A case-control study of body mass index and asthma in Asian children

Stanislav Henkin; Doug Brugge, PhD; Odilla I. Bermudez, PhD; and Xiang Gao, PhD

Background: The prevalence of obesity and asthma in the United States has increased in past decades. Numerous studies have focused on the relationship between the 2 factors. However, to our knowledge, this association in Asian Americans has not been extensively studied.

Objective: To assess the association between body mass index (BMI) and asthma in an Asian American pediatric population.

Methods: We conducted a case-control medical record review study of 94 pediatric patients with and without asthma at Tufts–New England Medical Center, Boston, Massachusetts. The BMI of asthmatic children before and after their asthma diagnosis was compared with the BMI of children without asthma.

Results: Multiple analyses showed no significant ($P > .05$) association between various measures of BMI and asthma in this population. After adjustment for atopic dermatitis, allergic rhinitis, and other allergies, the odds ratio in our longitudinal analysis using BMI greater than the 85th percentile for asthmatic children vs nonasthmatic children was 0.92 (95% confidence interval, 0.40–2.20).

Conclusions: Either overweight and obesity do not lead to asthma in Asian immigrant children, consistent with our results, or something about our method limited our ability to observe the association. In either case, more research in the population is needed.

Ann Allergy Asthma Immunol. 2008;100:447–451.

INTRODUCTION

Numerous studies have shown that the prevalence of obesity[1] and asthma[2,3] in children in the United States has increased in recent decades (1970–2000). In fact, 17.1% of children and adolescents in the United States were overweight in 2003 to 2004, a significant relative increase in the prevalence of overweight from 13.8% in 1999 to 2000.[4,5] Between 1980 and 1996, asthma increased by almost 74%,[6] so that in 2003, 12.5% of children and adolescents were reported to have physician-diagnosed asthma.[7]

The National Health and Nutrition Examination Study III, a cross-sectional study that was conducted from 1988 to 1994, was one of the first studies to suggest an association between asthma and overweight or obesity; the researchers showed that children in a representative sample of US children and adolescents, aged 4 to 17 years, with a body mass index (BMI) in the top quartile were at increased risk of being diagnosed as having asthma relative to those with a BMI in the lowest quartile (odds ratio [OR], 1.98).[8] Prospective studies seem to show a role of sex in the relationship. For example, girls had a strong association between overweight or obesity and asthma.[9,10] Girls who became obese from the age of 6 to 11 years were 7 times more likely to develop asthma symptoms by the age of 11 years.[11] In contrast, a study[12] of children and adolescents in California reported that being overweight or obese increased the risk of new-onset asthma (relative risk, 2.06) only in boys. A recent prospective study[13] also found that boys (hazard ratio, 2.4), but not girls (hazard ratio, 0.8), with a higher BMI might be at increased risk of developing asthma. Two other studies[14,15] of children found an association between obesity and asthma in both sexes, but for girls more so than for boys.

Since 1999, of more than 30 cross-sectional and case-control studies on obesity and asthma, only three[16] (OR, 1.02 for boys and 1.06 for girls[17]; and OR, 1.02[18]) have reported no association between asthma in the obese or overweight children.[19] Overall, there is growing evidence that obesity increases the risk of asthma, but more studies need to be done to find the molecular basis for this hypothesis.

Several hypotheses have been proposed for a potential causal mechanism connecting obesity and asthma, including common causes (fetal programming and genetic pleiotropy), effects of obesity on lung mechanics (reduced tidal volume and lower than normal functional residual capacity), and adipokines (proteins synthesized and secreted from adipose tissue that may affect airway function).[20] For example, a twin cohort study found that obese females have an increased risk of asthma, which may partly be because of common genes.[21] In addition, studies have shown that gastroesophageal reflux, which is a result of obesity, can exacerbate asthma.[22] Furthermore, recent research[23] has hypothesized that immune-related diseases, such as asthma, could, in part, be caused by decreased immunological tolerance because of the secretion of adipokines and cytokines by white adipous tissue. A

Affiliation: Department of Public Health and Family Medicine, Tufts University School of Medicine, Boston, Massachusetts.

Disclosures: Authors have nothing to disclose.

Funding Sources: Mr Henkin was supported by Summer Scholars Funding from Tufts University, and Dr Brugge was supported by the Jonathan M. Tisch College of Citizenship and Public Service at Tufts University.

Received for publication June 25, 2007; Received in revised form September 18, 2007; Accepted for publication October 24, 2007.

study[24] that has looked at weight loss and asthma control concluded that consistent weight loss in obese patients improves lung function and other respiratory symptoms.

In most studies concerning overweight or obesity and asthma, the population is primarily composed of white or African American (black) children, whereas Asians are not included or compose a minority of the population. One exception is a study[25] of Taiwanese children that found that obesity was a predictor of allergic symptoms. The prevalence of childhood overweight and obesity is highest in the United States (25.4%) and lowest in China (7.0%),[26] and asthma symptoms have been reported as 6.0% for 13- to 14-year-old adolescents in China.[27] Also relevant to our study is the observation that Chinese persons immigrating to the United States tend to change their dietary patterns toward a more Western eating style[28] and tend to have a higher risk of becoming overweight with time spent in the United States.[29]

We, therefore, conducted a study to examine the association of change in BMI (calculated as weight in kilograms divided by height in meters squared) with the timing of diagnosis of asthma in Asian American children aged 4 to 18 years. We hypothesized that overweight children would have a higher risk for developing asthma.

METHODS

Study Population

The Tufts–New England Medical Center, Boston, Massachusetts, institutional review board approved the medical record review study protocol. Data collected were anonymous and deidentified. An alphabetical list of patients diagnosed as having asthma was obtained from the hospital's data management department. The first 94 Asian patients (48 boys and 46 girls), aged 4 to 18 years, with physician-diagnosed asthma who met the criteria were included. Those patients who transferred to Tufts–New England Medical Center from other medical institutions and were diagnosed as having asthma were excluded. Other exclusion criteria involved incomplete or inadequate medical records (missing weight or height); children with cystic fibrosis, chronic cardiac diseases, and severe mental disorders, such as autism; those with a last physician visit more than 2 years before the asthma diagnosis or no physician visits after the asthma diagnosis; and active smokers (cigarettes or marijuana).

To select control subjects, we obtained an alphabetical list of patients without asthma from the hospital's data management department. The first 94 patients who met the criteria were matched by age (age at asthma diagnosis within 1 year) and sex using the same exclusion criteria as for cases. Height and weight for at least 1 visit before and 2 visits after the age of diagnosis in cases and the corresponding age of the matched cases were recorded.

Additional recorded information included sex, date of birth, place of birth (United States or foreign, if available), atopic dermatitis, allergic rhinitis, food allergy, and other allergies, all of which were obtained from patients' medical records.

Data Entry

Data were entered into a database (Microsoft Access Database; Microsoft Corporation, Redmond, Washington). To eliminate as much height-measurement inaccuracy as possible, age vs height of each patient was graphed using computer software (Microsoft Excel; Microsoft Corporation) and the resulting linear R^2 was generated. We corrected data for those children who showed implausible biological growth in heights, such as having a lower height at the age of 8 years than at the age of 7 years. We set the critical value of R^2 at 0.9; thus, the heights of the individuals with R^2 of less than 0.9 were adjusted by taking out the height point(s) furthest away from the linear trend line, generating a new line, and extrapolating the new heights using the formula created by the computer software. This method was used for 7 cases and 0 controls.

Body mass index percentiles were generated using the Centers for Disease Control and Prevention (CDC) Child and Teen Calculator (available at: http://apps.nccd.cdc.gov/dnpabmi/Calculator.aspx). Each child was assigned to 1 of the following categories, consistent with CDC growth charts for boys and girls aged 2 to 20 years: less than 20% (underweight or at risk for being underweight), 20% to 85% (normal weight), 85% to 95% (risk for overweight), and more than 95% (overweight).

Cross-sectional Analyses

Data were transferred into a commercially available software program (SPSS for Windows, version 12.0; SPSS Inc, Chicago, Illinois) and cross-checked by reference to the hard copy for errors. Paired-sample *t* tests for the variables of age, height, weight, BMI, and BMI percentile at diagnosis were conducted for boys and girls separately and combined.

We used χ^2 tests to examine differences in risk between cases and controls. First, we compared the rates of atopic dermatitis, allergic rhinitis, food allergy, and other allergies in asthmatic vs nonasthmatic children, for total study population and boys and girls separately. After creating categories for BMI percentile, we tested for significance for this variable for the total population and boys and girls separately. In addition, we tested associations when BMI percentiles were combined from 1% to 85% and greater than 85%.

Longitudinal Analysis

To test for significance between the number of cases and controls that were overweight before or after the diagnosis/matched age, we created 2 new variables: overweight before and overweight after (BMI percentiles >85%). We conducted χ^2 tests on these 2 variables, for the total population and boys and girls separately.

We tested for the difference between cases and controls for the slope of the line of their BMI percentile before and after asthma diagnosis/matched age. We created 2 variables: general slope before asthma diagnosis/matched age and general slope after asthma diagnosis/matched age. For each variable, there were 3 possibilities: flat line ($-0.004 < m < 0.004$),