Comparing the asthma control in overweight/obese and normal weight pediatric patients: A retrospective study in West Texas

Jason Huang, Jarrett Lever, Bhargavi Kola MD

ABSTRACT

Asthma is one of the most common chronic diseases in children. Excess weight is thought to contribute adversely to this disease and has been associated with both an increased incidence and severity of asthma in multiple studies. However, this information does not seem to be conclusive, since there are also studies showing either no relationship or a relationship only in certain subpopulations of children. The aim of this study was to see if we could identify any pattern in the relationship of weight and asthma severity and control in our pediatric population at a university affiliated clinic in rural West Texas. We were unable to find statistically significant differences either in the overall population or in the boys or girls subpopulations. We estimate based on our results that future studies would need at least 800 children to achieve adequate statistical power. More well designed studies are needed to clarify and confirm the relationship between obesity and asthma control and severity in children.

Keywords: childhood asthma, childhood obesity, childhood overweight, asthma management

INTRODUCTION

Asthma is one of the most common chronic diseases in children, affecting 8-9% in the United States, and has a significant health impact. In 2013, 49.0% of school-age children with asthma missed one or more school days, a total of 13.8 million days of school per year, and in 2016, 16.7% had an emergency department or urgent care visit due to an asthma attack.[1] Some studies show associations between obesity and asthma incidence;[2-6] Beuther and Sutherland found a dose-dependent increase in the odds of asthma incidence in men and women with obesity.[6] Moreover, a link between improved asthma symptoms and weight reduction has been reported.[7,8] Lazarus et al found that ventilatory function decreased with increasing proportions of body fat,[3] and Ekstrom et al found that overweight body mass indices (BMIs) and obese BMIs were associated with airway obstruction.[9]

The current prevalent view is that obesity is strongly associated with poor asthma control; the CDC advises on its factsheets, for example, that "obesity is associated significantly with the development of asthma, worsening asthma symptoms, and poor asthma control."[10] And indeed, studies have found that higher BMIs and obesity were associated with worse asthma control and quality of life.[11] In this study, we examined our pediatric population at a university affiliated clinic in rural West Texas to see if a relationship between asthma control and obesity could be demonstrated in our patients.

Corresponding author: **Bhargavi Kola**
Contact Information: Bhargavi.kola@ttuhsc.edu
DOI: 10.12746/swrccc.v6i25.478

METHODS

Retrospective systematic chart reviews of pediatric patients who had been diagnosed with asthma at the Texas Tech University Health Sciences Center at

the Permian Basin pediatric clinic in Odessa, Texas, were conducted for dates between 01/01/2017 and 12/31/2017. The Asthma Control Test (ACT) scores, BMIs, demographic information, and medication were recorded from the electronic medical records. An eight item data collection sheet included age, gender, BMI, asthma severity, ACT score, and documentation of any exacerbations, hospitalizations, or emergency room visits during the last 12 months. Each study subject was assigned a unique study number. Patients within the age range 4-15 years, both male and female, with prior history of asthma and who were registered in the institute's asthma registry were included for the study purpose. Patients with other chronic diseases, such as cystic fibrosis or other neurological conditions that would affect lung function, were excluded from the study. Ninety-nine records were found that had both BMI-for-age percentiles and ACT scores at baseline. Since subsequent appointments did not show a consistent and balanced number of patients, only first appointment data were used. Patients were categorized as either overweight or obese when their BMI-for-age was above 85th percentile or 95th percentile, respectively, using CDC criteria. Asthma was categorized as controlled when ACT scores were greater than 19 according to 2007 National Heart Lung Blood Institute's National Asthma Education and Prevention Program's Expert Panel Review 3 guidelines. Asthma severity was also categorized based on the same 2007 guidelines.[12]

Categorical data were summarized as frequency (percentage). Age, BMI-for-age, and ACT did not have normal distributions and were summarized as medians with interquartile ranges (IQR). For group comparisons, Wilcoxon rank-sum tests for medians, and χ^2 or Fisher's exact tests for frequencies were used. Cohen's *d* was calculated as a standardized effect size estimate. The significance level was set at <0.05.

Results

No statistically significant differences in age or gender was noted between the study groups. By definition, BMI-for-age percentile was significantly higher in the overweight/obese group (Table 1).

Table 1. Sample characteristics the two groups

	Overweight/obese status		
	No (n = 53)	**Yes (n = 46)**	**p-value**
BMI-for-age percentile, median (IQR)	56 (33–72)	97 (93–99)	**<0.001**
Age (years), median (IQR)	9.0 (7–11)	9.5 (6–12)	0.970
Gender, n (%)			0.558
Female	25 (47.2)	19 (41.3)	
Male	28 (52.8)	27 (58.7)	

IQR = interquartile range. P-values were calculated using Wilcoxon rank-sum test for medians, and χ^2 or Fisher's exact test for frequencies.

No statistically significant differences were found in asthma control based on ACT scores between overweight/obese patients and non-overweight/obese patients based on our sample size (p = 0.34; n = 99; study power 17%). Asthma was well controlled in 63% of the overweight/obese patients and 72% of the non-overweight/obese patients (p = 0.358) (Table 2 and Figure 1).

No statistically significant difference was found in the asthma severity distribution between the two groups of overweight/obese and non-overweight/obese for girls (p = 0.072) (Table 3). However, the

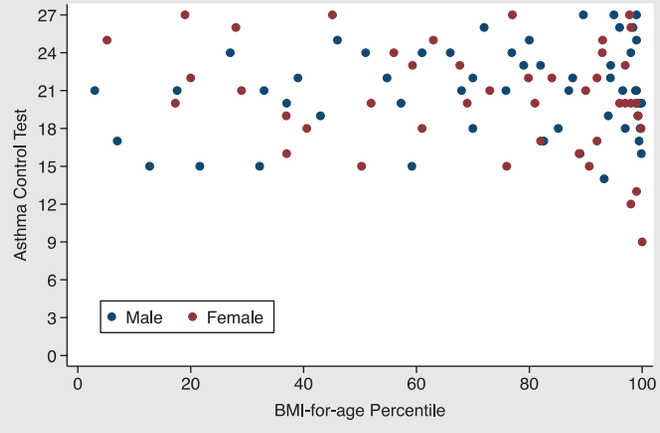

Figure 1. Asthma Control Test score plotted against BMI-for-age percentile.

Table 2. Asthma control and severity between groups

	Overweight/obese status		
	No (n = 53)	Yes (n = 45)	p-value
ACT, median (IQR)	21 (19–24)	20 (18–23)	0.349
Severity, n (%)			0.339
Intermittent	17 (32.1)	10 (22.2)	
Mild Persistent	22 (41.5)	27 (60.0)	
Moderate Persistent	11 (20.8)	6 (13.3)	
Severe Persistent	3 (5.7)	2 (4.4)	
Asthma controlled, n (%)	38 (71.7)	29 (63.0)	0.358

IQR = interquartile range. P-values were calculated using Wilcoxon rank-sum test for medians, and χ^2 or Fisher's exact test for frequencies.

severity distribution did differ in boys with a higher percentage of overweight/obese boys having intermittent or mild persistent asthma. Asthma was well controlled in 57.9% of overweight/obese girls and 66.7% of overweight/obese boys compared to 72.0% and 71.4% of non-overweight/obese girls and boys, respectively (Table 3).

Discussion

We did not find statistically significant differences in asthma control, as measured with the ACT, between the overweight/obese children and the non-overweight/obese children. While unexpected, this result is not without precedent since there is a lack of consensus in the literature. On the relationship between the development of asthma and obesity, Akinbami found that the trends of increasing obesity were not associated with trends of increasing asthma in the National Health and Nutrition Examination Survey data for 40,644 children aged 2-19 during the years 1988 to 2014.[13]

There also appears to be some uncertainty about the association between asthma severity and obesity. Our study found a significant negative association between asthma severity and obesity in boys but not girls; other investigators have found improved asthma symptoms and ventilatory function with decreased BMIs.[3,7,8] Others, however, found no relationship between asthma severity and BMI.[2,4,11] Toennesen et al did not find that childhood obesity was a risk factor for increased airway hyperresponsiveness or higher fractional exhaled nitric oxide levels in adults.[14] If obesity is associated with asthma severity, Ekstrom's study suggested that the airway obstruction was due to hyperresponsiveness and not due to airway inflammation, especially in boys. They found no association between BMI status and FE_{NO} in either boys or girls. Overweight and obese girls had higher blood neutrophil counts, and obese girls had higher eosinophil counts. There was no association between an overweight or obesity status and blood neutrophil counts or eosinophil counts in boys.[9] Ekstrom's finding of increased hyperresponsiveness, especially in boys, may be a potential explanation for our finding less asthma severity in overweight/obesity boys if these patients respond better to conventional asthma medications.

Our study did not find a significant relationship between adiposity and asthma control in either boys or girls. However, Kattan et al found an association of adiposity with poorer asthma control in girls, but they did not find the same association for boys in their study of inner-city adolescents.[15] In contrast, Borrell et al found that worse asthma control was uniformly associated with increased BMIs in boys but not in girls. These investigators noted that the direction of association varied by race/ethnicity.[16]

We also considered whether or not medications might have had a role in our results since obesity also affects the efficacy of asthma medications. In particular, it appears that inhaled corticosteroids are less effective in obese and overweight groups than in normal weight groups. There was less effect whether beclomethasone,[17] fluticasone,or fluticasone and salmeterol were used.[18] This appears to apply to children also since Forno found that overweight and obese children had decreased responses to inhaled budesonide compared to normal weight children.[19] Asthma responses to leukotriene antagonists, however, do not seem to be affected, as responses to montelukast

Table 3. Asthma control and severity between male and female patients

	Overweight/Obese status		
Female patients	**No (n = 25)**	**Yes (n = 19)**	**p-value**
BMI-for-age percentile, median (IQR)	56 (36.9–73)	97 (92–99)	**<0.001**
Age (years), median (IQR)	8 (6–11)	10 (8–13)	0.153
ACT, median (IQR)	21 (19–24)	20 (16–23)	0.183
Severity, n (%)			0.072
Intermittent	13 (52)	4 (21)	
Mild Persistent	10 (40)	10 (53)	
Moderate Persistent	2 (8)	5 (26)	
Severe Persistent	–	–	
Asthma controlled, n (%)	18 (72.0)	11 (57.9)	0.328
Male patients	**No (n = 28)**	**Yes (n = 26)**	
BMI-for-age percentile, median (IQR)	56 (33–71)	98 (94–99)	**<0.001**
Age (years), median (IQR)	9.5 (7.5–12)	9.0 (6–12)	0.192
ACT, median (IQR)	21 (18.5–24)	21 (18–24)	0.933
Severity			**0.044**
Intermittent	4 (14.3)	6 (23.1)	
Mild Persistent	12 (42.9)	17 (65.4)	
Moderate Persistent	9 (32.1)	1 (3.85)	
Severe Persistent	3 (10.7)	2 (7.7)	
Asthma controlled, n (%)	20 (71.4)	18 (66.7)	0.702

IQR = interquartile range. P-values were calculated using Wilcoxon rank-sum test for medians and χ^2 or Fisher's exact test for frequencies.

were not significantly different among obese, overweight, and normal weight groups.[17] Interestingly, BMI may also have some impact on body's innate ability to modulate airway function ; Peters-Golden et al found that increased BMIs significantly decreased responses to placebo during controlled asthma trials.[17] We do think that our study's lack of significant differences in asthma control between these two groups of children reflected different medication use in the two groups. In general, we manage all children according to national guidelines, including beta agonists for acute symptoms and inhaled steroids (beclomethasone and fluticasone), leukotriene inhibitors (montelukast), and combinations of inhaled steroids and leukotriene inhibitors for chronic symptoms.

Given the lack of consensus in the medical literature regarding the relationship of obesity with asthma incidence, asthma severity, and asthma control, we should consider the possibility that there is, in fact, no relationship between obesity and asthma in the children followed in this West Texas pediatrics clinic. We also need to consider the possibility that confounding variables, such as socioeconomic and environmental factors and medication compliance, contribute to an association between asthma and obesity and were not analyzed in this study. Also, the lack of statistical significance in our study may be due to the small sample size. Based on our results, we estimate that future studies will need at least 800 children to achieve an adequate statistical power. These children will need a

comprehensive assessment to record all factors that affect asthma control.

Acknowledgements: We thank all participants in this study and all the staff involved. Dr. Eneko Larumbe and the TTUHSC Clinical Research Institute are also acknowledged for their invaluable statistical support.

Article citation: Huang J, Lever J, Kola B. Comparing the asthma control in overweight/obese and normal weight pediatric patients: A retrospective study in West Texas. The Southwest Respiratory and Critical Care Chronicles 2018;6(25):14–18
From: Department of Pediatrics, Texas Tech University Health Sciences Center in Odessa, Texas.
Submitted: 6/14/2018
Accepted: 7/3/2018
Reviewer: James Tarbox MD
Conflicts of interest: none

References

1. Zahran HS, Bailey CM, Damon SA, et al. Vital Signs: Asthma in Children—United States, 2001-2016. MMWR Morb Mortal Wkly Rep 2018;67:149–55.
2. Beuther DA, Weiss ST, Sutherland ER. Obesity and asthma. Am J Respir Crit Care Med 2006;174:112–9.
3. Lazarus R, Colditz G, Berkey CS, et al. Effects of body fat on ventilatory function in children and adolescents: cross-sectional findings from a random population sample of school children. Pediatr Pulmonol 1997;24:187–94.
4. Gennuso J, Epstein LH, Paluch RA, et al. The relationship between asthma and obesity in urban minority children and adolescents. Arch Pediatr Adolesc Med 1998;152:1197–200.
5. Manion AB. Asthma and obesity: the dose effect. Nurs Clin North Am 2013;48:151–8.
6. Beuther DA, Sutherland ER. Overweight, obesity, and incident asthma: a meta-analysis of prospective epidemiologic studies. Am J Respir Crit Care Med 2007;175:661–6.
7. Stenius-Aarniala B, Poussa T, Kvarnström J, et al. Immediate and long term effects of weight reduction in obese people with asthma: randomised controlled study. BMJ 2000;320:827–32.
8. Eneli IU, Skybo T, Camargo CA. Weight loss and asthma: a systematic review. Thorax 2008;63:671–6.
9. Ekström S, Hallberg J, Kull I, et al. Body mass index status and peripheral airway obstruction in school-age children: a population-based cohort study. Thorax 2018; 73(6):538–545.
10. Center for Disease Control and Prevention. Asthma and Obesity. 2013. (Accessed June 1, 2018, at https://www.cdc.gov/asthma/asthma_stats/asthma_obesity.htm.)
11. Lavoie KL, Bacon SL, Labrecque M,et al. Higher BMI is associated with worse asthma control and quality of life but not asthma severity. Respir Med 2006;100:648–57.
12. Program NAEaP. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. J Allergy Clin Immunol 2007;120:S94–138.
13. Akinbami LJ, Rossen LM, Fakhouri THI, et al. Asthma prevalence trends by weight status among US children aged 2–19 years, 1988-2014. Pediatr Obes 2017.
14. Toennesen LL, Bjerregaard A, Porsbjerg C, et al. Overweight in childhood and adolescence: Does it lead to airway hyperresponsiveness in adulthood? J Asthma 2018;55:137–44.
15. Kattan M, Kumar R, Bloomberg GR, et al. Asthma control, adiposity, and adipokines among inner-city adolescents. J Allergy Clin Immunol 2010;125:584–92.
16. Borrell LN, Nguyen EA, Roth LA, et al. Childhood obesity and asthma control in the GALA II and SAGE II studies. Am J Respir Crit Care Med 2013;187:697–702.
17. Peters-Golden M, Swern A, Bird SS, et al. Influence of body mass index on the response to asthma controller agents. Eur Respir J 2006;27:495–503.
18. Boulet LP, Franssen E. Influence of obesity on response to fluticasone with or without salmeterol in moderate asthma. Respir Med 2007;101:2240–7.
19. Forno E, Lescher R, Strunk R, et al. Decreased response to inhaled steroids in overweight and obese asthmatic children. J Allergy Clin Immunol 2011;127:741–9.