



## Breastfeeding and respiratory tract infections during the first 2 years of life

To the Editor:

Breastfeeding protects against respiratory tract infections (RTIs) in infants [1–3], but whether its effects persist beyond that age is not well understood. Some studies have reported that protection diminishes soon after weaning [2], while others have found that it extends until the age of 2 years [4] or more [5, 6]. It is noteworthy that many previous studies grouped RTIs broadly into upper or lower tract infections, rather than studying specific diseases [3, 7], and few adjusted adequately for confounding factors [5] or investigated a possible effect modification by sex, which had been suggested by several studies showing a stronger protection in girls [8, 9].

This study aimed to quantify the protective effect of breastfeeding against RTIs during the first 2 years of life, while adjusting for potential confounding factors and testing whether the effect varied by sex.

We analysed data from the Leicester Respiratory Cohorts, a population-based random sample of children from Leicestershire, UK, which has been described in detail elsewhere [10]. For this analysis we included only children born between 1996 and 1997 who were aged 1–1.99 years at the date of the first survey in 1998. Parents completed a standardised questionnaire that requested detailed information on breastfeeding and respiratory symptoms. We assessed the duration of breastfeeding (no breastfeeding,  $\leq 6$  months or  $> 6$  months), the prevalence of frequent colds ( $> 6$  episodes), ear infections and croup within the last 12 months, and any episodes of bronchiolitis or pneumonia. We extracted perinatal data and demographic information from maternity records. The Leicestershire Health Authority Research Ethics Committee approved the study.

The survey requested information on a number of RTIs for each child, so we first performed an omnibus logistic regression to determine whether breastfeeding was associated with the occurrence of any RTI. By reforming the data into long format, this omnibus logistic regression also adjusted for the clustering of observations within each child [11]. Following a significant omnibus test, we performed unadjusted and adjusted logistic regressions to determine which RTIs were affected by breastfeeding practice. Adjusted models controlled for sex, ethnicity, socioeconomic status (Townsend deprivation score [12]), perinatal factors (gestational age, birthweight, birth season), environmental factors (pre- and post-natal maternal smoking, number of older siblings, day care attendance) and parental history of asthma, hay fever and bronchitis. We tested for effect modification by sex by adding interaction terms into adjusted models. Finally, we performed a sensitivity analysis including a subgroup of children with information on exact breastfeeding duration, by using breastfeeding as a continuous exposure, rather than categorical. All analyses were performed in Stata (version 14.2, Stata Corporation, Austin, TX, USA).

The survey in 1998 was sent to 5400 families with children aged between 1 and 1.99 years. Questionnaires were returned by 4100 parents (response rate of 76%). After excluding 47 children who had no breastfeeding information and 13 children born extremely prematurely (gestational age of  $< 28$  weeks [13]), 4040 children remained in the analysis. Of these, 52% were boys, 81% were white and 19% were of South Asian ethnic origin, 1659 (41%) had never been breastfed, 1639 (41%) had been breastfed for  $\leq 6$  months and 742 (18%) for  $> 6$  months. Of the 4040 included children, 769 (19%) were reported by their parents to have had frequent colds, 1685 (42%) ear infections and 293 (7%) croup within the last 12 months. Any episodes of bronchiolitis were reported for 453 children (11%) and pneumonia for 53 (1%).



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When considering all aforementioned infections together, we found evidence for an association between breastfeeding and any of the five infections (omnibus logistic regression test,  $p=0.0314$ ). Proceeding with individual unadjusted logistic regression tests, we found that breastfeeding protected against bronchiolitis during the first 2 years of life, with an odds ratio (OR) of 0.79, 95% confidence interval (CI) of 0.64–0.97 and  $p$ -value of 0.028 for breastfeeding for  $\leq 6$  months and OR 0.68, 95% CI 0.51–0.91 and  $p=0.009$  for breastfeeding for  $>6$  months compared to children who had never been breastfed (table 1). We also found a weak protective effect of breastfeeding for  $>6$  months against ear infections (OR 0.84, 95% CI 0.70–0.99,  $p=0.048$ ) (table 1). We did not find any associations between breastfeeding and frequent colds, croup or pneumonia. After adjusting for confounding factors, only breastfeeding for  $>6$  months remained protective against bronchiolitis (adjusted OR 0.72, 95% CI 0.52–0.97,  $p=0.034$ ) (table 1). There was no statistical evidence of effect modification by sex for any RTIs ( $p$ -values of interaction terms ranging from 0.059 to 0.953). Exact information on breastfeeding duration was available for 2286 children. In this subgroup,

TABLE 1 Associations between breastfeeding duration and respiratory tract infections

Breastfeeding duration as categorical exposure	Unadjusted (n=4040)		Adjusted <sup>#</sup> (n=3963)	
	OR (95% CI)	p-value	OR (95% CI)	p-value
<b>Frequent colds</b>				
No breastfeeding	1.00		1.00	
$\leq 6$ months	0.97 (0.82–1.16)	0.749	1.00 (0.83–1.21)	0.985
$>6$ months	0.99 (0.80–1.24)	0.958	1.01 (0.80–1.27)	0.953
<b>Ear infections</b>				
No breastfeeding	1.00		1.00	
$\leq 6$ months	0.91 (0.80–1.05)	0.198	0.97 (0.84–1.13)	0.710
$>6$ months	0.84 (0.70–0.99)	0.048	0.88 (0.73–1.06)	0.177
<b>Croup</b>				
No breastfeeding	1.00		1.00	
$\leq 6$ months	0.92 (0.71–1.19)	0.523	0.95 (0.72–1.26)	0.738
$>6$ months	0.92 (0.66–1.28)	0.612	0.86 (0.60–1.23)	0.408
<b>Bronchiolitis</b>				
No breastfeeding	1.00		1.00	
$\leq 6$ months	0.79 (0.64–0.97)	0.028	0.89 (0.70–1.12)	0.316
$>6$ months	0.68 (0.51–0.91)	0.009	0.72 (0.52–0.97)	0.034
<b>Pneumonia</b>				
No breastfeeding	1.00		1.00	
$\leq 6$ months	1.28 (0.70–2.35)	0.421	1.44 (0.76–2.73)	0.260
$>6$ months	1.18 (0.55–2.55)	0.675	1.11 (0.48–2.55)	0.810
Breastfeeding duration as continuous exposure	Unadjusted (n=2286)		Adjusted <sup>#</sup> (n=2248)	
	OR <sup>¶</sup> (95% CI)	p-value	OR <sup>¶</sup> (95% CI)	p-value
<b>Frequent colds</b>				
No breastfeeding	1.00		1.00	
Breastfeeding (per month)	1.00 (0.98–1.03)	0.736	1.00 (0.98–1.03)	0.734
<b>Ear infections</b>				
No breastfeeding	1.00		1.00	
Breastfeeding (per month)	0.99 (0.97–1.01)	0.277	0.99 (0.97–1.01)	0.408
<b>Croup</b>				
No breastfeeding	1.00		1.00	
Breastfeeding (per month)	1.00 (0.96–1.04)	0.827	0.99 (0.95–1.03)	0.571
<b>Bronchiolitis</b>				
No breastfeeding	1.00		1.00	
Breastfeeding (per month)	0.95 (0.91–0.99)	0.016	0.96 (0.92–1.00)	0.054
<b>Pneumonia</b>				
No breastfeeding	1.00		1.00	
Breastfeeding (per month)	1.00 (0.91–1.10)	0.972	1.00 (0.90–1.11)	0.991

Baseline group: children that had never been breastfed. <sup>#</sup>: for sex, ethnicity, socioeconomic status (Townsend deprivation score), perinatal factors (gestational age, birthweight, birth season), environmental factors (pre- and post-natal maternal smoking, number of older siblings, day care attendance) and family history of asthma, hay fever and bronchitis. <sup>¶</sup>: ORs here are presented as odds with every 1-month increase of breastfeeding duration compared to odds of children who had never been breastfed.

breastfeeding duration ranged from 0 to 48 months (mean=1.72, SD=4.18). The sensitivity analysis using this exposure also found evidence for a protective effect of breastfeeding against bronchiolitis, with a crude OR of 0.95 per month of breastfeeding (95% CI 0.91–0.99, p=0.016) and an adjusted OR of 0.96 per month of breastfeeding (95% CI 0.92–1.00, p=0.054; table 1).

In summary, this large study from the UK found very limited evidence of a protective effect of breastfeeding against all types of RTIs during the first 2 years of life. However, the data suggest that extended breastfeeding (>6 months) might protect against bronchiolitis.

The prevalence of ever breastfeeding in our study is lower than in other studies from the UK or USA [2, 4, 6], perhaps because our study population was born earlier and at that time breastfeeding had not been well promoted in the UK. The prevalence of RTIs in our study population is comparable with other studies [2, 4]. It could be speculated that, while breastfeeding confers limited protection against becoming infected with a virus, such as colds, it could prevent viral infection from developing into bronchiolitis through improved host defence, but the mechanisms for this would need to be identified. We did not find clear evidence that breastfeeding protects against ear infections during the first 2 years of life, in contrast to the report by BOWATTE *et al.* [14]. However, there was a trend towards a protection against ear infections and a dose response with longer breastfeeding duration. The majority of the studies on the effect of breastfeeding on pneumonia come from low- and middle-income countries, such as India and Brazil, said HORTA *et al.* [5] in a systematic review, where children usually have a higher exposure to infections, a poorer nutritional status and reduced access to healthcare.

The strengths of our study are the large unselected cohort and the fact that we investigated several RTIs and could control for many confounding factors. Although we relied on parent reports for breastfeeding and RTIs, our questionnaire had excellent repeatability (Cohen's kappa ( $\kappa$ ): 0.80–0.96) for breastfeeding [15]. In addition, we were able to explore the effects of breastfeeding as a continuous exposure, which supported our main finding. The main limitation of the study is that we had no information on the exact dates of infections and insufficient resolution to determine the severity of infections. Future studies should be prospective, and assess dates and severity of upper and lower respiratory infections.

In conclusion, this study suggests that prolonged breastfeeding might protect against bronchiolitis during the first 2 years of life in developed countries. This provides further evidence in favour of improving breastfeeding practice worldwide.

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