The Relationship Between Asthma and Obesity in Urban Minority Children and Adolescents

Jennifer Gennuso, MD; Leonard H. Epstein, PhD; Rocco A. Paluch, MA; Frank Cerny, PhD

Objective: To investigate the relationship between asthma and obesity in children and adolescents.

Design: Medical record review.

Setting: Urban community health center.

Participants: One hundred seventy-one children aged 4 to 16 years, 85 with asthma and 86 nonasthmatic controls.

Main Outcome Measures: Diagnosis of asthma, age, and sex-adjusted body mass index (weight in kilograms divided by the square of the height in meters).

Results: Seventy-eight percent of the sample was Hispanic, 17% was African American, 2% were white, and 3% were other minorities. There were significantly more children with asthma (30.6%) who were very obese (≥95th body mass index percentile) compared with controls (11.6%) (P = .004). Children with asthma were also significantly more overweight than controls (mean ± SD, 22.5% ± 28.3% vs 12.0% ± 19.6% overweight; P = .004). The difference in obesity between children with asthma and controls was significant for both sexes and across the 4.5 to 10.9 years and 11 to 16 years age groups. Asthma severity was not related to obesity.

Conclusion: Asthma is a risk factor for obesity in children and adolescents.


Obesity, a very prevalent disorder in children, increases the risk of the child becoming an obese adult, and increases mortality in adulthood from multiple health problems including cancer, hypertension, diabetes, and heart disease. Asthma represents another major cause of morbidity in the United States, and childhood asthma is the principal cause of chronic illness and school absenteeism. As with obesity, the prevalence and severity of asthma in children and adolescents is increasing. While obesity currently affects approximately one fourth of children and adolescents, asthma affects 10% to 15% of boys and 7% to 10% of girls during childhood. The male-to-female ratio for asthma changes over time, with an equal percentage of males and females with asthma during adolescence, and more female than male adults with symptoms.

Based on the prevalence of these 2 conditions it would not be surprising to find many children with comorbid obesity and asthma, and it is important to examine relationships between these conditions. There are limited but consistent observational data on the relationship between asthma and obesity. In a large study of Dutch adults, severe obesity in women was associated with self-reports of asthma and bronchitis. In a small study of obese children aged 7 years and younger, 30% of the obese children had asthma compared with approximately 10% of the general population. Research comparing the prevalence of obesity in African American and Hispanic 2- to 18-year-old children with a reference control population that had a more restricted age range and that included some asthmatic children showed asthmatic children to be at 1.5 times the risk of being obese in comparison with controls. In this study, we examine the differences in body mass index (BMI) (weight in kilograms divided by the square of the height in meters) and the prevalence of obesity in an urban sample of children with and without asthma, aged 4 to 16 years, controlling for child age and sex.
SUBJECTS AND METHODS

Medical record review was performed for all patients aged 4 to 16 years who had been seen at an urban community health center in the past year for complaints that were attributed to asthma by the physician or nurse practitioner. Asthma was diagnosed by a combination of clinical symptoms and observation of wheezing. One hundred six children had clinic visits attributable to asthma. Twenty-one cases were excluded from analysis, owing to missing data in 8 and owing to chronic comorbid medical conditions (attention-deficit/hyperactivity disorder requiring medication, severe mental retardation, or chronic renal failure) in the other 13. The total number of children with asthma used for analysis was 85. Controls were chosen from a random list of patients at the same health center who had been seen in the past year during a routine well-child examination. These patients had no history of asthma, severe mental retardation, psychiatric diagnoses, or chronic comorbid medical conditions that could influence height or weight. Eighty-six controls were identified.

Information was gathered from the medical records on sex, age, and ethnicity. Body mass index was obtained from the most recent clinic visit. For diagnostic purposes, the BMI percentiles based on the child’s sex and age were calculated, and children were categorized as less than the 85th BMI percentile (nonobese); equal to or greater than the 85th BMI percentile but less than the 95th BMI percentile (obese); or equal to or greater than the 95th BMI percentile (very obese). While BMI percentiles provide a useful method for diagnosing obesity, they are restricted in regard to understanding individual differences in the degree of obesity, because all very obese children will be classified similarly, as greater than the 95th percentile. To obtain a continuous measure of obesity, percent overweight based on the 30th BMI percentile, based on the child or adolescent’s sex and age, was calculated. In this way, the degree of obesity, quantified as percent overweight, could be compared across sex and age groups. Current asthma medications, number of uses of oral prednisone in the past year, number of visits to the clinic in the past year for asthma, number of visits to the emergency department in the past year for asthma, and any admissions to the hospital in the past year for asthma were recorded. From this information, subjects were divided into 2 groups based on the severity of asthma. The mild-moderate group included those using albuterol or cromolyn metered-dose inhalers who had used oral prednisone (5-day treatment) less than 2 times in the past year, and had been to the emergency department less than 2 times. The subjects in this group had 0 admissions to the hospital in the past year for asthma. The moderate-severe group included those who, in addition to using albuterol or cromolyn metered-dose inhalers, also had used oral prednisone twice or more in the past year, those who had been to the emergency department twice or more in the past year for asthma, and those admitted to the hospital for asthma in the past year. The severity of asthma may be relevant to understanding the relationship between these chronic conditions, but also because extensive use of prednisone may be related to excess adiposity, and thus should be examined in any statistical analyses.

The age, ethnic, and sex distributions of children with asthma and controls were compared. The proportion of children who were obese (≥85th BMI percentile) and very obese (≥95th BMI percentile) as a function of diagnosis of asthma was determined. To take advantage of percent overweight as a continuous variable, the influence of asthma, sex, and age group (4.5-10.9 years, 11-16 years) on percent overweight was established using factorial analysis of variance. For children with asthma, severity was assessed in a second factorial analysis of variance, with sex and age as categorical variables. Data were analyzed using the SYSTAT statistics program. All values were expressed as mean ± SD.

Table 2 presents the distribution of subjects who were obese and very obese and the percent overweight values for these subjects. There was significantly more obesity in children with asthma than in those without asthma (45.9% vs 30.2%; P=.04). The effect was more significant for those with severe obesity. Approximately one third (30.6%) of the children with asthma had a BMI greater than the 95th percentile, while only 12% of controls were this obese (P=.002). There was no relationship between asthma severity and obesity status, with 48% (32/66) of those with mild-moderate asthma being obese, and 37% (7/19) of those with moderate-severe asthma being obese. Likewise, severity of asthma was not related to degree of obesity. Thirty percent (20/66) of those with mild-moderate asthma were very obese, while 32% (6/19) of those with moderate-severe asthma were very obese, a nonsignificant difference. Sixty-one percent (32/52) of the children with asthma had no steroid use or regular use of metered-dose inhalers. Though the numbers were small, there did not seem to be any influence of steroid use on obesity (Table 3).

Analysis of variance showed that percent overweight was significantly greater for children with asthma (22.3% ± 28.3%) compared with controls (P=.004). No signifi-
Table 1. Characteristics of the Study Sample

<table>
<thead>
<tr>
<th></th>
<th>Children With Asthma</th>
<th>Controls</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of subjects</td>
<td>85</td>
<td>86</td>
</tr>
<tr>
<td>M/F ratio</td>
<td>48/37</td>
<td>45/41</td>
</tr>
<tr>
<td>Mean ± SD age, y</td>
<td>10.0 ± 2.9</td>
<td>9.8 ± 2.6</td>
</tr>
<tr>
<td>Mean ± SD percent overweight</td>
<td>22.5 ± 28.3</td>
<td>12.0 ± 19.6*</td>
</tr>
<tr>
<td>Ethnic category, No. (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>64 (75.3)</td>
<td>70 (81.4)</td>
</tr>
<tr>
<td>African American</td>
<td>17 (20)</td>
<td>12 (14.0)</td>
</tr>
<tr>
<td>White</td>
<td>2 (2.4)</td>
<td>2 (2.3)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (2.4)</td>
<td>2 (2.3)</td>
</tr>
</tbody>
</table>

*P < .005.

Table 2. Percentage of Subjects Who Were Obese (≥85th BMI Percentile) and Very Obese (≥95th BMI Percentile) and Their Percent Overweight in Relationship to Asthma Status*

<table>
<thead>
<tr>
<th>No. (%)</th>
<th>Nonobese</th>
<th>Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Mean ± SD)</td>
<td></td>
</tr>
<tr>
<td>Obese (≥85th BMI Percentile)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthmatic</td>
<td>39 (45.9)</td>
<td>27 ± 6.5</td>
</tr>
<tr>
<td>Nonasthmatic</td>
<td>26 (30.2)</td>
<td>2 ± 10.6</td>
</tr>
<tr>
<td>Obese (≥95th BMI Percentile)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthmatic</td>
<td>26 (30.6)</td>
<td>7.1 ± 11.6</td>
</tr>
<tr>
<td>Nonasthmatic</td>
<td>10 (11.6)</td>
<td>6.8 ± 12.9</td>
</tr>
</tbody>
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* BMI indicates body mass index (weight in kilograms divided by the square of the height in meters). χ² Analyses for obese and very obese children are χ² = 9.25, P = .002, and χ² = 4.44, P = .04, respectively.

This study showed that children with asthma are significantly more likely to be obese and have significantly higher percent overweight than controls without asthma. There was 2.6 times the prevalence of severe obesity in children and adolescents with asthma in comparison with controls (30.6% vs 11.6%). Children with asthma had 1.9 times the degree of percent overweight than controls without asthma (22.4% vs 12%). These associations are consistent with those observed previously.11 The relationship between asthma and obesity was independent of sex, age, and the severity of asthma.

One hypothesis for the possible influence of asthma on obesity is a reduced energy expenditure due to low levels of physical activity in children with asthma. Exercise-induced bronchospasm is very common in children with asthma13 and the aversiveness of subjective symptoms associated with exercise-induced bronchospasm16 could lead to a reduction in physical activity and energy expenditure and the development of obesity. Increased energy intake can lead to obesity, but research suggests that children with asthma do not consume more calories than children without asthma.17,18 Likewise, resting energy expenditure, which makes the largest contribution to total energy expenditure, has been shown to be greater, rather than suppressed, in children with asthma in comparison with children without asthma.18

Tolerance to exercise in children with asthma may be affected by both their degree of control of asthma and their level of activity. There are a wide variety of medications that children with asthma can use in preparation for exercise, including mast cell stabilizers and sympathomimetics. If asthma is under proper control, even children with moderately severe asthma can enjoy life with few physical limitations.3 Children with asthma who experience respiratory symptoms during exercise have poor control of their asthma, and even mild asthma can be very restrictive if it is not properly controlled with medications and environmental alterations.5,15 Children with severe asthma have worse endurance performance, suggesting low fitness, and increased skinfold thickness compared with children without asthma.19 However, Fink et al20 found that children with asthma and active lifestyles had similar exercise tolerance to a control group. Only the children with mild asthma and a sedentary lifestyle had poor physical fitness. Likewise, when children with and without asthma were matched for body size and habitual physical activity, they did not differ in fitness or pulmonary function.21 These observations suggest that asthma per se may not be associated with the increased prevalence of obesity, but rather that asthma may have an influence on behaviors associated with positive energy balance.

In addition to the influence of asthma and reduced activity level on the development of obesity, obesity may influence bronchial hyperactivity in children without asthma. A significantly greater frequency and degree of bronchospasm of the smaller airways occur in obese children without asthma as compared with their nonobese counterparts, particularly related to the amount of subcutaneous fat.22 Further study is needed to determine whether exercise-induced bronchospasm leads to exercise avoidance and obesity or whether obesity causes or...
enhances bronchial hyperreactivity to exercise, leading to an increased diagnosis of asthma in the obese.\textsuperscript{22} There are several implications of our results. Pediatricians should be aware of the relationship between asthma and obesity, and initiate preventive dietary and activity measures if the child or adolescent with asthma is in a family with obese parents or obese older siblings or if the child begins to show large increases in BMI for his or her age and sex. Children and adolescents with comorbid asthma and obesity should be provided treatments for their obesity, which include decreasing inactivity and increasing vigorous physical activity to improve exercise tolerance. Advances in medical care have resulted in exclusion of only the children with the most severe asthma from any sport.\textsuperscript{3} It is important to ensure that the asthma does not result in other chronic conditions, such as obesity, that can carry on into adulthood\textsuperscript{23} with their own associated complications.\textsuperscript{24} Although respiratory symptoms disappear in many children with asthma, and as adults they may believe that they have outgrown their disease, adults still have the potential to respond to inhaled allergens and may experience a resumption of their asthma in middle age.\textsuperscript{25} Increases in physical activity should be part of a comprehensive treatment program for pediatric asthma, which would improve exercise tolerance\textsuperscript{2} and reduce the sedentary lifestyle associated with the etiology of obesity.\textsuperscript{26} It may be useful to consider lifestyle modifications that children and their families can incorporate into their daily routines\textsuperscript{27,28} as well as interventions that focus on a reduction in sedentary behaviors that may compete with being active.\textsuperscript{29} This recommendation may be particularly important for an urban population, where optimal health care may not be readily available.

Additional research is needed to better understand the generalizability of these data to other samples, since this study was performed in a low socioeconomic status, predominantly Hispanic population. The relationship between asthma severity and degree of obesity requires additional research because in the present study asthma severity was based on medical record review of medical use rather than by measurement of pulmonary function. It would be useful to understand the order of onset of asthma and obesity to determine causal relationships between the 2 disorders. This was not possible in the present sample because many children entered the clinic with a diagnosis of asthma or obesity for whom sufficient background data were not available to determine exact age of onset. Finally, basic research is also needed to understand the mechanisms responsible for the increased prevalence of obesity in children with asthma, with a particular emphasis on testing the hypothesis that the obesity is due to reduced physical activity and lowered total energy expenditure. This research may provide a basis for improved treatment for asthma in youth.

In conclusion, the results of this study suggest that, in a predominantly urban Hispanic population, there is a strong association between asthma and both overweight and obesity in both sexes across a wide age range. This relationship was demonstrated across young and older children, and was not related to sex or asthma severity. These results may affect our understanding of risk factors for obesity, and should be considered in the development of interventions for children with asthma who are also obese.

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Reprints: Leonard H. Epstein, PhD, Behavioral Medicine Laboratory, Park Hall, Department of Psychology, State University of New York at Buffalo, Buffalo, NY 14260.

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