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# Breastfeeding Does Not Increase the Risk of Asthma at 14 Years

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## ABSTRACT

**OBJECTIVES.** There are conflicting data regarding the impact of breastfeeding on the development of asthma in late childhood. Our aim with this study was to investigate the relationship between breastfeeding and the prevalence of asthma in children at 14 years.

**METHODS.** The Mater-University of Queensland Study of Pregnancy is a birth cohort of 7223 women and their infants recruited from a public antenatal clinic in Brisbane, Australia, between 1981 and 1984. Data regarding breastfeeding and the duration of breastfeeding were collected through the use of a questionnaire completed by the mother 6 months postdelivery, and the prevalence of asthma was determined through the use of a questionnaire completed by the mother 14 years postdelivery.

**RESULTS.** Data regarding both breastfeeding and asthma were available for 4964 children. The prevalence of asthma in children at 14 years was 28.4%. Breastfeeding for  $\geq 4$  months was not found to have a significant effect on the prevalence of asthma in 14-year-olds. The unadjusted odds ratio of developing asthma at 14 years if the child was breastfed for  $\geq 4$  months was 1.03. The odds ratio of developing asthma did not change appreciably when allowance was made for potential confounding factors.

**CONCLUSION.** Data from this study indicate that breastfeeding neither increases nor decreases the prevalence of asthma in children at 14 years.

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### Key Words

breastfeeding, asthma

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**B**REASTFEEDING IS PROMOTED as the preferred method of infant feeding.<sup>1,2</sup> There are a number of established health benefits from breastfeeding including the prevention of gastroenteritis,<sup>3</sup> atopic eczema,<sup>3</sup> and respiratory infections in the first year of life,<sup>4</sup> reduced risk of childhood obesity,<sup>5</sup> and improved cognitive outcomes.<sup>6</sup> However, there are conflicting data regarding the impact of breastfeeding on the development of asthma.

A number of studies have demonstrated that breastfeeding either has no effect or provides a protective effect against the development of asthma.<sup>7-9</sup> However, 2 recent cohort studies have reported an increased relative risk of developing asthma in children who were breastfed either within the cohort as a whole<sup>10</sup> or specifically in those whose mother had asthma.<sup>11</sup> The methodologic quality of both of these cohort studies was critically appraised recently by Peat et al.<sup>12</sup> Their principal concern regarding the Dunedin cohort was that breastfeeding data were obtained at 3 years of age, leaving open the possibility of inaccurate or biased recall. The rates of breastfeeding and duration of breastfeeding were also low compared with more recent trends within Australia.<sup>13</sup> The Tucson cohort was drawn from a population of infants who obtained care from pediatricians attached to a specific insurance provider and thus represent a middle-class population. Both cohorts were criticized for not defining the degree of exclusive breastfeeding and a lack of scientific plausibility for their results.

However, both cohort studies have a number of strengths. The Tucson cohort was well powered and had good outcome measures in terms of asthma and atopy, and some have argued that there are biologically plausible explanations for their findings. In defense of their cohort, Sears et al<sup>14</sup> indicated that there was a high degree of correlation of breastfeeding data with more contemporaneous child health records and that the cohort met the majority of criteria proposed by Kramer<sup>15</sup> for determining the effect of breastfeeding on asthma (see Table 1). It was also suggested that the hygiene hypothesis may provide a plausible explanation for a

link between breastfeeding and increased atopic disease. The hygiene hypothesis has been proposed to account for the observed rise in the prevalence of atopic diseases in a number of populations as they have become more Westernized and their children have been exposed to fewer infectious diseases.<sup>16</sup> Nonparasitic microbial infections simulate an immune response dominated by type 1 T helper (Th1) cells rather than by type 2 T helper (Th2) cells, as occurs in association with atopic conditions. In the case of breastfeeding it might be argued that there is a protection from viral infections and thus a skew of the immune system to a Th2-dominated profile. The Th2/Th1 imbalance may then place the child at an increased risk of atopic disease. However, this concept remains controversial.<sup>17</sup>

A number of studies reporting a protective effect of breastfeeding assessed asthma at ages ranging from 2 to 8 years.<sup>9</sup> If breastfeeding increases rates of atopic wheeze but decreases rates of viral wheeze, then one might expect a higher odds ratio of asthma in breastfed subjects in late childhood when the atopic asthma phenotype is more common.<sup>18</sup> The Tucson cohort assessed asthma at 6, 9, 11, and 13 years,<sup>11</sup> and the Dunedin cohort assessed asthma every 3 to 5 years from 9 to 25 years.<sup>10</sup> There is a need for a large birth cohort that has contemporaneously documented breastfeeding rates, is able to measure and adjust for confounding factors, and has assessed asthma in late childhood. The Mater-University of Queensland Study of Pregnancy<sup>19</sup> is a large birth cohort that has data regarding breastfeeding collected at 6 months and an assessment of asthma made at 14 years. Data from this birth cohort were used to examine the relationship between being breastfed and having asthma at 14 years. The hypothesis was that breastfeeding would have a protective effect against the development of asthma and that this relationship would be independent of maternal asthma.

## METHODS

### Study Population

Subjects were recruited as part of the Mater-University of Queensland Study of Pregnancy. Details of the recruitment for the cohort have been published elsewhere.<sup>19</sup> In brief, 8556 women attending a public antenatal clinic at the Mater Mother's Hospital (Brisbane, Australia) between 1981 and 1984 were invited to participate. Of those who were invited, only 93 (1%) declined to be involved. Subsequently, there were 7661 live singleton term deliveries at the Mater Mother's Hospital. Of these, 7223 (94%) mothers completed a questionnaire at birth, and these infants constitute the birth cohort.

**TABLE 1** Criteria for Cohort Studies Examining the Relationship Between Breastfeeding and Asthma

Exposure: breastfeeding	Nonreliance on prolonged maternal recall Blind assessment of infant feeding history Sufficient duration of breastfeeding Sufficient exclusivity of breastfeeding
Outcome: asthma	Strict diagnostic criteria Blind assessment of outcome Severity of outcome Age of onset of outcome
Statistical analysis	Control for confounding factors Assessment of dose-response effect Assessment of effect in children at high risk Adequate statistical power

## Questionnaires

Data were obtained through the use of questionnaires completed by the mother during pregnancy, after birth, and at 6 months, 5 years, and 14 years postdelivery.

## Exposure

Breastfeeding data were collected at 6 months. Mothers were asked to indicate whether they had never breastfed or breastfed for <3 weeks, 3 to 6 weeks, 7 weeks to 3 months, or  $\geq 4$  months (including continuing to breast-feed).

## Outcomes

At 14 years postdelivery, mothers were asked simply if their child had asthma (possible answers: "yes" or "no") and in the last 6 months if they had suffered from asthma (possible answers: "often," "sometimes," and "rarely/never"). Unfortunately, there were no reliable data regarding asthma collected at 5 years.

A supplementary questionnaire was introduced during the 14-year follow-up when additional research funding became available. A total of 3720 mothers completed the additional questionnaire, which included questions about their child regarding the frequency of use of asthma medications, the number of days missed from school because of asthma in the previous year, and hospital admissions because of asthma and whether either they or the biological father suffered from asthma.

## Statistical Analysis

Statistical analysis was performed by using Statistical Package for Social Sciences 12.0.1 (SPSS Inc, Chicago, IL). The statistical significance of an association was assessed by using the  $\chi^2$  test for categorical variables and analysis of variance for the difference in the means of normally distributed continuous variables. A 2-tailed *P* value of <.05 was taken as statistically significant. Lo-

gistic-regression modeling was used to control for potential confounders.

## Ethics

Approval for the cohort study was given by the Mater Health Services Research Ethics Committee, and informed written consent was obtained from all study participants.

## RESULTS

Data regarding both breastfeeding and asthma at 14 years were available from 4964 subjects (69%). Mothers with incomplete data regarding either the duration of breastfeeding or asthma were more likely to have been socially disadvantaged and to have smoked during pregnancy (Table 2). Their infants were more likely to have been small for gestational age and/or premature and to have experienced more coughs, colds, or runny noses in the first 6 months of life.

On the basis of the mother's questionnaire, 1408 (28.4%) adolescents were reported to have asthma. There was no significant relationship found between the duration of breastfeeding and the report of asthma (*P* = .44) (Table 3). Stratification for the child's gender and reported parental asthma did not affect the relationship between the duration of breastfeeding and the prevalence of asthma. In particular, the rates of asthma were the same for the given rates of breastfeeding whether the child's mother did or did not have asthma. There also was no relationship between the duration of breastfeeding and the frequency of asthma symptoms in the previous 6 months.

There was no association found between the duration of breastfeeding and the reported use of asthma medications, days missed from school because of asthma, or admissions to the hospital with asthma (Table 4).

Although no relationship was evident between

**TABLE 2** Comparison of Patients Missing Data and Those With Data Regarding Breastfeeding and Asthma

	Subjects Missing	Study Subjects	<i>P</i>
Variables collected at birth ( <i>N</i> = 7223)			
<i>n</i>	2259	4964	
Gender (male), <i>n</i> (%)	1179 (52.2)	2579 (50)	.44
Birth weight, mean (SD), g	3350 (519)	3402 (513)	<.001
Gestation <37 wk, <i>n</i> (%)	111 (4.9)	185 (3.7)	.012
Mother smoked in early pregnancy, <i>n</i> (%)	1297 (57.9)	2256 (45.8)	<.001
Mother smoked in late pregnancy, <i>n</i> (%)	1052 (47.1)	1705 (34.7)	<.001
Mother completed secondary school, <i>n</i> (%)	1756 (78.4)	4109 (83.4)	<.001
Annual family income less than \$10 400, <i>n</i> (%)	915 (44.7)	1393 (29.6)	<.001
Variables collected at 6 mo ( <i>N</i> = 6671)			
<i>n</i>	1720	4951	
Attended child care, <i>n</i> (%)	854 (49.7)	2522 (50.9)	.19
Coughs and colds more than a couple of times per month, <i>n</i> (%)	375 (21.6)	908 (18.5)	.003
Skin rashes including eczema more than a couple of times per month, <i>n</i> (%)	352 (20.4)	1021 (20.8)	.38

**TABLE 3 Comparison of Duration of Breastfeeding and Asthma at 14 Years**

Duration of Breastfeeding	No Asthma, n (%)	Asthma, n (%)	Total
>4 mo	1515 (71.4)	606 (28.6)	2121
7 wk to 3 mo	500 (71.7)	197 (28.3)	697
3 wk to 6 wk	443 (69.8)	192 (30.2)	635
<3 wk	397 (73.5)	143 (26.5)	540
Not breastfed	701 (72.2)	270 (27.8)	971
Total	3556 (71.6)	1408 (28.4)	4964

$\chi^2 = 4.8$ ; degrees of freedom = 5;  $P = .44$ .

asthma and breastfeeding in the initial analysis, potential negative confounding was examined by using logistic regression. Breastfeeding was entered as 2 indicator variables (breastfeeding  $\geq 4$  months and breastfeeding 3 weeks to 3 months), with no breastfeeding as the reference category. Separate addition of maternal asthma, paternal asthma, smoking in early and late pregnancy, frequency of coughs and colds in the first 6 months of life, and annual family income at birth only minimally altered the odds ratio of developing asthma. The unadjusted odds ratio of asthma if the child was breastfed for  $\geq 4$  months was 1.03 (95% confidence interval: 0.9–1.2) and for 3 weeks to 3 months was 1.03 (95% confidence interval: 0.9–1.2).

There were only 554 mothers with no data regarding breastfeeding and 2055 subjects with no data regarding asthma. The relationship between breastfeeding and asthma was recalculated assuming that no mother who had missing breastfeeding data breastfed their child. The prevalence of asthma in those missing asthma data would need to be 41% for there to be a statistically significant relationship between breastfeeding and asthma ( $P = .05$ ). If it were to be assumed that the rates of breastfeeding for those missing breastfeeding data at 6 months were the same as the breastfeeding rates of those who provided data at 6 months but were lost to follow-up at 14 years, the prevalence of asthma would need to be 61% in those missing asthma data for there to be a statistically significant relationship ( $P = .025$ ). It is likely that the real rate of breastfeeding would lie between these 2 points; the relationships are statistically significant at these points but not clinically significant,

and the odds ratios remain only marginally above 1 (1.14 and 1.11).

## DISCUSSION

The findings from this study indicate that there is no significant relationship between the prevalence of asthma in 14-year-olds and either breastfeeding or the duration of breastfeeding. This relationship was not affected by the mother's asthmatic status.

The effect of breastfeeding on health-related outcomes has been assessed primarily through the use of observational studies, because it would be unethical and impractical to perform a randomized, controlled trial.<sup>3</sup> However, observational studies have a number of limitations, and criteria have been proposed against which cohort studies may be assessed<sup>15</sup> (see Table 1).

In this study breastfeeding was documented at 6 months when breastfeeding was often ongoing. Breastfeeding rates and duration were relatively high in this group, with 53% of women breastfeeding for 7 weeks to 3 months and 43% of women breastfeeding for  $\geq 4$  months. Unfortunately, the degree of exclusive breastfeeding is not known. Another study examined rates of exclusive breastfeeding in a similar population of women in 1995, 10 years after this cohort. In 1995, 64% of women were breastfeeding at 13 weeks (88% of them exclusively) and 48% were breastfeeding at 25 weeks (40% of them exclusively).<sup>13</sup>

Similar to many large epidemiologic studies, the diagnosis of asthma in this study was based on questionnaire data alone. There is no gold standard for the definition of asthma within large epidemiologic studies.<sup>20</sup> The estimated prevalence of asthma within this birth cohort of 28.4% is very similar to that reported by the International Study of Asthma and Allergies in Childhood, a benchmark in epidemiologic research into asthma in childhood. This group reported the mean lifelong prevalence of asthma in Australian children aged 13 to 14 years as 27.5% (SD: 2.4%) and wheeze in the last 12 months of 29.4% (SD: 4%).<sup>21</sup> These results suggest that for the majority of children the report of asthma is likely to correlate with accepted definitions of asthma. In addition, markers of asthma control, such as

**TABLE 4 Duration of Breastfeeding and Other Asthma Measures**

Duration of Feeding	Use of Asthma Medications, n (%) <sup>a</sup>			Days Missed From School, n (%) <sup>b</sup>			Admission to Hospital, n (%) <sup>c</sup>	
	Never	Sometimes	Often	Nil	1–4	>4	Never	Yes
$\geq 4$ mo	1170 (76.4)	85 (5.6)	276 (18)	1376 (91.3)	72 (4.8)	59 (3.9)	1410 (92.5)	114 (7.5)
3 wk to 3 mo	1065 (77.6)	74 (5.4)	233 (17)	1219 (90)	84 (6.2)	52 (3.8)	1255 (91.8)	112 (8.2)
Never	519 (77.2)	31 (4.6)	122 (18.2)	593 (89.6)	39 (5.9)	30 (4.5)	619 (92.7)	49 (7.3)
Total	2754 (77)	190 (5.3)	631 (17.7)	3188 (90.5)	195 (5.5)	141 (4)	3284 (92.3)	275 (7.7)

<sup>a</sup>  $\chi^2 = 1.5$ ; degrees of freedom = 4;  $P = .83$ .

<sup>b</sup>  $\chi^2 = 3.6$ ; degrees of freedom = 4;  $P = .46$ .

<sup>c</sup>  $\chi^2 = 0.7$ ; degrees of freedom = 2;  $P = .71$ .

the use of asthma medications and hospital admissions for asthma, were unaffected by the duration of breastfeeding. Mothers were unaware of a hypothesis regarding breastfeeding and asthma at the time that they completed any of the questionnaires.

There are a number of factors that are known to be associated with an increased risk of developing asthma. It is important to control for confounders (factors that will affect rates of both breastfeeding and asthma) in an observational study such as this. A review of the literature identified a number of possible confounding factors. If asthmatic women were more likely to breastfeed their infants, this may have resulted in an increased prevalence of asthma in breastfed children, given the established genetic predisposition to asthma.<sup>7,22</sup> Breastfeeding has been shown to provide protection against viral lower respiratory tract infections.<sup>4</sup> Although the link between recurrent infections in infancy and the development of asthma is controversial, some investigators have demonstrated a link between the prevalence of asthma and either a significant viral respiratory infection<sup>7</sup> or recurrent respiratory tract infections in infancy.<sup>23</sup> Children born to women who smoked during pregnancy and in the postnatal period have been shown to have reduced lung function in both infancy and later childhood, to have increased lower respiratory tract infections in infancy, and to suffer more frequent exacerbations of asthma and may have an increased risk of developing asthma.<sup>24</sup> There is a strong association between smoking and both the decision to breastfeed and the duration of breastfeeding.<sup>25</sup> The relationship between socioeconomic class and asthma has not been consistently demonstrated.<sup>26,27</sup> However, like smoking, socioeconomic factors are strongly related to rates of breastfeeding.<sup>13,25</sup> Adjustment for any of these potential confounding factors did not substantially change the relationship between breastfeeding and asthma. It is acknowledged that there may be confounders that were not measured and cannot be taken into account.

This is a large cohort, and it is adequately powered to demonstrate even a small effect of breastfeeding on asthma. A limitation of this study is that 31% of the original cohort was missing data regarding either asthma or breastfeeding. Those lost to follow-up were also different in a number of respects from those for whom data were available (see Table 2). However, the differences were seen primarily in socioeconomic factors and smoking. Given that these factors were not shown to affect the relationship between breastfeeding and asthma in the study group, it could be argued that the inability to include these subjects would not have altered the key findings of this study significantly. It was demonstrated also that the rates of asthma in those missing data would need to be significantly higher than in the study group for there to be a statistically significant relationship between breastfeeding and asthma, let alone a clinically

significant relationship. Analysis of subgroups (such as those in which the mothers were reported to have asthma) failed to demonstrate an effect of breastfeeding on asthma rates.

The findings from this cohort support the conclusions of previous studies that breastfeeding and the duration of breastfeeding do not seem to have a significant impact on the rates of asthma in late childhood. It is important to note that there does not seem to be an increased risk of asthma. Therefore, women may be encouraged to continue to make an informed choice regarding infant feeding with the reassurance that there are likely to be numerous health and other benefits associated with breastfeeding and little evidence to indicate any adverse consequences.

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