

Breastfeeding and allergies: time for a change in paradigm?

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Purpose of review

This review examines recent studies of the relationships between breastfeeding and the epidemiology of allergic diseases, especially atopic dermatitis in infants and asthma in early and later childhood.

Recent findings

Results from observational birth cohort studies, case–control studies, and one cluster randomized intervention trial have generally failed to demonstrate a protective effect of breastfeeding on outcomes of atopic dermatitis, allergic sensitization, wheezing, or asthma. Difficulties in interpretation relate to the absence of nonbreastfed control or reference groups in some studies, meaning outcomes can only be compared between different durations of breastfeeding. Studies with a nonbreastfed control group suggest there is an increased risk for atopy and asthma associated with breastfeeding and that prolonged breastfeeding may eventually reduce this increased risk. The family history, sex of the child, and the presence of other risk factors for allergy and asthma also influence the outcome.

Summary

Although breastfeeding is strongly recommended for its multiple benefits on child health, most recent studies do not confirm the 'conventional wisdom' that breastfeeding is protective against allergy and asthma. Early reduction in childhood wheezing may reflect protection from viral infections, but allergies and asthma at later ages may be increased.

Keywords

allergic disease, asthma, atopic dermatitis, breastfeeding, eczema, infant

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Introduction

For decades, conventional wisdom and much medical literature have stated that breastfeeding, in addition to its nutritional and sociological benefits, provided a number of specific health benefits to the infant, including reduction of the incidence of allergy and childhood wheezing. In 2004, Kemp and Kakakios [1] wrote 'It has been an article of faith amongst pediatricians and allergists that breastfeeding is beneficial for the prevention of allergic disease'. Now that paradigm is being challenged, as several studies published over the last few years suggest, there is no sustained protective effect, or even, that there is an increased long-term risk of allergy and asthma associated with breastfeeding. These reports contrast with studies demonstrating reduction of childhood wheezing and allergic diseases among breastfed children, leading to controversy and debate [2,3]. A recent editorial in the British Medical Journal concluded '...the claim that breastfeeding reduces the risk of allergy and asthma is not supported

by evidence' [4**]. This review examines reasons for the conflicting reports and suggests an over-arching perspective given recent evidence.

Breastfeeding is a natural phenomenon, providing balanced nutrition and mother–infant bonding, as well as a number of health benefits. These include reduced incidence of infectious diseases, including diarrheal diseases and lower respiratory tract infections, reduced incidence of diabetes and obesity, and improved mental performance [5,6]. There are numerous reasons why breastfeeding should be encouraged wherever possible, with few exceptions such as in the presence of maternal HIV infection [7].

Design of studies to examine benefits of breastfeeding

Whether or not a treatment or intervention is effective is best addressed in a randomized controlled trial (RCT) in

which all factors are maintained constant except for the intervention of interest. However, given the multiple reasons for encouraging breastfeeding, assessment of the benefits in terms of preventing allergy and asthma by a classical RCT is clearly not ethical or practicable in the usual sense. Nevertheless, a recently reported cluster randomized trial [The Promotion of Breastfeeding Intervention Trial (PROBIT)] did use the RCT principle to randomize some regions of a country to a strategy to promote more prolonged and exclusive breastfeeding and examined outcomes at age 6.5 years [8^{••}]. The intervention increased the uptake of any breastfeeding and of more prolonged breastfeeding among mothers who had already decided to breastfeed (44.3% practiced exclusive breastfeeding at 3 months vs. 6.4% in the nonintervention group), but there was no reduction in the risk of allergy and asthma symptoms in children in those regions at age of 6.5 years. After exclusion of sites with suspiciously high rates of positive skin tests, risk of allergy was in fact increased from two-fold to three-fold in the intervention group for the majority of antigens. The authors concluded that the study did not support a protective effect of prolonged or exclusive breastfeeding on asthma or allergy, though they did not report on the likelihood of allergic outcomes among those who actually received prolonged breastfeeding compared with those who did not.

In contrast to this RCT, the majority of studies of breastfeeding have been observational, comparing outcomes among those who did and did not breastfeed, or who breastfed for shorter or longer periods, with all the inherent difficulties in interpreting such studies. Mothers who do and do not breastfeed often demonstrate differences in personal and family characteristics, raising the potential for confounding of results. Such factors include cigarette smoking, socio-economic status, first-born or later-born children, maternal age, marital status, education, and the family history of allergy and asthma. Furthermore, it is not uncommon that, despite the desire to breastfeed, some mothers do not establish successful lactation. The duration of exclusive and of total breastfeeding may be impacted by social and cultural factors, such as the mother's wish to return to work. In addition, breastfeeding may be continued for a longer period if the child shows evidence of developing allergies, in the hope this will reduce the severity of such allergies [9]. Hence, such observational studies may be complex to interpret.

Specific outcomes of studies of breastfeeding

Studies have focused primarily on three outcomes – the occurrence of atopic dermatitis or eczema, development of allergic sensitization or 'allergic diseases', and risks for development of asthma.

Recent studies of the risks for atopic dermatitis or eczema

In a Netherlands cohort study [KOALA, a Dutch acronym for Child, Parent and Health; Lifestyle and Genetic Constitution], a longer duration of nonexclusive breastfeeding (over 9 months) was associated with a lower risk of eczema in infants of mothers without allergy or asthma [adjusted odds ratio (OR) 0.51, 95% confidence interval (CI) 0.29–0.89], while less (and nonsignificant) protection was afforded to children of mothers with allergy but no asthma, and no protection from eczema was evident among children of mothers with asthma [10].

The relationship between exclusive breastfeeding and atopic dermatitis was examined using questionnaire data in a cohort of 8346 Swedish infants [11]. A longer duration of exclusive breastfeeding was not associated with lower risk of atopic dermatitis in the first year of life, irrespective of the family history of atopy, in contrast to protection seen with the presence of furred pets. Short (<4 months) exclusive breastfeeding provided no protective benefit against atopic dermatitis.

Among 1128 infants recruited for the Prospective study on the Influence of Perinatal factors on the Occurrence of asthma and allergies (PIPO) project in Belgium and followed from mid-pregnancy, nonexclusive breastfeeding was not associated with eczema in the first year of life in the whole cohort, but among children of nonatopic parents, there was a nonsignificant trend to increased eczema (OR 1.9–2.2 with different durations of breastfeeding) [12]. The reverse trend was seen among children of atopic parents with OR 0.6–0.9, suggesting that the benefit of breastfeeding on atopic dermatitis may depend on parental atopy.

A retrospective cross-sectional analysis of childhood prevalence studies in Japan indicated a significant trend for an increased risk for eczema with both exclusive and nonexclusive breastfeeding compared with formula-fed children [13]. A prospective Finnish study from birth to 20 years provides stronger data, with strictly exclusive breastfeeding for at least 9 months being associated with increased atopic dermatitis and food allergy symptoms at age 5, particularly among children with a positive family history of allergy [14]. A New Zealand case-control study showed an increased risk of atopic dermatitis at 3.5 years among breastfed children (OR > 6), with an even higher risk (OR > 8) associated with prolonged breastfeeding for over 6 months [15].

Recent studies of the risks for allergic sensitization or 'allergic diseases'

In a study conducted in poor suburbs of Cape Town, South Africa, there was a reduced prevalence of allergic

disease in general among those with prolonged (>6 months) breastfeeding compared with nonexclusive breastfeeding for less than 6 months (OR 0.52, 95% CI 0.28–0.97) [16]. There was a significant linear inverse association between breastfeeding duration and allergic disease in children without allergic parents, but not in those with an allergic predisposition. This study had no reference group of nonbreastfed children.

In contrast, a Detroit childhood allergy study (CAS) found no association between the duration of breastfeeding and the likelihood of allergic sensitization, but children who were exclusively breastfed were 50% more likely to show allergic sensitization than exclusively formula-fed only children (OR 1.5, 95% CI 1.1–2.1) at 6–7 years of age [17]. The risk was greater for children of mothers with allergy vs. no allergy [relative risk (RR) 1.8 vs. 1.3], for children in homes without pets compared with having pets (RR 1.6 vs. 1.0) and for children with an older sibling vs. firstborns (RR 2.0 vs. 1.3). Hence, though breastfeeding may increase the risk of atopy, this was modified by birth order, exposure to household pets, and family history.

Recent studies of the risks for wheezing or asthma

A large Austrian study reported the lack of breastfeeding in the first 4–6 weeks of life was a risk factor of admission to hospital with atopic asthma among children aged 6–10 years, there being respectively 6.0 vs. 4.4 admissions per 1000 patient years, OR 1.32, 95% CI 1.02–1.70 [18]. Similarly, in Spain, Sunyer *et al.* [19] found a reduced risk of asthma (OR 0.33) and wheezing (OR 0.53) among breastfed children followed to age 4 years. Although these studies provide valid data, others claiming even more marked evidence of protection are flawed. For instance, a case–control study of a Mohawk population in New York state reported a more than five-fold reduction in risk of asthma among breastfed children (OR 0.18, 95% CI 0.05–0.75), but this was based on 25 asthmatics and 25 controls, with potential major biases [20]. Similarly, a study in India of only 50 urban and 50 rural children reported a markedly lower prevalence of atopic sensitization with exclusive breastfeeding for at least 6 months, OR 0.2, 95% CI 0.1–0.5 [21]. Much larger population-based studies are required to address these complex issues. Fortunately, several such studies have recently been reported, with multiple pertinent outcomes.

Recent studies reporting multiple outcomes (atopic dermatitis, allergy, or asthma)

Recent publications have followed up or re-analyzed data from two relatively large longitudinal birth cohort studies

that reported increased allergy and asthma among breastfed children. In a cohort in Tucson, Arizona, 84% of 1043 children were breastfed, though 59% of these received formula or other foods in the first 3 months of life [22]. In the first 2 years of life, exclusive breastfeeding was associated with significantly lower rates of recurrent wheeze, OR 0.45, 95% CI 0.2–0.9. Outcomes of doctor-diagnosed asthma and recurrent wheeze were subsequently assessed at ages 6 through 13 years and atopy by skin test at age 6 years. After adjusting for confounders, exclusive breastfeeding increased the risk of asthma at these later ages among children of asthmatic mothers, OR 8.7, 95% CI 3.4–22.2. This relationship was only evident for atopic children. In recent follow-up, a longer duration of breastfeeding was associated with increased lung growth in children, but in the presence of maternal asthma, longer breastfeeding was associated with decreased airflows, again highlighting the additional influence of the maternal history [23^{••}].

In a birth cohort followed in Dunedin, New Zealand, 504 of 1037 children were breastfed for 4 weeks or longer (established breastfeeding), with a mean duration of 21 weeks [24]. More children who were breastfed were atopic at ages 13 and 21 to house dust mite, cats, and grass pollen and reported more asthma at all surveys from age 9 to adulthood. No duration of exclusive breastfeeding had a protective effect against development of atopy and asthma in later childhood. Re-analysis of these data reported that the influence of breastfeeding on development of asthma and atopy differed by sex of the child, and by maternal and paternal atopy, with the greatest adverse effect (increased risks for atopy) among children at lower baseline risk [25^{••}]. Among those at higher risk (boys with a maternal history of asthma or atopy and girls with a paternal history of asthma or atopy), breastfeeding added little additional risk. Among boys with a paternal history, and girls with a maternal history, the baseline prevalence in nonbreastfed children was low and was substantially increased by breastfeeding.

In contrast to these studies, the Stockholm Children Allergy and Environmental Prospective Birth Cohort (BAMSE) study followed 4089 children to age 4 and found exclusive breastfeeding for 4 months or more reduced the risk of asthma (OR 0.72, 95% CI 0.53–0.97) compared with shorter duration of breastfeeding, irrespective of sensitization to common aeroallergens [26]. Exclusive breastfeeding for 3–4 months followed by partial breastfeeding for 3 months or longer reduced risk, with OR 0.44, 95% CI 0.21–0.87, with a greater effect in children without heredity for allergy. However, in this study, only 1.2% of children were not breastfed, and so comparisons are only possible between different durations of breastfeeding. It could be possible that a shorter duration of breastfeeding increased risk above

baseline, and longer duration decreased risk. This study also examined eczema as an outcome but excluded children who developed eczema and asthma during the breastfeeding period to avoid disease-related modification of exposure. Exclusive breastfeeding for at least 4 months reduced the risk for eczema (OR 0.78, 95% CI 0.63–0.96) irrespective of combination with asthma, sensitization to common allergens, and parental allergy. Again, the reference group comprised children breastfed for less than 4 months, and the same considerations apply.

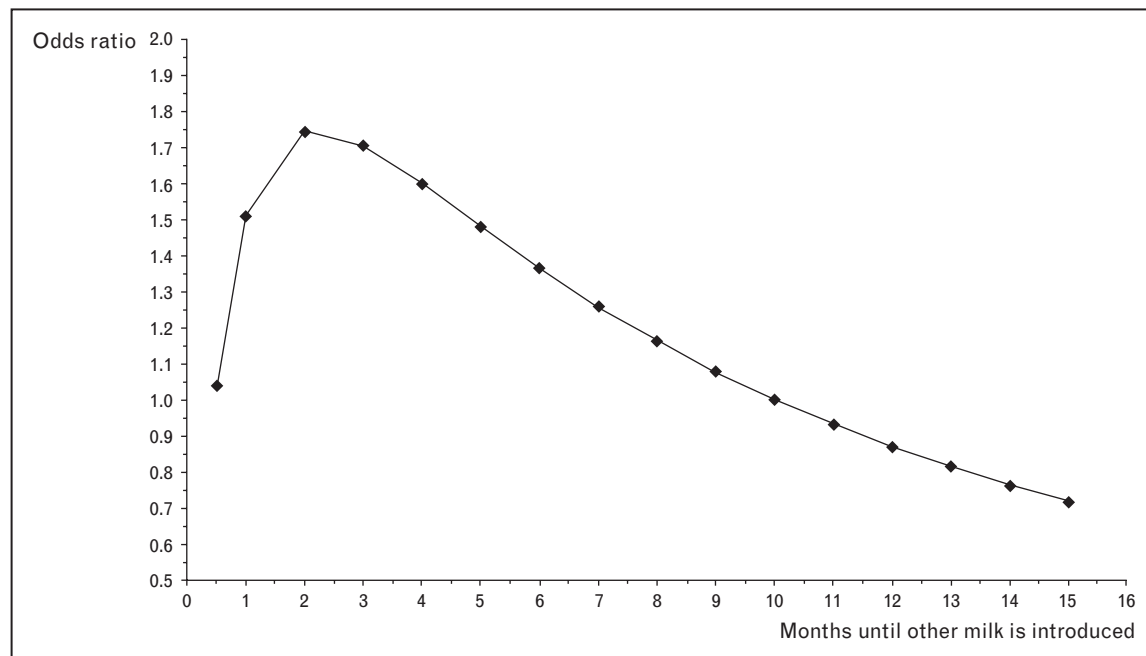
The age at which the outcome is assessed may be a critical factor in the differing results between studies. A significant benefit from breastfeeding was determined from the National Health and Nutritional Examination Survey-III (NHANES-III) study for children aged 2–71 months, with OR for asthma diagnosed before 24 months among ever breastfed compared with never breastfed children of 0.72 (0.54–0.95), but there was no significant reduction in risk of an asthma diagnosis after 24 months [27]. In this study, prolonged nonexclusive breastfeeding reduced the risk among infants concomitantly exposed to environmental tobacco smoke compared with nonbreastfed children (OR 0.53, 95% CI 0.33–0.86).

One of the most reported cohorts with respect to the impact of breastfeeding has been that followed in Perth, Australia, reporting data on benefits of exclusive breast-

feeding on outcomes of asthma at age 6 years [28]. Among this cohort of 2979 children, after adjusting for confounders including sex, gestational age, smoking in pregnancy, and early child care, the introduction of milk other than breast milk before age 4 months was a significant risk factor for doctor-diagnosed asthma (OR 1.25, 95% CI 1.02–1.54), wheeze three or more times since age 1 year (OR 1.41, 95% CI 1.15–1.76), wheeze in the last 12 months (OR 1.28, 95% CI 1.02–1.76), and positive reactions to aeroallergens (OR 1.27, 95% CI 1.10–1.59). Prolonging breastfeeding beyond 4 months reduced these risks assessed at age 6 years.

A more recent publication from this cohort reported that less exclusive breastfeeding was associated with increased asthma and atopy, with a 4% reduction in the risk of asthma with every additional month of exclusive breastfeeding (OR 0.96, 95% CI 0.92–1.00) [29]. ORs for asthma in 6-year-old children as compared with duration of exclusive breastfeeding (until other milk was introduced) on a month-by-month basis are shown in Fig. 1. The highest risk of asthma (OR 1.7) occurred with introduction of other milk by 2 months, and then the risk progressively declined to an OR of 1.0 at 9 months. Continued exclusive breastfeeding, with delay in introduction of other milk to 15 months, eventually reduced the OR for asthma to 0.75. The initial data point, with OR just above 1.0, presumably comprises children who had other milk introduced at, or very shortly after, birth. Hence, these data

Figure 1 Odds ratio for asthma in the birth cohort in Perth, Australia plotted by duration of exclusive breastfeeding (months until other milk was introduced)



Exclusive breastfeeding (withholding other milk) initially increased OR for asthma, with maximal effect at 2 months, followed by a progressive decline in risk with continued exclusive breastfeeding. After 9 months of exclusive breastfeeding, the risk for asthma decreased below the baseline risk. Reproduced with permission [29].

Table 1 Adjusted odds ratio and 95% confidence interval for association between various feeding practices and asthma at age 5 years

	Current asthma	Adjusted OR	Eczema	Adjusted OR	Atopy (≥ 2 mm weal)	Adjusted OR
Ever breastfed						
Yes	97/467	0.59	122/467	1.38	199/467	0.89
No	16/49	0.30–1.16	8/49	0.61–3.12	18/49	0.45–1.76
Breastfed for 6 months or more						
Yes	43/212	0.90	64/212	1.42	105/201	1.56
No	70/304	0.58–1.40	66/304	0.94–2.16	112/287	1.07–2.27
Fully breastfed to 3 months						
Yes	29/147	0.93	47/147	1.52	72/139	1.36
No	74/345	0.56–1.53	74/345	0.96–2.40	134/327	0.90–2.07
Solid food introduction by 3 months						
Yes	19/111	0.65	19/111	0.59	32/104	0.54
No	79/348	0.36–1.15	94/348	0.33–1.04	156/330	0.33–0.87
Allergenic food (cow's milk, eggs, nuts, fish) by 9 months						
Yes	81/375	0.96	98/375	1.14	150/355	0.67
No	32/140	0.60–1.54	32/140	0.71–1.83	67/132	0.45–1.02

OR, odds ratio. Adapted with permission [32**].

suggest that exclusive breastfeeding of up to 9 months duration, without introduction of other milk, actually increases the risk of asthma and that only after 9 months of exclusive breastfeeding does the risk of asthma decrease to equal that of children who were not breastfed or who discontinued breastfeeding quickly. These findings are thus not dissimilar to those reported from the Dunedin study in which children who were breastfed for less than 4 weeks had outcomes consistent with those who were not breastfed at all and had lower risks of atopy and asthma than those who were breastfed for 4 weeks or longer [24].

A population-based study in Greece found the prevalence of any breastfeeding at 6 months was 24% and exclusive breastfeeding only 17% [30]. Hence, very few mothers breastfeed exclusively for 9 months or more, which the data of Oddy *et al.* [29] would suggest is required to negate the increased risk of asthma introduced by breastfeeding.

Further support for this possible explanation of discordant data comes from a German study in which a reduced risk of atopic dermatitis and asthma was reported in 2-year-old children of nonatopic mothers who were breastfed for 6–9 months [31]. The risk of atopic dermatitis was in fact lowest among the small group of those not breastfed at all (prevalence 10.9% among those without a maternal history of atopic disease and 19.1% among those with maternal atopy). In comparison, the 'lowest' rates of atopic dermatitis associated with prolonged breastfeeding were 12.4 and 23.6% respectively. These data again suggest that breastfeeding may increase the risk of atopic dermatitis and that after prolonged breastfeeding, the risk is decreased toward baseline, but not to the prevalence seen in nonbreastfed children. Among those without maternal atopy, never breastfed children were less likely to have asthma than those breastfed 3–9 months, though for children of atopic mothers, prolonged breastfeeding did provide protection, with prevalence rates reducing from 23.8 to 14.3%.

Further detailed information came from an Australian study designed to assess the effects of omega fatty-acid dietary supplementation and house dust mite avoidance strategies on development of asthma [32**]. Among 516 high-risk children (one or more parents or siblings had asthma or wheezing) followed from birth to age 5 years, there was no association between the duration of breastfeeding or timing of introduction of solid foods and protection against asthma or other allergic diseases after adjustment for confounding factors (Table 1). In fact, breastfeeding for 6 months or more was associated with an increased risk of atopy at age 5 years (OR 1.56, 95% CI 1.07–2.27). There was no significant association between the presence of eczema at 4 weeks and at 3 months and continued breastfeeding beyond those times. Burgess *et al.* [33] followed Queensland children to age 14 years, with data on breastfeeding recorded at age 6 months and asthma outcomes by questionnaire completed by the mother at age 14 years. Breastfeeding for more than 4 months was not associated with asthma at 14 years (OR 1.03). One major paper has just been published by Elliott *et al.* [34] who report that breastfeeding was protective for wheeze in the first 3 years of life, odds ratio 0.80, but not for wheeze atopy or airway responsiveness at age 7 to 8 years. The authors conclude that there is no evidence for either deleterious or protective effect of breastfeeding on later risks of allergic disease in this large prospective birth cohort of children with objective outcome measures and extensive data on potential confounders and effect modifiers, and that the results are not related to reverse causation or loss to follow-up.

Do intervention studies help resolve the controversy?

In general, studies of primary prevention of asthma and allergy have adopted a multifaceted approach,

making it difficult if not impossible to determine the contribution (or otherwise) of breastfeeding on the outcome [35,36].

Other considerations

An interesting observation was made by Fredriksson *et al.* [37] in a prospective population-based study of 2568 Finnish children, 1984 of whom participated in a 6-year follow-up study. There was a U-shaped relationship between duration of breastfeeding and development of asthma. The lowest risk for current asthma was among those breastfed for 4–6 months, with increasing OR for durations below or above this (though none reached statistical significance because of small numbers). This duration-dependent relationship could explain some of the inconsistency among previous studies.

Duration of follow-up

The importance of long-term follow-up, and the change in results between short-term and long-term follow-up, is clearly seen in at least two studies. As noted above, the Tucson group initially reported protection from early childhood wheezing and then increased allergy and asthma when children were reassessed at an older age [22]. A Tasmanian study, which followed children from 7 years into adulthood, initially reported protection from current asthma associated with exclusive breastfeeding in the first 3 months of life (OR 0.8, 95% CI 0.6–1.0), but after age 7 years the risk reversed [38**]. At age 14, the breastfed children had an increased risk of current asthma (OR 1.46, 95% CI 1.02–2.07), confirmed at ages 32 (OR 1.84, 95% CI 1.06–3.3) and 44 (OR 1.57, 95% CI 1.15–2.14). These and other studies suggest protection from wheezing seen in early childhood does not persist into later childhood.

Modification of other risk factors

A study in the Netherlands comparing 221 infants with a positive family history of asthma with 308 infants with a negative history found that whereas parental smoking and house dust mite exposure increased the risks of asthma in the children with a family history, breastfeeding reduced that higher risk somewhat [39].

Concomitant obesity may be important in modulating or impacting breastfeeding outcomes. In a Canadian study, exclusive breastfeeding for less than 12 weeks was associated with overweight, and in combination with overweight was significantly associated with asthma. The authors suggest a common pathway to obesity and asthma through leptin and that a short duration of breastfeeding may lead to asthma in susceptible children [40].

Impact of the family history and sex of the child

As noted above, in both the Tucson [22] and Dunedin [24,25**] studies, the risk of breastfeeding differed according to the family history of allergy and asthma, by which parent was affected, and the sex of the child. In a study in Finland [41], the effects of breastfeeding were stratified by family history. Among 4-year-old children, all exclusively breastfed for at least 3 months or exclusively given formula, breastfeeding decreased the risk of allergic rhinoconjunctivitis (OR 0.41, 95% CI 0.18–0.95) and pet skin test positivity among children with atopic heredity, whereas in children without atopic parents, breastfeeding was associated with an increased risk of symptomatic atopy (OR 2.57, 95% CI 1.16–5.70) and higher IgE values. There was a significant interaction between heredity and breastfeeding. Van Merode *et al.* [42] examined sex-specific differences in asthma in young at-risk Dutch children (0–2 years with a positive family history). Breastfeeding for 4 weeks or longer reduced the risk of wheezing in boys, with OR 0.77 (95% CI 0.63–0.94) per 4 week longer exclusive breastfeeding, but this effect was not seen in girls (OR 1.00), suggesting sex as a modifier in the effects of breastfeeding.

Antibiotic exposure through breastfeeding

In the Dutch KOALA birth cohort study, infants exposed to antibiotics through breastfeeding had a greater risk of early, but not persistent, wheezing [43].

Breast milk composition

Oddy *et al.* [44] reported that an increased ratio of n-6:n-3 fatty acids in breast milk at 6 weeks and 6 months was associated with nonatopic eczema but not atopy or atopic eczema in high-risk infants (mothers with a history of asthma, hayfever, or eczema) at 6 months. Similarly, Wijga *et al.* [45] showed in the Prevention and Incidence of Asthma and Mite Allergy (PIAMA) study in the Netherlands that the risk of developing allergic symptoms (but not sensitization *per se*) was modified by intake of n-3 fatty acids through breast milk.

Conclusion

Kramer and Kakuma [46] undertook a systematic review of the optimum duration of breastfeeding, including weight and length gain, weight-for-age and length-for-age *z* scores, head circumference, iron status, gastrointestinal and respiratory infectious morbidity, atopic eczema, asthma, neuromotor development, and impact on maternal amenorrhea and maternal postpartum weight loss. Although data reviewed were inconclusive or even

conflicting in many respects, the World Health Organization recommended that exclusive breastfeeding should be continued for at least 6 months. Reviews of the benefits and potential risks and associated mechanisms related to breastfeeding on allergy and asthma outcomes have been published, including a review of the effects of breastfeeding on respiratory infections, atopy, and asthma, discussing many mechanisms that may be protective through their impact on the immune system and their potential pathways in disease modification [47,48].

The hygiene hypothesis may provide a plausible hypothesis for increased asthma and allergy associated with breastfeeding. Protection from viral infections by breastfeeding may induce a skew in the immune system to a Th2-dominated profile increasing the risk of atopic disease. If breastfeeding decreases the rates of viral wheezing but increases rates of atopic wheeze, one would expect a higher risk of asthma in later childhood when the atopic phenotype is commonest.

Breastfeeding is to be encouraged for its many positive nutritional and other benefits and may reduce early wheezing. There is little evidence for a protective effect of breastfeeding, even prolonged and exclusive, on reduction of risk of atopic dermatitis. Breastfeeding appears not to be protective for asthma if there is a positive family history of allergy. In longer term follow-up studies, not only does there appear to be no protection, but also breastfeeding is associated with an increased risk for atopic disease and asthma. Many studies cannot provide accurate risks or benefits for breastfeeding *per se*, because of the absence of a control or reference nonbreastfed group, and comparisons between studies are therefore difficult. A number of studies suggest the possibility that shorter term breastfeeding may increase the risks of atopy and asthma and that reduction in that increased risk is then seen with prolonged exclusive breastfeeding [24,29,30].

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 490–491).

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