Overweight, asthma symptoms, atopy and pulmonary function in children of 4–12 years of age: findings from the SCAALA cohort in Salvador, Bahia, Brazil

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Abstract

Objective: To evaluate the association between overweight and the occurrence of asthma and atopy in a cohort of children of 4–12 years of age living in the city of Salvador in 2005.

Design: Cross-sectional study nested in a cohort.

Setting: The metropolitan region of Salvador, Bahia, Brazil.

Subjects: The study included 1129 children of 4–12 years age who presented complete information on the variables used here. Skin tests for allergy, spirometry, faecal parasitology, serum IgE and anthropometric surveys were conducted. Poisson’s multivariate regression was adopted.

Results: Wheezing was found in 29.1% and asthma in 22.8% of children, both conditions being more common in those under 6 years of age and 34% more common in overweight children (prevalence ratio (PR) = 1.34; 95% CI 1.07, 1.67) following adjustment. The ratio between forced expiratory volume in 1 s and forced vital capacity was associated with overweight (PR = 1.35; 95% CI 1.11, 1.61). No statistically significant association was found between overweight and allergen-specific IgE or with wheezing.

Conclusions: These results are in agreement with the hypothesis that overweight is associated with asthma and pulmonary function, even following adjustment for intervening variables known to be associated with the pathogenesis of asthma.

Keywords

Children
Wheezing
Obesity

Obesity and asthma are health issues that have been the target of an expressive volume of research worldwide in recent years because of the increase in prevalence of these diseases, particularly in children and adolescents in developed countries(1,2). Recent reviews indicate the existence of a two-way association in which asthma may contribute towards obesity and obesity may cause or aggravate asthma(3,4).

In Brazil, where nutritional transition occurs rapidly, a decline in malnutrition has been observed at different intensity levels in all age groups, accompanied by an increase in overweight and obesity(5). According to phase III of the International Study of Asthma and Allergies in Childhood (ISAAC) in Brazilian schoolchildren, asthma has been reported to range from 8.6% to 32.1%. Brazil has been among the countries in which the prevalence of this disease is the highest(6).

Some investigators believe that this growing trend in overweight and obesity fails to explain the increase in asthma, and speculate that obesity may represent a marker of the recent changes in lifestyle associated with asthma and obesity(7). For other authors, children with a high birth
weight or who are overweight in infancy are at a higher risk of developing asthma in the future. Results of a recent meta-analysis corroborate this latter hypothesis.

Many factors that have been investigated may play a role in the occurrence of asthma in obese individuals (e.g. genetical, mechanical devices, immunological, hormonal and environmental factors). These factors may be involved in the possible association of obesity with asthma; however, the methodological problems present in many studies render these findings inconclusive. The role of inflammatory mediators produced by visceral fat in increasing subepithelial fibrosis and remodelling the airways has been studied in animal models. In humans, asthma is more common in children with abdominal obesity, indicating that the proinflammatory state of insulin resistance may contribute towards the occurrence of asthma in obese patients. The proinflammatory role of hypercholesterolaemia and leptin has been studied as a further risk factor for asthma.

There is also a discussion on whether gender may represent an additional risk factor for asthma in the obese. Under this hypothesis, obese female children would be at a greater risk for asthma at the beginning of puberty and immediately afterwards, inferring that the mechanisms involved in this period may be different from those found before puberty.

The objective of the present study was to determine whether there is an association between overweight, asthma symptoms, atopy and pulmonary function in children of 4–12 years of age residing in Salvador, Bahia, Brazil.

Methods

Study design

The present paper refers to a cross-sectional, population-based study nested within a cohort developed in 2005 in the metropolitan region of Salvador, a city of approximately 2.5 million inhabitants situated in the north-east of Brazil. Details of the methodology and the results of the first survey and of the cohort study have been described previously in detail. The children included in the present study are part of a prospective cohort study investigating the health impact of installation of a sewage system in marginal neighbourhoods in the city of Salvador. Data were collected from children born between 1994 and 2001 who lived in ‘sentinel’ areas scattered throughout the city. Data were collected between 1997 and 2003 (baseline) and in 2005 the children were re-surveyed. In each study period different children were recruited up to a total of 2973 participants.

Study population

Of the 2973 children recruited at baseline and resident in the twenty-four micro-areas with no basic sanitation at the time of the study, 1445 children were followed up with the principal objective of studying the risk factors for the occurrence of asthma and other allergic diseases in children. A total of 1129 children of 4–12 years of age who presented complete information for the variables used here were included in the present study.

Data collection

Socio-economic and environmental data and reported information on asthma symptoms were obtained using a standardized questionnaire adapted from the Portuguese version of the questionnaire used in the second phase of the ISAAC trial. The interview was conducted with the children’s parents or guardians for the specific purpose of obtaining data referring to signs and symptoms compatible with asthma and allergy and their risk factors. Mothers were classified as illiterate if they reported no schooling or incomplete elementary-school education.

Asthma was defined as the reported occurrence of wheezing in the 12 months before the interview and at least one of the following: diagnosis of asthma at least once; waking up at night because of wheezing in the past 12 months; wheezing while exercising in the past 12 months; and four or more episodes of wheezing.

Birth weight and duration of breast-feeding were assessed by questions on infant feeding at baseline when children were <3 years of age. The parents were asked how long the child was breast-fed and whether the mother was still breast-feeding, with the duration being defined as the age at which breast-feeding stopped. The highest limit of 2 months was used as the cut-off level to obtain an even number of children in each group. Unfortunately, the degree of exclusive breast-feeding in this population is not known.

The children were weighed on portable electronic microscales (Filizola, model E-150/3P, São Paulo, Brazil) and measured using a portable stadiometer (Leicester height measure). Variations of 100 g were permitted for weight and 0.1 cm for height and length. The mean of two measurements was considered as the final measurement. The instruments were calibrated periodically. The recommended technical standards and criteria were observed in all steps of the anthropometric evaluation. The children’s ages were recorded from their birth certificates or from their health cards, and the difference was calculated between the measurement date and the child’s date of birth. Birth weight was obtained from the child’s health card. Children with BMI Z-scores ≥ +1 were considered to be overweight on the basis of the 2006 and 2007 reference standards of the WHO.

The presence of helminth eggs or protozoan cysts and oocysts in faeces, detected using the spontaneous sedimentation and/or the Kato-Katz techniques, was considered as an indication of a positive parasitology test.

Skin tests were conducted on the right forearm of each child using extracts (ALK-Abello, São Paulo, Brazil) for...
the following allergens: cat epithelium, dog epithelium, *Dermatophagoides pteronyssinus* (house dust mite), *Blomia tropicalis* (tropical dust mite), *Blatella germanica* (German cockroach), *Periplaneta americana* (American cockroach) and a mixture of fungi. Saline solution and histamine were used as negative and positive controls, respectively. The size of the skin wheal reaction was read after 15 min and the test was considered positive if the mean of the two perpendicular diameters (excluding the erythema and pseudopods) was ≥3 mm larger than that of negative controls. Skin reactivity was considered positive when there was positivity to at least one allergen.

In the case of children using antihistamines at the time of the skin test, information was obtained on when the treatment would end and these children were then re-evaluated later. In the case of a negative histamine result, information was requested on any recent antihistamine treatment and the child was re-evaluated later in accordance with the half-life of the medication.

Blood samples were collected for measuring allergen-specific IgE for *P. americana, D. pteronyssinus, B. tropicalis* and *B. germanica* using commercial ImmunoCAP kits (Pharmacia Diagnostic, Uppsala, Sweden). Allergen-specific IgE was defined in kU/l. The lower detection limit was 0-35 kU/l. For the purposes of this analysis, the presence of allergen-specific IgE in each child was defined as (0) non-detectable (<0-35 kU/l) and (1) detectable (≥0-35 kU/l) in concentrations. In addition, concentrations of serum IgE for the detection of allergens (≥0-70 kU/l) were also tested.

Spirometry was performed in accordance with the recommendations of the American Thoracic Society, using a Koko® spirometer (Pulmonary Data Services Instrumentation, Louisville, CO, USA). During the test, the children remained standing with their head in a neutral position. Children who showed evidence of not having performed the examination correctly, such as cases of early cessation, glottic closure or coughing, as well as those who were uncooperative, were excluded from the study. The volumes measured were forced vital capacity (FVC) and forced expiratory volume in 1 s (FEV1). The bronchodilatation test was performed by inhaling salbutamol 200 µg, with spirometry being performed 15 min after administration of the bronchodilator. Response to the bronchodilator was considered positive when there was an increase of ≥12% in FEV1 and ≥200 ml in its absolute value in relation to the value measured before inhalation of the short-acting β2 agonist. The program used by the spirometer permitted predicted percentage values to be automatically calculated for each patient in accordance with the Brazilian standard curve. Since few children had results below normal (i.e. <80%) for FEV1:FVC ratio or the Tiffeneau index, the median (98%) of the percentages obtained when the value found was compared with the predicted value was used for the purpose of analysis in the present study.

### Statistical analyses

The prevalence rates of asthma, atopic sensitivity and wheezing in the past 12 months were calculated as a measure of occurrence and compared between the exposure groups using prevalence ratios (PR) as a measure of association. Since the study outcome is not a rare event, overestimation of OR may be observed as compared with the PR. Therefore, rather than using logistic regression, multivariate Poisson regression models were defined with robust variance. Unadjusted associations between dependent variables and other variables were examined using the $\chi^2$ test, and the Student's $t$ test was used to examine BMI in Z-scores.

Multivariate analyses were performed using Poisson regression models to identify possible confounding factors and effect-modifying covariables. The interaction was interpreted as a change in the magnitude of the effect in the presence of a third variable using the Wald test. The variables were classified as ‘interaction variables’ when the $\chi^2$ reached a $P$ value $\leq$ 0.10.

The statistical criteria adopted to recognize confounding factors were based on a variation of at least 10% in the measurement of the principal association when the crude PR was compared with the adjusted PR. The backward elimination procedure was adopted for this analysis, also taking the epidemiological criteria into consideration. Missing data in the breast-feeding variable, although consisting of only two cases in this sample, were recovered by imputation, using the median value of the duration of breast-feeding.

As previously described, allergen skin-test reactivity, serum IgE, FEV1:FVC ratio, wheezing in the 12 months before the interview and asthma were considered dependent variables, with BMI as the independent variable. In the statistical analysis, the following were considered risk categories, according to previous studies, in the adjustment variables: being male; <6 years of age; birth weight <2500 g; poor maternal educational level; having more than one child under 5 years of age living in the home; <2 months of breast-feeding; father or mother having asthma; and infection by *Ascaris lumbricoides* or *Trichuris trichiura*. The cut-off age was 6 years because asthma is higher among young children.

The Epi Info statistical software program version 6-4 (Centers for Disease Control and Prevention, Atlanta, GA, USA) was used for data entry and all statistical analyses were performed using STATA statistical software package version 9-0 (StataCorp., College Station, TX, USA).

The protocol of the present study was submitted to the Institutional Review Board of the Institute of Collective Health, Federal University in Bahia, and approved before initiation. Results of the stool tests (both positive and negative) were returned to the children’s parents. In the case of positive test results, the children received the appropriate treatment. When necessary, nutritional orientation was provided to the child’s parent or guardian.
Results

A total of 1445 children aged 4–12 years were selected to constitute the cohort. For the effects of analysis, children were only included if their data for the variables that were analysed in the study were complete. Consequently, children with incomplete data were excluded from the study; however, there were no statistically significant differences between the groups. Therefore, the final sample included in the study consisted of 604 boys and 525 girls, adding up to a total of 1129 children of 4–12 years of age. The anthropometric characteristics of the children are shown in Table 1.

The mean BMI Z-score and so show that children with positive skin reactions and lower FEV1:FVC ratios had significantly higher mean BMI (Table 2). With respect to the events investigated, 29-1% of the children (329 of 1129) had symptoms of asthma, 29-9% (328 of 1098) had a skin reaction to some of the allergens tested and 48-6% (523 of 1075) had a serum IgE level ≥0·35 kU/L. Overweight and obesity was identified in 15·3% (173 of 1129) of the children. Positivity for A. lumbricoides infection was found in 16·9% (191 of 1129) and for T. trichiura in 14% of children (158 of 1129; data not shown).

In the bivariate analysis, statistically significant differences were found between the sexes with respect to sensitivity to allergens and IgE ≥0·35 kU/L, with boys being more sensitive than girls. Boys also had lower FEV1:FVC ratios compared with girls. The prevalence of wheezing in the 12 months before the interview and of asthma symptoms was greater in children under 6 years of age and in those infected with A. lumbricoides. In the absence of both this parasite and T. trichiura, the prevalence of skin reactivity to allergens was significantly higher. In the children belonging to mothers with better educational levels, the prevalence of positive skin reactivity was also higher (Table 3).

The results of regression models for the estimation of crude and adjusted associations between BMI and allergen skin-test reactivity, serum-specific IgE, FEV1:FVC ratio, wheezing in the past 12 months and asthma symptoms are shown in Table 4. A statistically significant association was found between overweight and skin reactivity; however, this significance was lost following adjustment for confounding factors (PR = 1·25, 95% CI 1·00, 1·50). Statistically significant differences were found

<table>
<thead>
<tr>
<th>Table 1 Anthropometric characteristics of the children according to gender and age</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;6 years of age</td>
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<tr>
<td></td>
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<tr>
<td>----------------</td>
</tr>
<tr>
<td>Birth weight (g)</td>
</tr>
<tr>
<td>Height (cm)</td>
</tr>
<tr>
<td>Weight (kg)</td>
</tr>
<tr>
<td>BMI Z-score</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2 Mean BMI Z-scores, according to asthma symptoms, atopy markers and lung function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI Z-score</strong></td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Skin test</td>
</tr>
<tr>
<td>Positive</td>
</tr>
<tr>
<td>Negative</td>
</tr>
<tr>
<td>Specific IgE</td>
</tr>
<tr>
<td>Positive</td>
</tr>
<tr>
<td>Negative</td>
</tr>
<tr>
<td>Wheezing in the past 12 months</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Asthma symptoms</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>FEV1:FVC ratio (%) ≤98</td>
</tr>
<tr>
<td>&gt;98</td>
</tr>
</tbody>
</table>

FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity.
Uncontrolled analysis.
*P < 0·05.
†Student’s t test.
Table 3 The prevalence of study endpoints according to the characteristics of the sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Wheezing in the past 12 months (n 1129)</th>
<th>Asthma symptoms (n 1129)</th>
<th>Skin reactivity (n 1098)</th>
<th>IgE ≥ 0.35 kU/l (n 1075)</th>
<th>FEV1:FVC ratio ≤ 98% (n 865)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes (n 329)</td>
<td>Yes (n 257)</td>
<td>Positivity (n 328)</td>
<td>Positivity (n 523)</td>
<td>Positivity (n 394)</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%†</td>
<td>P value‡</td>
<td>n</td>
<td>%†</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>171</td>
<td>28.3</td>
<td>0.511</td>
<td>142</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>158</td>
<td>30.1</td>
<td>115</td>
<td>21.9</td>
</tr>
<tr>
<td>Age (years)</td>
<td>≥6</td>
<td>155</td>
<td>21.9</td>
<td>0.000*</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>&lt;6</td>
<td>174</td>
<td>41.2</td>
<td>136</td>
<td>32.2</td>
</tr>
<tr>
<td>Birth weight (g)</td>
<td>&lt;2500</td>
<td>34</td>
<td>33.0</td>
<td>0.365</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>≥2500</td>
<td>295</td>
<td>28.8</td>
<td>227</td>
<td>22.1</td>
</tr>
<tr>
<td>Breast-feeding (months)</td>
<td>&lt;2</td>
<td>222</td>
<td>29.9</td>
<td>0.449</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>≥2</td>
<td>107</td>
<td>27.7</td>
<td>0.231</td>
<td>83</td>
</tr>
<tr>
<td>Number of children &lt;5 years of age in the household</td>
<td>≤1</td>
<td>194</td>
<td>28.1</td>
<td>0.322</td>
<td>155</td>
</tr>
<tr>
<td></td>
<td>&gt;1</td>
<td>135</td>
<td>30.8</td>
<td>102</td>
<td>23.3</td>
</tr>
<tr>
<td>Mother’s schooling</td>
<td>University/high school</td>
<td>71</td>
<td>29.6</td>
<td>0.911</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>Did not finish high school</td>
<td>176</td>
<td>28.6</td>
<td>137</td>
<td>22.3</td>
</tr>
<tr>
<td></td>
<td>Illiterate</td>
<td>82</td>
<td>29.9</td>
<td>0.252</td>
<td>69</td>
</tr>
<tr>
<td>Ascaris lumbricoides infection</td>
<td>Yes</td>
<td>70</td>
<td>36.6</td>
<td>0.012*</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>259</td>
<td>27.6</td>
<td>202</td>
<td>21.5</td>
</tr>
<tr>
<td>Trichuris trichiura infection</td>
<td>Yes</td>
<td>50</td>
<td>31.6</td>
<td>0.455</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>279</td>
<td>28.7</td>
<td>218</td>
<td>22.5</td>
</tr>
</tbody>
</table>

*P < 0.05.
† Prevalence.
‡ χ² test.
between overweight and asthma symptoms and between overweight and FEV1:FVC ratio, even after adjustment. Compared with the group of normal and underweight children, the prevalence of asthma symptoms and lower FEV1:FVC ratios were $>34\%$ and $35\%$, respectively, in the group of overweight children (Table 4). Serum IgE levels $\geq 70$ kU/l for the detection of allergens were also tested in the multivariate analysis (data not shown) and no statistically significant differences were found in the results obtained at levels $\geq 35$ kU/l.

The duration of breast-feeding was confirmed as an effect modifier of the associations between overweight and skin reactivity and between overweight and asthma symptoms, indicating that the analyses should be stratified in accordance with this variable (Table 5). In the children who had been breast-fed for $<2$ months, skin-test positivity was more common when the child was overweight compared with normal or underweight children (PR = 1.28, 95% CI 1.01, 1.70) even after adjustment for confounding factors. Likewise, a $53\%$ higher prevalence of asthma symptoms was found in overweight children who had been breast-fed for $<2$ months compared with normal or underweight children (PR = 1.53; 95% CI 1.11, 2.09; Table 5).

**Discussion**

In the present study population, the prevalence rates of wheezing in the past 12 months and of asthma, defined according to reported symptoms, were high (>20%), which was consistent with findings from other studies, placing Brazil among the countries with the highest prevalence rates of this disease in children $^{32}$. On the other hand, the prevalence of overweight and obesity (15-3%) in the study population is similar to that found in the literature for children of the same age group in Salvador (15-8%) $^{33}$ and lower than that found by Suñe et al $^{34}$ in the south of Brazil (24-8%), although it should be emphasized that comparison with previous studies is...
difficult because of the diversity of criteria used for the
definition of nutritional status since no standard or
reference was agreed upon internationally. Different
estimates of nutritional status may also be found when
factors such as age, gender and also the time at which
the study was conducted are taken into consideration,
especially in Brazil where rapid nutritional transition has
been observed over the past 10 years.

Our results corroborate similar findings in different
contexts and with different methodologies that have
reported the existence of a positive association between
the occurrence of overweight and asthma symptoms in
children. In the present study, overweight children had
34% more asthma, even after adjusting for potential
confounders. Several studies conducted worldwide in
children or adults have indicated the existence of a
statistically significant association between obesity and
asthma, with a few publications suggesting the
reverse and these consisting predominantly of case–
control studies with limited sample sizes. In a study
conducted on 14,908 English and Scottish children of
4–11 years of age, who participated in the National Study
of Health and Growth, the risk of asthma was found to be
28% higher in obese children compared with those of
normal weight. Obesity was also associated with
wheezing, a precursor of diagnosis of asthma, in the 12
months preceding the interview in children under 5 years
of age living in fourteen townships in Bahia and São
Paulo. The authors found a 2.57% higher risk of the
occurrence of wheezing in obese children.

Another important finding in the present study was the
interrelationship between overweight, breast-feeding and
asthma. A shorter duration of breast-feeding combined
with overweight was significantly associated with asthma
and positive allergen skin-test reactivity. Overweight
children who were breast-fed for <2 months had 32%
more skin reactivity and 54% more asthma. This finding is
in agreement with the results published by Oddly et al.,
who investigated a cohort of Australian-born children of
up to 6 years of age. In that study, a shorter duration of
breast-feeding increased the likelihood of the child
developing asthma, atopy or overweight in the future, the
latter being a risk factor for asthma. In another study
conducted by the same investigator, each additional
month of breast-feeding contributed towards a reduction
in the risk of developing overweight. It is suggested that
a common pathway between asthma and obesity and
the short duration of breast-feeding may be a common
influence on overweight and asthma. Children who
were breast-fed for a short time early in life could have
low levels of circulating leptin, which is a hormone pre-

sent in breast milk and inversely associated with weight
gain in infancy, and the risk of overweight and asthma
could be higher in later life. Unfortunately, in this
population, leptin was unavailable. We would suggest
that future studies should be carried out in which leptin
and adiponectin levels are taken into consideration in
order to acquire further information on their role in the
occurrence of asthma and atopy in these children.

Moreover, asthma causes airway inflammation, and the
proinflammatory state of obesity as a consequence of the
endocrine activity of adipose tissue is known to be
associated with wheezing and asthma. The macrophages
present in adipose tissue, particularly those found in
central or visceral obesity, are a source of inflammatory
mediators such as inflammatory adipokines, leptin and
ghrelin, and of inflammatory markers such as IL-6, IL-18,
TNF-α and C-reactive protein. Insulin resistance is also
associated with the occurrence of asthma symptoms and
obesity and asthma may be related to the same inflam-
atory trajectory.

In the present study, overweight children also have less
respiratory capacity, as reflected in lower FEV1:FVC
ratios. This association was robust and persisted even
after inclusion of potential confounding factors into the
model. Pulmonary function has been consistently shown in
the literature to be impaired in the presence of obe-

sity. Pulmonary volume is inversely proportional to
the degree of adiposity, the reasons for the reduction
being associated with mechanical effects. Obesity is
known to be a restrictive process that promotes altera-
tions in pulmonary volume and in total lung capacity,
while a reduction in expiratory reserve volume and func-
tional residual capacity. Flow volume is low in the
expiration of obese individuals and airway smooth
muscle becomes shortened, also leading to constriction
and rigidity of the airways, which in turn contribute
towards lower airway surface tension, resulting in an
unfavourable cycle that is detrimental to lung function.
Obesity does not directly cause airway obstruction, but
may lead to airway hyper-responsiveness, one of the
clinical characteristics of asthma through the mechanisms
described previously.

Allergen skin test also showed that, when the indivi-
dual was not infected by A. lumbricoides or T. trichiura,
the prevalence of allergen skin-test positivity was sig-
ificantly higher. Geohelminths infections are known to
be negatively associated with atopy. Mechanisms that
have been proposed include the induction of regulatory
T cells, which are able to suppress allergic effector
responses at distal sites, and generation of an immuno-
suppressiv environment in the host organism.

The present study took advantage of being part of a
large prospective cohort study that collected data in early
childhood on variables that could interfere with the
associations studied. Nevertheless, the results are subject
to the inherent limitations of a study design. The first
limitation, typical of any observational study, is the
impossibility of controlling all the possible confounders;
thus it becomes impossible to rule out residual con-
 founding related to the principal association. Moreover,
since it is a cross-sectional study in which overweight and
asthma were measured simultaneously, the researchers’ possibilities for inferring causal relationships based on the observed associations should be weighed with caution.

There is a consensus that a longer duration of breast-feeding protects infants against asthma and allergies as well as from other diseases\(^4\)\(^5\), although previous studies showed that breast-feeding and the duration of breast-feeding do not seem to have a significant impact on the rates of asthma in late childhood\(^4\)\(^6\). Other studies have shown that the protective effect of breast-feeding appears to be greater in children with a family history of atopy, particularly in those who live in less-developed countries\(^4\)\(^7\). This fact may have led to controversies in the findings of studies in which the objective was to evaluate the association between breast-feeding, asthma and other allergic diseases\(^4\)\(^7\). Another explanation for these findings lies in the hygiene hypothesis. The protection against infections conferred by breast-feeding may induce the immune system to a Th2 profile, thus increasing the risk of atopy\(^4\)\(^7\).

Nutritional factors have received more attention in recent years as a possible way of preventing and treating chronic diseases. Particularly in the case of asthma and atopy, diseases with few possibilities for prevention, the promotion of breast-feeding, a healthy diet and maintenance of adequate weight have come to represent a real possibility in the prevention and control of these conditions and in maintaining patients’ quality of life. Particularly in childhood, the possibility of prevention is even greater. On the other hand, both asthma and obesity constitute significant public health issues that cause an impact on hospitalization rates and mortality, a fact that heightens interest in studies and interventions aimed at reducing the occurrence of these two problems in the population. Understanding the mechanisms involved in the association between obesity and asthma, in addition to providing further data on how they are associated, may contribute towards the development of new therapeutic strategies. Efforts to promote breast-feeding and reduce childhood obesity may lead to a reduction in the occurrence of asthma and atopy.

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**References**


