

Exposure to maternal smoking in the first year of life interferes in breast-feeding protective effect against the onset of respiratory allergy from birth to 5 yr

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The aim of this study was to evaluate the interaction between the exclusive breast-feeding protective effect and the exposure to tobacco smoke at domicile in the first year of life, on the onset of respiratory allergy (asthma and rhinitis) in children until 5 yr of age. This is prospective cohort study, observational, institutional based. Three hundred children born in a public hospital of Salvador-Bahia (Brazil) were followed from birth to 5 yr of age. Data from 268 children at 60 months of life were analyzed. Occurrence of allergic symptoms were studied and correlated with gender, allergic relatives in first degree, exclusive breast-feeding duration, smoking mother, and presence of other smoker at home, considering the first year of life. Exclusive breast-feeding for at least 6 months showed a protection effect against the onset of respiratory allergy in children from birth to 5 yr ($p < 0.05$); odds ratio (OR): 0.33 (95% CI: 0.18–0.59). Breast-fed children for less than 6 months compared with those breast-fed for 6 months or more, presented a higher risk (OR: 2.34–95% CI: 1.4–3.74) for developing allergic respiratory symptoms just to 5 yr. The protective effect of exclusive prolonged breast-feeding on the onset of respiratory allergy in children from birth until 5 yr was lost when their mothers were smokers (OR: 2.50–95% CI 1.19–5.19). Therefore, the protective effect of breast-feeding in the first year of life on the onset of allergic symptoms until the age of 5 yr was confirmed. This study proposes a confounding effect of maternal smoking on this protection, exposed by a higher risk for present allergic symptoms until the age of 5 yr, in children exclusively breast-fed for 6 months or more, when their mothers smoked.

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Exclusive breast-feeding for a prolonged period is a confirmed protective factor against the development of allergic manifestations (1–9). This protective factor is stronger when exclusive breast-feeding is practiced for a minimum period from 3 to 6 months (1, 2, 5–9). Such protection has been attributed, among other factors, to immuno-modulating qualities of the breast milk and the delaying of the exposure to food aller-

gens, while the intestinal mucous barrier is still immature (1, 9, 10). However, this protective factor could not be demonstrated by some authors (4, 11).

Passive smoking has been associated with the development of asthma and rhinitis in atopic children (12–14). Higher risk for these diseases is associated with smoking mothers (14). A recent study showed that not only maternal, but also

grandmaternal smoking patterns were associated with early childhood asthma (15).

A previous observational cohort study analyzed data referring to 268 children from Salvador, to study the appearance of allergic symptoms during the first year of life. This study showed the important influence of the early weaning on allergy development in the first year of life (16). It also evidenced that children whose mothers smoked showed a higher risk of developing respiratory allergies in the first year of life (RR: 4.56, 95% CI: 2.80–7.44), when compared with children whose mothers did not smoke. When smoking, in the children's house, was practiced by other co-inhabitants who were not the parents, the relative risk decreased, but remained present (RR: 3.45, 95% CI: 1.78–6.72).

The aim of this study was to verify the duration of exclusive breast-feeding protective effect and the influence of maternal smoking and domiciliary smokers during the first year of life, on respiratory allergic symptoms development until 5 yr of age.

Methods

Methodological design

Observational, prospective, institutional based cohort study. Eutrophic children, born at the main public general hospital in the city of Salvador-Bahia integrated the cohort and were followed from birth to 5 yr of age. Salvador is situated in the northeastern region of Brazil and *Hospital Central Roberto Santos* is a reference for patients from this poor country's region, and attends predominantly the low-income population.

The children were allocated in the study, if obeying the following inclusion criteria: being born at that hospital and exclusively breast-feeding until the first consultation in the ambulatory, which should occur until 60 days of life. The children born pre-maturely, with low weight or who presented some degree of respiratory suffering during the perinatal period, and those who manifested any sign of disease before the first consultation at the ambulatory, were excluded. All mothers who accepted to participate in the study signed a written informed consent.

Three hundred children were recruited; however three of them were excluded of the final analysis for incompleteness of data. Other 29 children interrupted the clinical follow-up. The cohort contained, therefore, valid data from 268 children, followed until 5 yr of age, with an evasion index of 10.66% (32 children). The characteristics of these children are given in Table 1.

Table 1. Characteristics of the studied children

Characteristics	N (268)	%
Gender		
Male	129	48.1
Female	139	51.9
Family history of allergy		
Absent	117	43.7
Present	151	56.7
Smoker at home on first year of life		
No	139	51.9
Yes	129	48.1
Smoking mother		
No	233	86.9
Yes	35	13.1
Exclusive breast-feeding for 6 months or longer		
No	142	53.0
Yes	126	47.0
Respirat. manifestations of allergy until 5 yr		
No	199	74.3
Yes	69	25.7

Follow-up procedures

The children were followed at the Pediatrics and Puericulture Ambulatory of the hospital, through monthly visits until 1 yr of age; every 3 months from 1 to 2-yr old and half-yearly from then on. Non-routine visits occurred, when necessary.

At the first visit, the mothers' consents were obtained informing that the data from their children would be used for the study without any identification. A standard questionnaire about study variables was also administered at the first visit by a trained team. Following the ambulatory routine, detailed guidance regarding general information about children care and stimulus to exclusive breast-feeding were provided. At each subsequent visit, the mothers answered a simplified written questionnaire about the habits that changed from last visit. General data (anthropometry, psycho-motor development, etc) and new health occurrences were registered and new orientations for health were given, according to the needs of each child. The mothers were advised to take their children to the ambulatory at any sign of disease. Complete questionnaires were administered again when allergic symptoms were reported or observed. For those children who did not present allergy manifestations, the questionnaire was re-applied at the next visit after their birthdays.

The following definitions of allergic manifestations were used: asthma – two or more episodes of reversible airways narrowing, characterized by wheezing, difficulty breathing and cough, without fever or infectious systemic symptoms and

also without a history of possible foreign body aspiration; confirmed by a benefic reaction to the therapy with inhaled bronchodilators; allergic rhinitis – inflammation of the nasal membranes, characterized by recurring nasal congestion and one or more of the following symptoms: sneezing, nasal itching, hyaline rhinorrhea and tearing, without fever or infectious systemic symptoms. The respiratory allergy symptoms were seen by a doctor and the allergy diagnosis was confirmed by positive skin prick tests to aeroallergens.

Variables

Dependent variables: respiratory allergic symptoms – asthma and/or rhinitis, according to the definitions described above. **Other variables:** gender; exclusive breast-feeding duration, categorized in ‘until 6 months’ and ‘over or equal to 6 months’; family history of allergy, defined as a report of allergy symptoms in one or more of first-degree relatives (mother, father, brother, sister) based on medical diagnosis (there was no information about confirmation tests); presence of smokers at the domicile, defined as the presence of a smoker inhabitant at the domicile of the child during the first year of life and smoking mother, considering the first year of the child’s life.

Statistical procedures

Correlations between independent and dependent variables were analyzed through comparison proportions by chi-square test. Risks for each independent variable were estimated by the odds ratio (OR), and relative risk (RR), when applicable. The confounding effect was analyzed through the Cochran’s and Mantel-Haenszel tests. Proportional hazards regression analysis by Cox model was also applied. The probability of error type α of 5% as significance level and 95% confidence interval were considered. The software used for statistics analysis was SPSS for Windows, version 9-0-0.

Results

The period of exclusive breast-feeding varied from 1 to 13 months, with an average of 4.87 months (SD = 2.39); the mode was 6 months. After categorization, 53% of the children were exclusively breast-fed for a period lower than 6 months, despite receiving orientation about advantages of exclusive breast-feeding; whereas 47% were exclusively breast-fed for 6 or more months. (Table 1).

Table 2. Association of variables with respiratory allergic manifestations until 5 yr of age

Variables	Respiratory allergic manifestation until 5 yr of age			p
	N (%)	No	Yes	
Gender				
Male	129 (48.1%)	97 (48.7%)	32 (46.4%)	0.78
Female	139 (51.9%)	102 (51.3%)	37 (53.6%)	
Weight at birth (g)				
2500–3000	84 (31.3%)	60 (30.2%)	24 (34.8%)	0.58
>3000	184 (68.7%)	139 (69.8%)	45 (65.2%)	
Family history of allergy				
Absent	117 (43.7%)	85 (42.7%)	32 (46.4%)	0.67
Present	151 (56.7%)	114 (57.3%)	37 (53.6%)	
Smoker at home during first year of life				
No	139 (51.9%)	105 (52.8%)	34 (49.3%)	0.67
Yes	129 (48.1%)	94 (47.2%)	35 (50.7%)	
Smoking mother				
No	233 (86.9%)	179 (89.9%)	54 (78.3%)	0.02
Yes	35 (13.1%)	20 (10.1%)	15 (21.7%)	
Exclusive breast-feeding for 6 months or longer				
No	142 (53%)	92 (46.2%)	50 (72.5%)	0.02
Yes	126 (47%)	107 (53.8%)	19 (27.5%)	

Table 3. Risk of onset of respiratory allergic manifestations until 5 yr of age, considering the study variables

Variables	OR	95% CI	p
Gender (female)	1.10	0.63–1.90	0.78
Family history of allergy	0.86	0.50–1.50	0.67
Exclusive breast-feeding until 6 months of age	2.34	1.40–3.74	0.02
Exclusive breast-feeding for a period of 6 months or longer	0.33	0.18–0.59	<0.001
Exclusive breast-feeding for a period of 6 months or longer*	0.30*	0.16–0.55	<0.001
Smoker at home during first year of life	1.15	0.66–1.99	0.67
Smoking mother	2.49	1.19–5.19	0.02
Smoking mother†	2.85	1.33–6.13	0.007
Smoking mothers (exclusive breast-feeding until 6 months)	2.00	0.70–5.70	0.27
Smoking mothers (Exclusive breast-feeding for a period of 6 months or longer)	4.62	1.52–14.00	0.011

OR, odds ratio; 95% CI, 95% confidence interval.

*Adjusted for ‘Mother smoker’ – Mantel-Haenszel test to avoid confounding effect.

†Adjusted for ‘Exclusive breast-feed for 6 months or longer’ – Mantel-Haenszel test to avoid confounding effect.

Exclusive breast-feeding for a minimum period of 6 months showed statistical association with the onset of respiratory allergic manifestations in children up to 5 yr of age ($p < 0.05$) (Table 2), indicating a protective effect (OR: 0.33; 95% CI: 0.18–0.59) (Table 3). Breast-fed children for a shorter period than 6 months, when compared with those breast-fed for 6 or more months, showed risk of 2.34 (95% CI: 1.4–3.74) for presenting respiratory allergic manifestations until 5 yr of age. (Table 3).

Table 4. Significance levels for associations between variables considered for the logistic regression analysis

Variable	p-value	eRR* (95% CI)
Exclusive breast-feeding for a period of 6 months or longer	<0.001	0.26 (0.14–0.49)
Smoking mother	0.004	3.17 (1.42–7.04)
Family history of allergy	0.24	0.70 (0.39–1.26)
Gender	0.47	1.24 (0.69–2.24)
Low weight at birth (<2500)	0.13	0.62 (0.33–1.16)

95% CI, 95% confidence interval.

*Estimated Relative Risk calculated by Cox proportional hazards model.

Maternal smoking, when considered as isolated factor, was associated with the occurrence of respiratory allergic manifestations until 5 yr of age with OR = 2.49 (95% CI: 1.19–5.19) (Table 3) and RR = 1.96 ($p = 0.02$). Exposure to smoking showed no association with occurrence of respiratory allergic manifestations if the smoker at domicile was not the child's mother (OR: 1.15; 95% CI: 0.66–1.99; $p = 0.67$) (Tables 2 and 3). The estimated risk for respiratory allergic manifestation until 5 yr of age, in children whose mothers were smokers, increased considerably with the duration of breast-feeding. For these children, when the period of exclusive breast-feeding was 6 months or longer, OR was 4.62 (95% CI: 1.52–14.00); if the children were exclusively breast-fed for a period until 6 months then the OR was 2.00 (95% CI: 0.70–5.70) (Table 3).

Applying the Mantel-Haenszel test, to avoid the putative confounding effect of maternal smoking, the protective role of extensive exclusive breast-feeding over the development of allergic manifestations until 5 yr of life was even greater (OR: 0.30; 95% CI: 0.16–0.55). (Table 3).

Applying the Logistic Regression to estimate the proportional risks for all variables, the high level of significance of the association between exclusive breast-feeding for 6 or more months and the reduction of the occurrence of allergic manifestations until 5 yr of age was confirmed (eRR = 0.26; 95% CI: 0.14–0.49; $p < 0.001$). The pernicious effect of maternal smoking was also demonstrated (eRR = 3.17; 95% CI: 1.42–7.04; $p = 0.004$). (Table 4).

Discussion

This prospective cohort study from birth until 5 yr of life, demonstrated a significant protective effect of prolonged exclusive breast-feeding on development of respiratory allergic manifestations. Exclusive breast-feeding for a period of 6 months or longer, reduced the risk of mani-

festing respiratory allergy until 5 yr of age, in approximately 1/3 (OR: 0.33; 95% CI: 0.18–0.59). This finding is similar to the reports of various previous studies (1, 2, 4–8). Although some authors have refuted the protective value of breast-feeding for a prolonged period, concerning allergies (3, 11), the immuno-protective value of breast-feeding against atopic manifestations and other damages to health is well known (5, 6). Additionally, the practice of breast-feeding guarantees good quality of feeding to newborns from low-income populations, reducing malnourishing and general morbidity in these children.

An hypothesis to justify the increase of the risk to develop respiratory allergic manifestations until 5 yr of age in children of smoking mothers breast-fed for 6 or more months, would be the higher intensity of passive exposure of these children to the tobacco smoke. The closer contact of the baby with smoke or even cigarette smell during breast-feeding, enable an intense and more frequent irritation of the respiratory tracts, caused by the cigarette's toxic substances (7). Another possibility would be the transfer of allergenic substances through breast milk (substances from cigarette and other sensibilizing factors), increasing the risk for allergic manifestations in first childhood (7, 17). When the confounding factor presented by the maternal smoking is corrected, applying the statistical procedure of Mantel-Haenszel, the protective effect of breast-feeding against respiratory allergic manifestations until 5 yr of age presents even higher with OR of 0.30 (95% CI: 0.16–0.55).

This study demonstrated that the practice of exclusive breast-feeding for a period of 6 months or longer was a protective factor for respiratory allergic manifestations in children born eutrophic, in a group of children from Salvador, until 5 yr of age.

Prolonged breast-feeding practiced by smoking mothers would increase the risk of occurrence of respiratory allergic manifestations in children until 5 yr of age, which should be the object of other studies, considering its importance compared with other risks of the non-adoption of breast-feeding. The main orientation should be to avoid smoking and not to restrict breast-feeding.

The information obtained supports the need to stimulate educational actions aiming at the prophylaxis of damages to health, specifically the stimulus for practice of breast-feeding and combat against smoking, to reduce not only the frequency of allergic symptoms but also other morbid conditions.

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