhelpful functioning of the immune system. These diseases range from allergic rhinitis (hay fever) to asthma, eczema, insulin-dependent diabetes mellitus and rheumatoid arthritis. As far as food is concerned, there needs to be a distinction between true allergy... and food intolerance...
and finally to chopped foods. If a food is not accepted, it should be removed and, in the case of a child under the age of 1 or 2 years, an alternative offered. Children must never be forced fed; however, a refused food could be offered again, 1–2 weeks later, and this will often be accepted.

Proprietary foods do have their uses; they are like any convenience foods and may be handy when away from home. As already mentioned, they are fortified with vitamins and minerals and so should be used occasionally. However, by the time infants reach 18 months of age, they should be able to eat the same foods as the rest of the family.

Feeding children involves following a few, simple rules and should be a time of fun and exploration for all concerned. However, it does not always work out like that. The Children’s Society has done some pioneering work with children classed as failing to thrive (Underdown and Birks, 1999). It states that up

PRACTICAL ADVICE

Most parents have no difficulty in appreciating the importance of good nutrition for their children. A television programme about childhood nutrition was followed by an offer of written information, and 1033 viewers took the trouble to write in to request the offered package (Miller, 1996). These were mostly parents, but also grandparents and some health professionals. This anecdotal evidence suggests that parents are not getting good quality advice. Community nurses are in the forefront of this important area of advising parents, and need to equip themselves with up-to-date information, including cultural practices within different groups of the community they serve (Underwood et al, 1997).

Often the greatest need is for simple, practical advice (Stehlin, 1993). Parents may well ask about how to start introducing beikost. They may need advice on what foods to introduce first. Traditionally, children have been started on cereals, e.g. baby rice, but there is no reason for this practice. Although nutritious, it is very bland, and will not introduce the infant to new tastes or textures.

Instead, they may like to try carrot, or eating apples or pears. Initially, foods offered to babies need to be completely smooth and soft; depending on the parents’ level of skill, they may need advice on how to cook and puree these foods.

Parents used to be expected to provide food that was, effectively, sterile. This advice has been found to be unnecessary, and possibly harmful, as it discouraged parents from experimenting with home-cooked foods. By avoiding exposure to all antigens, infants might miss one of the stimuli to developing a robust immune system, which could also lead to autoimmune diseases.

Once parent and child have become used to feeding from a spoon, the number and size of meals can be increased. Because of the possibility of developing allergies, parents were advised to only offer one new food every few days. It is now recognized that this is, in most cases, unduly onerous, and means that a variety of foods will not be offered in the early days of weaning, precisely when infants are most likely to accept novel tastes.

Carers are free, then, to introduce most foods that they think the infant may like. The infant can move from pureed food to mashed
to 5% of children display this pattern, which they prefer to term ‘faltering growth’, at some time in their lives. Only 5% of these children have a previously undiagnosed organic disease, although faltering growth may complicate already diagnosed conditions, such as cerebral palsy or congenital heart disease. Also, contrary to popular belief, only a tiny proportion of these children are abused or neglected in the usual sense of the word (Underdown and Birs, 1999). They are often in very loving and caring families. It is precisely the conscientious parent who becomes most concerned when children refuse food; these parents are vulnerable to developing unhelpful interactions with the child, particularly around feeding times and some guidance may be needed, particularly in relation to behaviour and interaction at mealtimes.

Underdown and Birs (1999) state that mealtimes for these children and their families are times of conflict, leading to anxiety, guilt and stress for the parents and confusion and conflict for the children. The result is that these children are not taking enough nutrients, and consequently faltering in their growth. In their programme, ‘Feeding Matters’, The Children’s Society employs a number of strategies that are used to help make mealtimes more pleasant and sociable (Underdown and Birs, 1999). This programme leads to at least satisfactory progress in two-thirds of cases.

CONCLUSION

This article has tried to outline some of the gaps in the research of this important aspect of nutrition. There is a tendency for health professionals to offer conflicting advice in this area. It is our professional responsibility to provide helpful information that is, as far as possible, research-based. Eating should be a pleasant activity, one that promotes the welfare of both individual and his/her social group. Childhood is the time to start such a pattern.

The next article in this series outlines the complex area of nourishing the school-aged child.

Advising parents on feeding healthy babies. Patient Care 32(5): 58–74


KEY POINTS

- The time for weaning babies is 4–6 months.
- Health professionals are obliged to keep up to date with the advances in weaning.
- An infant’s diet must contain the essential fatty acids and fat-soluble vitamins.
- Foods likely to cause allergic reactions should be avoided until the child is older.
- Meal times should be pleasant family/social occasions.