Obesity is Associated with Asthma in Patients from an Underserved Low Physician to Patient Ratio Area in a New York Pediatric Emergency Department

H Malik, K Kumar, J Fogel, M Frieri

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Abstract

Objective: To determine the degree of association between asthma and obesity based on body mass index (BMI) percentile categories in a low physician to patient ratio setting.Methods: Data were studied for children with asthma (n=75) and control group (n=75). Body mass index (BMI) percentile categories were classifed into underwight, normal, overweight, and obese. Multivariate logistic regression was used to determine association of body mass index (BMI) percentile categories along with relevant covariates for a diagnosis of asthma. Results: Those with asthma had 48.0% classified as obese. The obese BMI percentile category was significantly associated with a diagnosis of asthma (OR:6.34, 95% CI: 2.60, 15.44, p<0.001). Also, younger age was significantly associated with a diagnosis of asthma (OR:0.89, 95% CI:0.83, 0.96, p=0.001)Conclusion: Obesity is associated with a diagnosis of asthma. Public health interventions should target low physician to patient ratio settings to address the potentially negative relationship of obesity to asthma.

INTRODUCTION

Asthma accounts for 13.9 million outpatient visits, 2 million emergency department (ED) visits, 500,000 hospitalizations and 5,000 deaths annually in the United States according to a study published in 2010 (1). Asthma prevalence is higher in African-Americans and Hispanics than in Caucasians (1). Also, childhood obesity is a major public health epidemic and obesity rates in the United States have more than quadrupled among children ages 6 to 11, more than tripled among adolescents ages 12 to 19 and nearly tripled among children ages 2 to 5 (2). In addition to obesity, 31% of children aged 6 through 19 years are either overweight or at risk for being overweight in the United States (3).

There are a number of studies among children reporting an association of asthma with being overweight or obese (2, 3). A prospective study of 9,828 children in United States aged 6 to 14 years showed that, after a mean follow-up of 5 years, obesity increased the risk of incident asthma (2). A study from Japan showed that being either underweight or overweight increases the likelihood of asthma among schoolchildren (3). A study from New York City found that asthma was a risk factor for obesity in adolescents and children (4). There were considerably more children with asthma (30.6%) who were very obese (>95th BMI percentile) compared with controls (11.6%) (4). Children with asthma were also notably more overweight than the controls (4).

Our hospital is a safety-net based hospital for the underserved due to the low physician to patient ratio. Many patients go to the emergency department for care because of the lack of a primary care physician. Triggers due to weight status contributing to asthma exacerbations may not be considered important by these families and patients, especially if there is little contact with a primary care physician. We studied the relationship of body mass index to asthma in a sample of mostly minority patients from a low physician to patient ratio setting seen in an emergency department. Our study has two aims. First, we report the percentage of those with asthma with different BMI percentile categories (underweight, normal, overweight, and obese. Second, we calculate odds ratios and compare those with asthma to a comparison group of those with a first episode of abdominal pain, another common diagnosis seen in the emergency department. The diagnosis of abdominal pain for the comparison group was chosen because it was a very common diagnosis and most of these patients had their

height s and weights recorded in the charts. In particular, charts were only reviewed if it was the first episode of abdominal pain that started within a few hours of the emergency department visit, so the abdominal pain diagnosis would not have affected the weight or the BMI.

METHODS

SETTING

This Institutional Review Board (IRB) approved retrospective study reviewed charts of patients seen between 2006 and 2012. Patients were from a public hospital located in a suburban region of the New York City metropolitan area with a low physician to patient ratio (5). All pediatric patients ages 2-21 years with asthma exacerbations that had data for both weight and height and were treated in the emergency department from 2006-2012 were included (n=75). As a comparison group, 75 consecutive patients with a first episode of abdominal pain from the years 2006-2012 were included. This comparison group was chosen since it is a common diagnosis seen in the emergency department. Our hospital is in a small enclave of Long Island in New York and it is considered underserved because of low physician to patient ratio (5). We also have majority of Hispanic and African American population.

VARIABLES

Variables included age (years), sex (boy/girl), race/ethnicity (Hispanic, African American, Caucasian, and other), and body mass index (BMI) percentile. Also, BMI percentiles were categorized using Centers for Disease Control and Prevention (CDC) guidelines into underweight (<5), normal (5-84.99), overweight (85-94.99), and obese (>95). These variables were selected based on previous studies. The sex, race/ethnicity and height were self-reported while weight was objectively measured. Age was calculated based on the date of birth and the date of visit to the emergency department.

STATISTICAL ANALYSES

Descriptive statistics of mean and standard deviation were used for the continuous variables and percentage and frequency were used for the categorical variables. Inferential univariate statistics of analysis of variance (ANOVA) was used to compare the continuous variables and as appropriate either the Pearson chi-square test or the Fisher's exact test for the categorical variables. Multivariate logistic regression was used for the outcome variable of asthma diagnosis (coded as 1) as compared to abdominal pain (coded as 0). There were two analytical models. Model 1 included only the variables statistically significant in the univariate analyses (age, BMI), with BMI now classified into categories. Model 2 included the above variables along with sex and the interaction of sex with age. Although sex was not significant in the univariate analyses, as there is literature that suggests that asthma may be associated with the interaction of sex and age, we included both sex and the interaction of sex with age in this analysis. All p-values were two-sided. IBM SPSS Statistics (Version 19) was used for all analyses.

RESULTS

Table 1 shows the comparisons for the variables. The abdominal pain patients as compared to the asthma patients had a significantly greater mean age and a significantly lower mean BMI percentile. There were no significant differences for sex or race/ethnicity.

The BMI percentile category groups included for abdominal pain the following: underweight (n=6, 8.0%), normal weight (n=48, 64.0%), overweight (n=11, 14.7%), and obese (n=10, 13.3%) and for asthma the following: underweight (n=4, 5.3%), normal weight (n=23, 30.7%), overweight (n=12, 16.0%), and obese (n=36, 48.0%). The percentile categories significantly differed ($p<0.001$) with the abdominal pain group having greater percentages of normal BMI percentile category and the asthma group having greater percentages of obese BMI percentile category. The Figure shows these percentages.

Table 2 shows the multivariate logistic regression analysis. In model 1, younger age was significantly associated with a diagnosis of asthma. Also, obese BMI percentile category was significantly associated with a diagnosis of asthma with odds ratios greater than 6. In model 2, a similar pattern was obtained for younger age and obese BMI percentile. Both sex and the interaction of sex with age were not statistically significant.

Figure 1

Table 1: Characteristics of the Sample of Pediatric Emergency Department Patients from 2006-2012 Comparing Asthma with a Comparison Group of Abdominal Pain

Variables	Abdominal Pain M (SD) or % (Frequency) (n=75)	Asthma M (SD) or % (Frequency) (n=75)	p-value
Age (years)[1]	13.0 (5.46)	9.4 (4.92)	<0.001
Sex[2]			0.33
Boy	46.7% (35)	54.7% (41)	
Girl	53.3% (40)	45.3% (34)	
Race/ethnicity[3]			0.25
Hispanic	49.3% (37)	46.7% (35)	
African American	29.3% (22)	41.3 (31)	
Caucasian	16.0% (12)	10.7% (8)	
Other	5.3% (4)	1.3% (1)	
BMI percentile[1]	59.0 (32.17)	80.3 (31.54)	<0.001

Note: M=mean, SD=standard deviation, BMI=body mass index
[1]Analysis of variance, [2]Pearson chi-square test, [3]Fisher's exact test

Figure 2

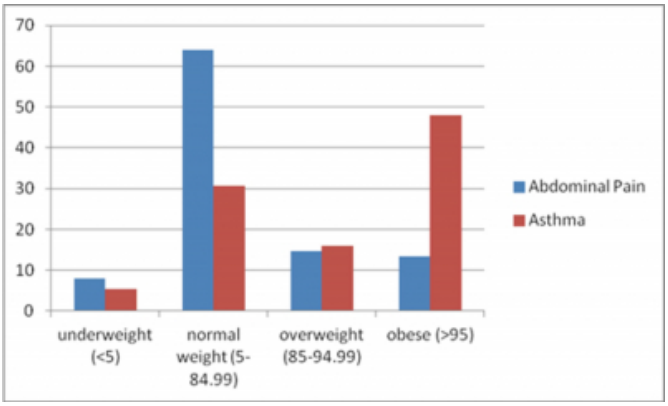
Table 2: Multivariate Logistic Regression Analyses for Predictors for a Diagnosis of Asthma in the Pediatric Emergency Department from 2006-2012

Variables	Model 1 OR (95% CI)	p-value	Model 2 OR (95% CI)	p-value
Age (years)	0.89 (0.83, 0.96)	0.001	0.87 (0.79, 0.96)	0.007
Sex	---	---	0.64 (0.11, 3.56)	0.61
Age by Sex Interaction	---	---	1.05 (0.91, 1.21)	0.48
BMI Percentile Category				
Normal (5-84.99)	1.00		1.00	
Underweight (<5)	1.28 (0.31, 5.34)	0.74	1.30 (0.30, 5.53)	0.73
Overweight (85-94.99)	2.27 (0.84, 6.15)	0.11	2.29 (0.82, 6.06)	0.12
Obese (>95)	6.34 (2.60, 15.44)	<0.001	6.68 (2.68, 16.69)	<0.001

Note: OR=odds ratio, CI=confidence interval, BMI=body mass index

Figure 3

Figure 1: BMI Classifications of Patients with Asthma Versus Abdominal Pain Patients in the Pediatrics Emergency Department from 2006-2012



DISCUSSION

Obese BMI percentile category was significantly associated with a diagnosis of asthma. However, overweight BMI percentile category was not significantly associated with a diagnosis of asthma. Also, we found that younger age was significantly associated with a diagnosis of asthma as compared to abdominal pain.

We found that obesity status but not overweight status was significantly associated with a diagnosis of asthma. Also, 48.0% of our sample with asthma was obese while our comparison group of those with abdominal pain only had 13.3% that were obese. Previous literature reports that both overweight and obese status is associated with an asthma diagnosis (4). Our study is similar for the obese category but differs for the overweight category. The reason for the lack of significance for the overweight category may be due to the relatively small number of individuals in our study from that category. Also, our percentage for obesity with asthma (48%) is greater than the reported percentages for children with asthma which range from 30-30.6% (4). Our study adds to the literature that those from low physician to patient ration areas have a greater percentage of obese children with asthma.

We found that younger age was significantly associated with a diagnosis of asthma as compared to abdominal pain. This finding is specific to our choice of sample groups. Those with asthma have physical symptoms that parents are more likely to notice even without the child reporting this to the parent. Also, wheezing, a symptom of asthma, can be heard with auscultation. Abdominal pain can sometimes be disguised, as children can report somatic complaints in other areas and also pain cannot always be objectively measured.

Our finding that obesity is associated with asthma has a number of possible mechanisms from the basic science and adult literature. First, eotaxin which is a chemokine, is important in extrinsic asthma, an inflammatory disorder. Adipose tissue explants secrete eotaxin and diet-induced weight loss in humans can lead to reduction in plasma eotaxin levels, demonstrating that clinical interventions that target obesity can modulate systemic eotaxin levels (6). Second, some theories describe leptin as a key player in the development or worsening of asthma (7). Support for this theory includes that atopic subjects with asthma had significantly higher leptin levels than did nonatopic subjects (8). Also, in children with asthma, inhaled corticosteroid therapy reduces leptin concentrations to within the range observed in nonasthmatic control subjects (9). The ultimate cause of the relationship between high BMI and asthma has not been fully identified. Some basic research on the possible role of adipose tissue in modulating asthma susceptibility and symptoms suggests the presence of altered

T-cell responses, IFN-γ production, and mast cell numbers in the tracheas of obese mice that were sensitized to ovalbumin as compared with those seen in lean control animals (10).

Our study has several limitations. First, this study was from a single location and may not generalize to other locations. Second, we had a relatively small sample size for those both underweight and overweight and this may have resulted in lack of statistical significance. Third, our lack of significance for sex and also the interaction of sex with age may be due to the relatively smaller sample size. Fourth, as this was a retrospective study, we were not able ask patients whether they had regular access to a primary care physician. Future research should include measurement of regular access to a primary care physician to determine the relationship of obesity to asthma in low physician to patient ratio settings.

In conclusion, obesity is associated with a diagnosis of asthma in low physician to patient ratio settings. Preventing obesity during childhood is critical especially in underserved areas where patients may not be able to access primary care physicians. Public health interventions should address weight management as it relates to asthma in communities that have a low physician to patient ratio. This can include a focus on healthy eating and lifestyle modifications to maintain a healthy weight.

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Author Information

Hamood Ur-Rehman Malik, BSc, MD, and FAAP
Department of Pediatrics, Nassau University Medical Center, East Meadow, New York, USA

Krishan Kumar, MD
Department of Pediatric Emergency Medicine, Nassau University Medical Center, East Meadow, New York, USA

Joshua Fogel, PhD
Department of Pediatrics, Nassau University Medical Center, East Meadow, New York, USA; Department of Finance and Business Management, Brooklyn College of the City University of New York, Brooklyn, NY, USA

Marianne Frieri, PhD, MD
Department of Medicine, Division of Allergy Immunology, Nassau University Medical Center, East Meadow, New York, USA