

Is 6 months still the best for exclusive breastfeeding and introduction of solids? A literature review with consideration to the risk of the development of allergies

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ABSTRACT

Health professionals advising mothers on the introduction of solid foods to infants need evidence-based guidelines. A literature review on this topic was undertaken to examine the current international recommendations of expert bodies and evidence-based research published since 2003. Particular reference in this review is made to the timing of introducing food allergens and the risk of development of allergy in the child. Recommendations in developed countries of reducing this risk by avoidance of allergenic foods until the child is of varying ages past 6 months have been challenged by recent population studies. Where the risk of allergy is a key consideration, currently-available research suggests that introducing solids at 4–6 months may result in the lowest allergy risk. When all aspects of health are taken into account, the recommended duration of exclusive breastfeeding and age of introduction of solids were confirmed to be 6 months, but no later.

Keywords: allergy, complementary feeding, exclusive breastfeeding, guidelines, infant feeding, introduction to solids

Breastfeeding Review 2009; 17 (2): 23–31



INTRODUCTION

There is currently agreement in different countries regarding the recommended timing for the introduction to solids as no earlier than 4 months of age (ESPGHAN Committee on Nutrition 2008; Fiocchi, Assa'ad & Bahna 2006; Greer et al 2008; Prescott & Tang 2005). However, the World Health Organization (WHO) recommends delaying solids until 6 months, worldwide (Dewey 2003). Australian health authorities have adopted the WHO recommendation of 6 months (National Health and Medical Research Council 2003). Evidence from studies specifically in developed countries is scarce and some authors, such as Fewtrell and colleagues (2007), question whether a recommendation of 6 months is necessary or desirable in these countries or whether it should be 4–6 months of age. An issue not considered in depth by the WHO is that of allergy prevention and the best timing of solids, including potential allergenic foods, to induce immune tolerance (Dewey 2003, 2005).

This literature review seeks to briefly examine the evidence for the current recommendation for exclusive breastfeeding of 6 months versus the older recommendation of 4–6 months, and the introduction of complementary foods in a developed country such as Australia. The timing of introduction of complementary foods and risk of development of allergy will be the focus of the review. It will also examine in detail the documented evidence

to date for timing during infancy of introduction of foods that are considered to be more allergenic. Taking all this evidence into consideration, overall recommendations will be formulated; however, it should be noted that evidence continues to emerge in this area and recommendations may change in the future.

METHOD

A literature search was conducted using the electronic databases Medline and Proquest with the search terms 'exclusive breastfeeding', 'introduction to solids', 'infant feeding', 'complementary feeding', and these last three also combined with 'allergy'. A further search on Google was carried out using the term 'complementary feeding' to obtain a different range of potentially useful literature, such as organisations' position statements. The searches were performed in the last 2 weeks of August and the first 2 weeks of September 2008 for articles published in the previous 5 years, 2003–2008. Only journals and information in the English language were used. Further relevant journal articles were sourced from citations in found articles. A brief final search for articles on food allergy development that may have been published subsequent to the original search, was carried out in January 2009 using Proquest and Google Scholar. Search terms used were 'allergy' and 'solids' or 'complementary'.

The current position statements and guidelines of expert bodies were obtained, including those of the WHO; American Academy of Pediatrics; American College of Allergy, Asthma and Immunology; Canadian Pediatric Society; European Society for Pediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN); Australian Society of Clinical Immunology and Allergy; and the National Health and Medical Research Council (NHMRC).

Relevant recent citations from current position papers were accessed for details of original research and information directly related to the purpose of the literature review.

Recommendations for duration of exclusive breastfeeding

The WHO defines 'exclusive breastfeeding' as the infant receiving only breastmilk, that is, no other food or drink, not even water. However, it does allow for drops and syrups containing vitamins, minerals or medicines (WHO 2008).

Following a systematic review in 2001 (Kramer & Kakuma 2007), the WHO altered its global recommendation for exclusive breastfeeding, from the previously recommended 4–6 months, to exclusive breastfeeding for the first 6 months of life, followed by the introduction of complementary foods and continued breastfeeding for at least 2 years. This change was based on evidence that showed the potential for reduction in infant morbidity and mortality with prolonged exclusive breastfeeding. Decreased rates of gastrointestinal infection were found in infants who breastfed for ≥ 6 months compared with those breastfed for 4–6 months. It was acknowledged that this recommendation will not be appropriate for all infants, and emphasised the importance of management on an individual basis, with growth and micronutrient requirements being considered (Dewey 2003, 2005; National Health and Medical Research Council 2003).

This recommendation has been adopted by a number of international health authorities, including the Canadian Pediatric Society, NHMRC in Australia and the American Academy of Pediatrics (American Academy of Pediatrics 2005; Canadian Pediatric Society, Dietitians of Canada & Health Canada 2005; NHMRC 2003). There is still considerable debate about the appropriateness of the recommendation as a global public health initiative (Foote & Marriott 2003; Reilly & Wells 2005). Fewtrell and colleagues (2007) investigated the strength of the evidence for altering recommendations for exclusive breastfeeding from the previous 4–6 months, to the current recommendation of 6 months. Their study concluded there was insufficient evidence to recommend 6 months as an optimal duration for exclusive breastfeeding in developed countries, as opposed to the former recommendation of 4–6 months. It stated the risks of not exclusively breastfeeding for 6 months, such as increased rates of infection, were not as significant in developed countries as compared to developing countries. Concerns were also expressed regarding the energy content and nutritional adequacy of breastmilk for meeting the full requirements of an average 6-month-old infant (Chantry, Howard & Auinger 2007; Reilly, Ashworth & Wells 2005).

In contrast to the opinion of Fewtrell et al (2007) that the protective effect of exclusive breastfeeding for 6 months against infant mortality and morbidity is less important in developed countries, some recent studies conducted on populations in developed countries have found increased rates of infection in non-breastfed infants. Quigley, Kelly and Sacker (2007) studied 15,980 UK infants between 2000 and 2002, and found exclusive and prolonged breastfeeding protected against hospitalisation for lower respiratory tract infections and diarrhoeal illness. The study did not directly compare infants exclusively breastfed for 4–6 months with those breastfed for ≥ 6 months, but stated prolonged breastfeeding was recommended. Considering the rate of exclusive breastfeeding for ≥ 6 months was only 1.2%, the authors considered any message to promote the extension of breastfeeding as having positive public health implications.

A study that compared full breastfeeding for ≥ 6 months versus 4–6 months in a developed country setting was reported by Chantry, Howard and Auinger (2006) using secondary data from the US National Health and Nutrition Examination Survey III (NHANES III). Full breastfeeding was defined in this study as almost exclusive breastfeeding, where the infant received only occasional other foods/liquids, but not on a regular or daily basis. Breastmilk formed the overwhelming majority of the infant's diet. Data from 2277 infants aged 6–24 months were analysed to assess whether there was any difference in rates of respiratory tract infection. It was found that infants who were fully breastfed for ≥ 6 months had a decreased risk of respiratory tract infection, including decreased rates of pneumonia and recurrent otitis media, compared with those fully breastfed for only 4–6 months. This study showed that full breastfeeding for ≥ 6 months had a positive impact on rates of infant infection outside a developing country setting.

The major concern over the recommendation for exclusive breastfeeding to 6 months is related to the adequacy of energy and micronutrients in breastmilk. Reilly, Ashworth and Wells (2005) reviewed evidence on the energy content of breastmilk. These authors found this content was lower than what was often reported, but the transfer rate was actually higher (Reilly & Wells 2005). Based on the evidence related to metabolisable energy content, it was hypothesised that breastmilk alone may be inadequate to meet the energy requirements of some infants by 6 months of age. The authors recommended encouraging the concept of individual management of infants, with responsiveness to growth and development.

The micronutrients that are of most concern in exclusively breastfed infants are iron and zinc as they are essential for growth and cognitive development (Dewey 2003). Research has shown an infant's estimated iron and zinc requirements cannot be met at any stage of infancy by human milk alone (Butte, Lopez-Alarcon & Garza 2002) and the infant must rely on endogenous prenatal stores to meet nutrient needs in the early months of life. Although it is estimated that these stores are sufficient to meet the needs of average, full-term breastfed infants for about 6 months, there is concern that if prenatal stores are exhausted, an infant will quickly become deficient unless an exogenous source is

provided (Butte, Lopez-Alarcon & Garza 2002). Pre-term infants are at even greater risk and may require supplementation if being exclusively breastfed (NHMRC 2003).

Chantry, Howard and Auinger (2007) investigated the risk of iron-deficiency associated with full breastfeeding for ≥ 6 months, compared to the former recommendation of 4–6 months. Data from 2268 children aged from 6–24 months from the NHANES III survey in the USA were analysed for self-reported iron-deficiency anaemia. It was found that the risk of iron-deficiency anaemia was greater in infants fully breastfed for ≥ 6 months (10%) compared with those who ceased exclusive breastfeeding between 4–5 months (2.3%). It was also shown that low mean birth weight was associated with increased rates of iron-deficiency anaemia. When the results were adjusted for confounders such as birth weight, ethnicity, poverty and parental educations, they were still significant. The major limitation in this study was potential bias of results from the awareness of the risk of iron-deficiency in infants who are exclusively breastfed for prolonged periods. This awareness may have increased the likelihood of these infants being tested for iron-deficiency anaemia more regularly than those breastfed for shorter time-periods, leading to a bias in the results.

Introduction of solids and nutritional adequacy

When breastmilk alone is no longer sufficient to meet the energy and nutrient requirements of infants, solid foods are introduced while breastfeeding continues in a process known as complementary feeding. This term is often interpreted differently with some definitions referring to the use of artificial baby milk to supplement breastfeeding. In this review the term complementary feeding refers to solid foods and liquids other than breastmilk or artificial baby milk, as consistent with the definition of the ESPGHAN Committee on Nutrition (2008).

There is a strong consensus that the introduction of solids should not occur before 4 months due to the replacement of energy and nutrient-rich breastmilk with poorer nutritional quality solid foods and inadequate gut maturity (ESPGHAN Committee on Nutrition 2008). There is also consensus that complementary feeding should commence no later than 6 months due to the risks of nutritional deficiencies and inadequate energy intake leading to growth faltering (ESPGHAN Committee on Nutrition 2008; European Network for Public Health Nutrition 2006). In the past, recommendations for the introduction of solids were based on cultural factors rather than being evidence-based. There continues to be minimal scientific research in the area of introducing solids, acknowledged in the Pan American Health Organization (PAHO)/WHO guidelines for complementary feeding (Dewey 2003, 2005).

Nutritional adequacy of complementary foods is essential to optimise growth and development at this critical age. The dependence on complementary foods at this age is primarily due to declining infant stores of zinc and iron. The levels of these micronutrients in breastmilk are considered insufficient to meet the requirements of an infant after 6 months of age (Krebs 2007). Therefore it is essential that complementary feeding be focused on

providing sufficient sources of iron and zinc. Often iron-fortified infant cereals are recommended as one of the first introductory foods (NHMRC 2003). While these are beneficial for iron status, they do not provide a source of zinc. It is recommended that meat be introduced at or shortly after 6 months to contribute to both iron and zinc status, as well as providing vitamins B₆ and B₁₂ (Krebs & Hambridge 2007). The PAHO/WHO guidelines for complementary feeding recommend that meat, poultry, fish or eggs be consumed daily to provide sufficient iron and zinc (Dewey 2003).

It is also important to limit the amount of foods that are low in nutritional value for this age-group. The majority of infant feeding recommendations advise that the introduction of cows' milk as a drink be delayed until 12 months of age (Canadian Pediatric Society, Dietitians of Canada & Health Canada 2005; ESPGHAN Committee on Nutrition 2008; Foote & Marriott 2003). This recommendation is based on the increased risk of iron-deficiency associated with the displacement of iron-rich solid foods, as cows' milk is a poor source of iron. Dietary fat restrictions should also be avoided, including fat-reduced dairy products, in the first 2 years of life, as the fat is necessary for energy intake and essential fatty acids (Canadian Pediatric Society, Dietitians of Canada & Health Canada 2005). For the same reason of displacement of more nutrient-dense foods, it is recommended that fruit juice intake should be limited, with a maximum of 120 mL per day (Dewey 2003, 2005; European Network for Public Health Nutrition 2006).

The overall nutritional adequacy of an infant's diet depends on the frequency of feeding, amount consumed and energy density. It is recommended from 6–8 months that infants be offered solids 2–3 times per day. From 9–12 months and onwards, solids are recommended 3–4 times per day with 1–2 nutritious snacks if required (Dewey 2003, 2005; European Network for Public Health Nutrition 2006). It is important that infants are offered food regularly because they have a small stomach capacity, and require frequent meals to meet their nutrient requirements (Dewey 2003). The size of meals should also increase with age, however recommendations are not prescriptive regarding portion sizes; rather they focus on being responsive to the infant and their satiety cues (Dewey 2003, Dewey 2005).

Energy density is also important in maintaining overall nutritional adequacy of the diet. It is estimated the energy requirement of an infant aged 6–8 months is approximately 600 kcal/day; at 9–11 months, approximately 700 kcal/day; and at 12–23 months, approximately 900 kcal/day (Dewey 2005). These estimates include energy from both milk and complementary foods. Up to 12 months, breastmilk is usually still the major source of energy for infants whereas after 12 months 'family foods' become the main source of energy. However, regular breastfeeding is still encouraged until at least 2 years of age (NHMRC 2003). In practice, the exact energy content of foods is not usually measured. It is important to ensure energy-dense foods are offered regularly, for example full-fat dairy foods, which have a greater energy density than pureed fruit and vegetables. Overall nutritional adequacy is determined by a combination of

factors including frequency of meals, the amount consumed and the energy density.

The process of introducing solids

Recommendations for introducing solids have previously advised on the sequence of introducing certain foods and food groups. However, the sequence of introducing foods is no longer thought to be a significant issue due to adequate gut maturity by 6 months of age (Butte et al 2004; Krebs 2007; National Health and Medical Research Council 2003). Nutritional adequacy is considered to be more important than introducing certain foods in sequence. The infant has a need for adequate amounts of iron and zinc as mentioned but also adequate fat, protein, vitamins and other essential minerals. To achieve this, the focus is on providing infants with a variety of different foods from all of the food groups (Dewey 2003, 2005). Offering different types of foods will thus ensure that the infant consumes a balance of nutrients (NHMRC 2003). Indeed, Cooke (2007) found continued exposure and opportunity to sample a variety of healthy foods resulted in adequate nutrient intakes and healthy diets in childhood and through to adulthood.

Only the Canadian guidelines still specify the introduction of certain foods at certain times (Canadian Pediatric Society, Dietitians of Canada & Health Canada 2005). The guidelines recommend offering iron-containing foods first, such as fortified cereal or meat, followed by fruits and vegetables to add colour, flavour and texture. Milk products such as cheese and yoghurt are to be introduced next with egg whites being withheld until 1 year of age. It is now widely accepted that recommendations such as these, which were mostly based around assumed allergy risk, are not evidence-based (Butte et al 2004).

It is recommended for solids to be first introduced as single foods such as a single type of fruit or vegetable or minced meat rather than as a combined meal (Butte et al 2004; Canadian Pediatric Society, Dietitians of Canada & Health Canada 2005; NHMRC 2003). This practice aids in identifying the food responsible if an adverse reaction occurs. Once tolerance has been established, the food can be given as part of a combination meal. A 2–7-day interval is recommended between trialling foods to provide time to observe an adverse food reaction (Butte et al 2004).

The guidelines for the introduction of solids with regard to texture are very consistent (Dewey 2003, 2005; European Network for Public Health Nutrition 2006; Foote & Marriott 2003). It is widely recommended that food texture be increased with age. From 6 months of age, infants should be offered purees, mashes and then semi-solid foods in fairly rapid succession. Most infants are able to eat 'finger foods' by 8 months, as they are able to chew and swallow foods with lumps and in greater quantities (European Network for Public Health Nutrition 2006). By 12 months, it is expected infants are able to eat 'family foods', which are the types of foods eaten by the rest of the family. It is still important to consider nutrient density. It is also important that foods with a high choking risk such as raw carrots (unless grated) or whole nuts are avoided before 2 years of age. This increase in texture is essential for oral motor development. Northstone,

Emmet and Nethersole (2001) found infants not introduced to 'lumpy' textured food until after 10 months of age had greater feeding difficulties at 15 months than those introduced to lumpy food before 6 months, or between 6 and 9 months of age. The research indicated the presence of a 'critical window' of opportunity for introducing these textured foods to reduce the risk of later feeding difficulties.

A new concept of infant feeding known as 'baby-led weaning' has been suggested recently (Rapley & Murkett 2008; Volders 2008). This method encourages infants to be introduced to hand-held solid foods at 6 months of age with no prior use of purees. This practice gives the infant control over their own food intake, arguing the use of purees may actually delay the development of oral motor skills as well as increasing risk of constipation and long-term fussy eating behaviours. With the majority of introduction-to-solids guidelines advising the use of pureed textures for first foods, there is currently a lack of scientific evidence to support recommending baby-led weaning over these traditional recommendations (Reeves 2008).

The PAHO/WHO guidelines emphasise the social aspects of introducing solids to an infant (Dewey 2003, 2005). These guidelines recognise the impact of not only what they are eating but where, when and with whom they are eating. It is important to be responsive to infant cues, such as satiety, hunger or self-feeding to promote adequate nutritional intake (Butte et al 2004). The introduction of solids should be a positive experience for the infant. Offering a variety of foods and encouragement to infants promotes this enjoyment of food. It is acknowledged these recommendations are not evidence-based but are based on a consensus by experts in infant feeding to be optimal practice (Dewey 2004, 2005).

Timing of introduction of solids and allergy risk

There is general agreement amongst most expert committees and bodies in developed countries regarding delaying introduction of solids until after 4 months of age (ESPGHAN Committee on Nutrition 2008; Fiocchi, Assa'ad & Bahna 2006; Greer et al 2008; Prescott & Tang 2005). This recommendation is based on two main concerns of earlier introduction of other foods, one being restriction of the duration of breastfeeding and the other being sensitisation to cows' milk in young infants exposed to intact cows' milk protein (Fiocchi, Assa'ad & Bahna 2006). As discussed earlier, the WHO recommends delaying the use of complementary foods until 6 months of age to minimise the risks of morbidity and mortality (Dewey 2003). Morgan and colleagues (2004) studied preterm infants in the UK and found introduction of four or more foods before 17 weeks of age increased the infant's risk of eczema at 12 months. Non-atopic parents who introduced their infant to any solids before 10 weeks also increased this risk. This risk was not associated with any particular allergen, nor was it related to type of milk feeding (Morgan et al 2004). However, a systematic review by Tarini and colleagues (2006) found no strong evidence that feeding solids earlier than 4 months was associated with allergic symptoms such as persistent food allergy, allergic rhinitis or animal dander allergy. It was suggested that there might

be an association with an increased risk of eczema but not with any other allergic conditions.

Expert committees and bodies in different countries currently vary in their recommendations for introduction of specific foods that are considered allergenic. It is currently recommended in Australia that specific foods such as fish and egg be delayed for several months after other solids have been introduced (NHMRC 2003). This was also the case in the USA prior to 2008 (Greer et al 2008). In Europe there are no specific foods considered unsuitable after 5 months of age (ESPGHAN Committee on Nutrition 2008; Fiocchi et al 2006; Zeiger 2003). However, the European committees have suggested that the first solids should be limited to those with low allergenicity (Zeiger 2003). The WHO's current opinion is that there is no documented evidence of benefit of further delaying allergenic foods for either breastfed infants (Dewey 2003) or non-breastfed infants (Dewey 2005).

Where delaying certain foods is recommended, the justification is often based on the logic that if cows' milk avoidance can prevent allergy to this food, then the same may apply to other foods. It is thought that the young infant's gut is highly permeable to large proteins and that there may be a significant chance that these could penetrate and provoke immune sensitisation (Foote & Marriott 2003). However, it is currently not known how best to induce tolerance to food proteins and more research is needed (Fiocchi et al 2006). In a recent discussion paper, it was argued that there is evidence pointing towards a 'critical window' for oral allergen exposure between 4 and 6 months of age that is important for developing tolerance (Prescott et al 2008).

The published position statement of the Australian Society of Clinical Immunology and Allergy (Prescott & Tang 2005) maintained there is no evidence for avoiding allergens after 4–6 months to protect from allergy development, but it was also stated that this area needs more research. To err on the safe side within the bounds of knowledge at the time of writing, avoidance of peanuts, tree nuts and shellfish for the first 2–4 years was still recommended, as the authors believed avoidance was unlikely to cause harm. However, it was stated that there was no actual evidence to support this recommendation (Prescott & Tang 2005). The Society's website statement on allergy prevention in children states there is insufficient evidence that avoidance of any allergens (including egg, peanuts, nuts, wheat, cows' milk and fish) after 6 months of age reduces the risk of food allergy or eczema, even in infants with siblings with allergies (Australian Society of Clinical Immunology and Allergy 2009).

Population studies

The timing of introduction of solids as a topic of study in its own right has been addressed only recently in the scientific literature. It has been previously included as part of other studies such as those on durations of breastfeeding (Fiocchi et al 2006). With regard to a link with allergies, the evidence has been conflicting and inconsistent (Fiocchi et al 2006) and studies used to formulate recommendations were known to have suffered from limitations (Greer et al 2008). Researchers have challenged the current official recommendations used in many developed countries. One study

of 642 UK children followed children until 5½ years of age and showed no evidence of protection from allergy by delaying the introduction of solids (Zutavern et al 2004). The results showed an *increase* in the risk of eczema with introduction of cows' milk after 6 months and egg delayed until after 8 months of age.

It should be acknowledged that the population studies discussed below, by nature of the type of study, included subjects who were exclusively breastfed, mixed fed and exclusively fed with artificial baby milks. While most research teams collected information on type of milk feeding prior to the introduction of solid foods, usually only at the age of 4 months, data analysis was generally not done comparing type of milk feeding and allergy development. Except for the study by Morgan and colleagues (2004) mentioned above, studies reported only on timing of the introduction of solid foods against allergy development. This is a limitation of these studies when specifically investigating exclusively-breastfed infants. The authors are unaware of any other studies specifically looking at the interrelationships of type of milk feeding, introduction of solid foods and allergy development.

Another significant problem with population-based cohort studies in this area of research is accounting for reverse causality. This issue occurs if parents delay the introduction of certain allergenic foods for longer than average when there is a family history of allergies or their infant has shown early signs of atopy (Zutavern et al 2006). This practice is commonly recommended in feeding guidelines (Zutavern et al 2004). However, in population-based, cohort studies, it results in bias when investigating a link between late introduction of allergenic foods and atopy.

In a large cohort study of 3097 German infants that were followed until 2 years of age (Zutavern et al 2006), the authors attempted to account for reverse causality by removing from the analysis those subjects who displayed evidence of atopy within the first 6 months of life. These infants were those most likely to have delayed introduction of allergenic foods as well as being the most likely to be atopic at the end of the study. The results showed no protection by delaying solids including allergenic foods such as cows' milk, egg and fish beyond 6 months; this held true when the parents were atopic as well (Zutavern et al 2006). This same group of children were studied again at the age of 6 years (Zutavern et al 2008). The results showed there was a greater risk of food and inhalant sensitisation in those children who had had later introduction to solids. However, the results for the development of eczema were less clear. Of those children not showing sensitisation at 2 years (from the previous study), introduction to solids at both 4–6 months and after 6 months was associated with increased sensitisation at 6 years compared to those children introduced to solids before 4 months. The authors concluded there was no protective effect of delaying solids for longer than 4–6 months on the risk of asthma, allergic rhinitis, or food or inhalant sensitisation. Furthermore, a more diverse diet of solids before 4 months was associated with a lower risk of sensitisation at 6 years. From an allergy viewpoint, an *earlier* introduction of solids lowered the risk. Both these effects were increased when infants who had

early skin and allergic symptoms were excluded to account for reverse causality (Zutavern et al 2008).

Another large cohort study in Germany found similar results using eczema development as an indicator of atopy in 5991 children, followed until the age of 4 years (Filipiak et al 2007). The intervention group consisted of infants from families with a history of allergy. The mothers in this group were encouraged to breastfeed their infants for at least 4 months and to introduce solids from 4 months, but withhold potentially allergenic foods (cows' milk, eggs, fish, tomatoes, nuts, soy products and citrus fruits) until after 12 months. The mothers in the non-intervention group (those without a family history of allergy or those with such a history but who did not wish to be included in the intervention group) were given no special dietary instructions. The proportions of infants exclusively breastfed for 4 months were 55% and 47% in the intervention group and non-intervention group, respectively. There was found to be no protection from the development of eczema by delaying the introduction of solids in general beyond 4 months or delaying allergenic solids beyond 6 months in either group. There was also no protection with regard to the diversity of solids introduced by 6 months. However, in the non-intervention group there was a decrease in the risk of eczema when soy and nuts were delayed beyond 6 months. (Filipiak et al 2007).

An ongoing prospective cohort study in the Netherlands was recently used to look at the relationship of the timing of introduction of cows' milk products and other foods with development of atopic symptoms in the first 2 years of life (Snijders et al 2008). Age periods studied for the introduction of solids were 3 months, 4–6 months, 7–9 months and >9 months. Parents of all cohort subjects completed questionnaires at 34 weeks gestation and at 3, 7, 12 and 24 months. Testing at 2 years was carried out for sensitisation of the children to food allergens egg, cows' milk and peanuts, as well as inhalant allergens birch, grass pollen, cat, dog and house dust mite. Eczema and wheezing were assessed at 2 years using information from the 7, 12 and 24-month questionnaires. Reverse causation was accounted for and delayed introduction of solids was consistently associated with trends of increased risk for eczema, recurrent wheeze, atopic sensitisation and inhalant allergen sensitisation. However, longer duration of breastfeeding reduced the risk for recurrent wheeze.

Another recent prospective cohort study was done in Sweden using the introduction of fish into the infants' diets (Kull et al 2006). It was found that infants who had been introduced to fish in the first year had a reduced risk of allergic disease by the age of 4 years. There was a dose-dependent effect for all types of allergic disease studied, namely asthma, eczema, allergic rhinitis and sensitisation to food and inhalant allergens. The effect was most pronounced in children with more than one of these conditions. The results showed a lower risk when fish was introduced between 3 and 8 months compared to after 9 months. The risk of development of antibodies to fish was greater in those introduced to this food after 8 months. However, the number of these cases was very small. The researchers in this study controlled for reverse causality by separate analysis after excluding data from subjects with eczema and/or recurrent wheeze in the first 12

months. It was postulated that the decreased risk in the infants eating fish early may be influenced by the anti-inflammatory effect of the omega-3 polyunsaturated fatty acids found in fish oils (Kull et al 2006). The ESPGHAN Committee on Nutrition (2008) also discussed the issue of restricting nutrients from fish such as the omega-3 polyunsaturated fatty acids that have both an immuno-protective role as well as a role in cognitive development of infants. This concern highlights a separate issue from simply considering sensitisation to specific allergens, to the possibility of food modulating the immune response. On balance, it is suggested that the immune benefits of early introduction of fish may outweigh the risk of sensitising an infant to fish allergen.

Consulting the literature on development of coeliac disease in infants and children may contribute to insight into this issue. In an American study of children already at high risk for coeliac disease, researchers found that introduction of gluten both earlier and later than the 4–6-month period increased the risk of coeliac disease (Norris et al 2005). European research found introducing gluten while the infant was still receiving breastmilk, regardless of age of introduction, reduced the risk of developing coeliac disease by the age of 2 years (Ivarsson et al 2002). These researchers commented that breastfeeding while the infant is introduced to solids may favour immune tolerance, rather than the timing. However, Norris and colleagues (2005) did not find the same protection of concurrent breastfeeding in their own findings. They pointed out that the European introduction of gluten was usually via flour as an ingredient in follow-on artificial baby milk, not in the form of solids, so differing results may be explained by different infant feeding practices. Another American study, using the same cohort as Norris and colleagues (2005), showed there was an increased risk of wheat allergy in children initially exposed to cereals later than 6 months compared to those exposed before that age (Poole et al 2006).

Recent and current studies on development of allergy to peanuts

A recent study compared prevalence of peanut allergy in Jewish children in the UK and Israel and found it to be ten times higher in the UK, and increasing (Du Toit et al 2008). After controlling for many factors, it was found that the most obvious difference between the two countries was the early introduction and frequent consumption of peanut products in Israel compared to strict and prolonged avoidance in the UK. It has been proposed that the early and frequent consumption of these products by infants in Israel may lead to oral tolerance. However, the conclusion was that there is still insufficient evidence to alter current recommendations on the timing of introduction of peanut to infants and young children in countries where avoidance is recommended.

There is also a major randomised controlled intervention study currently recruiting subjects in the UK, designed to determine whether early exposure to peanuts increases tolerance or sensitisation. The study began in December 2006 and is planned to run until the year 2014 (National Institute of Allergy and Infectious Diseases 2008). It is being conducted by the National Institute of Allergy and Infectious Diseases in collaboration with

the Immune Tolerance Network and is known as the Learning Early About Peanut Allergy (LEAP) Study. Only high-risk children, with pre-existing eczema and/or egg allergy are being enrolled as participants (Immune Tolerance Network 2009).

Review of guidelines

As a result of the recent population-based studies, official bodies in developed countries have been reconsidering their guidelines in this area. The American Academy of Pediatrics recently issued a new policy statement concluding that there were insufficient data to support a protective effect of any particular dietary intervention beyond 4–6 months of age with regard to atopic disease (Greer et al 2008). The European committees also published a position paper last year supporting the same conclusions (ESPGHAN Committee on Nutrition 2008). The recommendations were for exclusive breastfeeding for about 6 months, with no complementary feeding before 17 weeks and not later than 26 weeks. The conclusion, like that of the American Academy of Pediatrics, was that there is no convincing evidence for delaying introduction of potentially allergenic foods to reduce the risk of allergies even in those infants considered to be at high risk (ESPGHAN Committee on Nutrition 2008).

The Australian Society of Clinical Immunology and Allergy has documented similar statements (Australian Society of Clinical Immunology and Allergy 2009; Prescott & Tang 2005). Although the position statement published in 2005 expressed caution with peanuts, tree nuts and shellfish (Prescott & Tang 2005), further studies in this area have since been published and the Society's website now makes no such exceptions (Australian Society of Clinical Immunology and Allergy 2009). Tang and Robinson (2008) and Prescott and colleagues (2008) have considered the most recent evidence on this topic. Both groups of Australian/New Zealand researchers state that with regard to preventing allergy development, there appears to be no benefit of exclusive breastfeeding beyond 6 months, and rather than avoidance, repeated exposure to food allergens between the ages of 4 and 6 months might be important to the induction of tolerance (Prescott et al 2008; Tang & Robinson 2008). They call for further research specifically on this issue and both note the study on the early introduction of peanuts currently underway in the UK.

CONCLUSIONS

Breastfeeding is acknowledged globally as the most appropriate source of nutrition in the first months of life, and is important to health in both the short and long term. The WHO and the NHMRC recommend exclusive breastfeeding for 6 months as a result of evidence primarily on nutritional adequacy and infection risk. Although there are possible micronutrient limitations for some infants, the benefits of promoting exclusive breastfeeding for 6 months as a public health message outweigh the risks. This recommendation may not be appropriate for all infants and it is important to monitor individual growth and development.

It is recommended that solid foods be introduced at approximately 6 months of age while breastfeeding continues until the infant is at least 12 months of age. The first solids

offered should include sources of iron and zinc due to depleted endogenous stores at this age. Meat, fish, poultry and eggs are excellent sources of these minerals and should be eaten daily, or as often as possible. Cows' milk as a drink should be delayed until 12 months of age due to the risk of iron-deficiency associated with displacement of iron-rich solid foods. The amount of food offered should increase with age, with carers being responsive to the infant's satiety cues. Unlike previous recommendations, the sequence of introduction of solids is no longer thought to be significant, with nutritional adequacy now considered a more important focus of complementary feeding. To achieve this, it is important that the infant's diet is varied with a wide range of nutritious foods being offered from 6 months.

Recent research evidence on the timing of introduction of solids and allergy risk appears to be at odds with the recommendations based on nutritional adequacy and infection risk, as it suggests that introduction of solids at 4–6 months may provide the best outcomes. However, this must be balanced against other considerations, and in turn, the cessation of exclusive breastfeeding. At the present time, there are ongoing studies in this area seeking to clarify the causes and mechanisms of allergy development as it relates to infant feeding. Taking all aspects of the issue into account, there is currently insufficient evidence for a change of policy at this time. There is some evidence that delaying introduction of solids *beyond* 6 months may be detrimental in terms of both allergy risk and nutritional risk. More research is needed specifically looking at type of milk feeding and how this relates to allergy risk and the timing of introduction of solid foods.

With regard to delaying potentially allergenic foods beyond 6 months, there is insufficient evidence to recommend this. However, further research is needed to confirm whether early and repeated exposure to allergens increases tolerance or, as has traditionally been assumed, increases risk of sensitisation. Mounting evidence appears to be favouring the former effect. Fish is a special case where the benefit to the immune response provided by omega-3 fatty acids contained in this food may outweigh the potential risk of sensitisation to fish allergen. Confirmation of the changes in thinking and recommendations may be assisted by current research on peanut introduction being carried out in the UK. Further research is needed specifically looking at other major allergens.

The recommendations outlined above have been based on the best available evidence at the time of writing. It is acknowledged that the research has definite limitations with regard to the relationship of the duration of *exclusive* breastfeeding and development of allergy. Studies specifically addressing this relationship have yet to be done. Recommendations may change in the future as new evidence is published.

ACKNOWLEDGEMENT

The authors would like to acknowledge and thank Adele Morris APD for support and advice during the community placement, and for providing feedback on the original student project on which this review was based.

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ABOUT THIS STUDY

This literature review was prepared as a student project as part of a community placement undertaken at the South West Health Service, Bunbury, Western Australia to meet the requirement of the Postgraduate Diploma in Dietetics conducted through Curtin University of Technology. The original purpose of the review was to gather information to be used to assess and update current resources used to teach parents and other members of the community about infant feeding and the review has been modified for publication.

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ABA–ALCA CONSENSUS STATEMENT

The Australian Breastfeeding Association and ALCA are two Australian organisations whose primary focus is breastfeeding. We advocate the importance of breastfeeding and breastmilk to the health and wellbeing of the Australian community.

Our mutual aims are to:

1. empower women to breastfeed successfully
2. protect, promote and support breastfeeding
3. create community awareness of the value of breastfeeding and breastmilk
4. educate and support health workers in breastfeeding knowledge and skills
5. support the International Code of Marketing of Breastmilk Substitutes and the Australian Agreement on the Marketing of Infant Formula
6. encourage high standards of research in lactation.

We recognise the complementary roles each plays and urge all members to work together to achieve these aims.