



Association of obesity and severity of acute asthma exacerbations in Filipino children

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ABSTRACT

Background: Increased body mass index (BMI) may be a risk factor for the development and severity of asthma. However, the effect of obesity on asthma exacerbations is unclear.

Objective: To examine the association of obesity and the severity of acute asthma exacerbations.

Methods: A retrospective cohort of children aged 5 to 18 years who were seen in the emergency department and admitted for acute asthma exacerbation from 2009 to 2011 was reviewed. Weight and height data to compute the BMI were taken from the medical record review. The Centers for Disease Control and Prevention BMI-for-age growth charts for boys and girls aged 2 to 20 years were used to classify underweight, normal, overweight, and obese. Severity of asthma exacerbations into mild, moderate, or severe was determined using criteria by the Global Initiative for Asthma 2010. The χ^2 test of association or the Fisher exact probability test for small samples was used to determine the association between nutritional status and severity of asthma exacerbations.

Results: Of the 303 cases reviewed, most were boys with a mean (SD) age of 10 (3.8) years. The prevalence of overweight and obese children admitted for acute asthma exacerbation was 21% and 28%, respectively. No significant difference was found in the severity of asthma exacerbations, with 82.9% of the nonobese group and 86.8% of the overweight-obese group having moderate-to-severe exacerbation (likelihood ratio, 0.879; 95% CI, 0.42–0.41; $P = .88$).

Conclusion: Our findings suggest that the severity of acute asthma exacerbations was not affected by increased BMI.

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Introduction

A global increase in overweight and obese children has been seen in developed countries, with an additional 1% of children becoming overweight each year.¹ However, the prevalence of childhood obesity is also increasing rapidly in the low- and middle-income countries, such as in the Asia-Pacific region.² Likewise, the prevalence of childhood asthma has increased. In the United States, it has more than doubled, with an increase from 3.1% in 1980 to 7.1% in 2004³ and even higher to 9.1% in 2007.⁴ There is a parallel increase in the prevalence of obesity and asthma, 2 of the most common chronic diseases in childhood.^{5,6} In addition, numerous studies have reported an association between asthma development and severity and obesity.

Obesity has been identified as a risk factor for developing asthma in several longitudinal studies in children.^{7–9} with obese children with asthma having more severe disease.^{10–13} Obese children were more likely to have an increased risk for use of

β -agonists canisters and systemic corticosteroids,¹⁴ significantly more intensive care unit admissions, and slower recovery compared with normal weight children counterparts.¹⁵

A multicenter, prospective cohort study was performed in 17 states in the United States and 2 states in Canada to determine the prevalence of obesity among children presenting to the emergency department (ED) with acute asthma. Results indicate that the prevalence of obese patients who presented with acute asthma attacks was significantly higher than those of their nonobese counterparts.¹⁶ However, the severity of asthma attacks and its relation to body mass index (BMI) and its mechanisms still need to be investigated further. Our study therefore aimed to determine the prevalence of obesity in children 5 years and older admitted for acute asthma exacerbation in a private tertiary hospital and to examine the association between BMI and severity of their acute asthma exacerbation.

Methods

Study Design and Patients

The study retrospectively analyzed records from 2009 to 2011 of patients seen for acute asthma exacerbation in the pediatric ED of a

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tertiary care hospital and eventually admitted. Included were children aged 5 to 18 years diagnosed as having asthma by a physician as reported by the parent or guardian. Children with comorbidities and diagnoses, such as pneumonia, other active chronic respiratory diseases, chest wall abnormalities, respiratory anatomical abnormalities, and gastroesophageal reflux disease, were excluded from this study.

Data Collection

Weight and height data were all taken from the medical record review. The BMI of each patient was calculated by dividing the patient's weight in kilograms by the square of height in meters. The Centers for Disease Control and Prevention BMI-for-age growth charts for boys and girls aged 2 to 20 years were used to classify underweight (BMI for age in the fifth percentile or less), normal (BMI for age in the greater than 5th percentile but 85th percentile or less), overweight (BMI for age in the greater than 85th percentile but 95th percentile or less), and obese children (BMI for age in the greater than 95th percentile). Other data collected included medical history and family history of other atopic diseases; asthma control indicators, such as history of intensive care unit (ICU) admissions, prior intubations, and length of time since last exacerbation; and medications used for asthma.

The classification of the severity of an asthma exacerbation was determined using the table recommended by the Global Initiative for Asthma (GINA) 2010. The patients were classified as having mild, moderate, or severe asthma exacerbations.¹⁷ Classification was dependent on the following parameters: breathlessness, number of words spoken by the patient at a time (words, phrases, or sentences), alertness, respiratory rate, use of accessory muscles, wheezing, pulse per minute, pulsus paradoxus, peak expiratory flow (PEF) after initial bronchodilator use, and oxygen saturation. The presence of at least 1 of the parameters in the highest level of severity classification determined the severity of the asthma exacerbation of the patient.

Statistical Analysis

Data were analyzed using STATA statistical software, version 10 (StataCorp, Chicago, Illinois). Frequency tables were generated to show the distribution of patients with asthma according to demographic factors (age, sex), health history (family history of asthma, personal history of atopy), asthma control indicators (previous ICU admission, medications taken before attack, length of time since last exacerbation), presence of comorbidities, clinical features (nutritional status using BMI classification, use of accessory muscles, presence of wheezes, oxygen saturation at room air, classification of severity of asthma exacerbation according to GINA guidelines), and need for intensive care.

To determine the association between nutritional status and severity of asthma exacerbations, a χ^2 test of association or a Fisher exact probability test was used for small samples when appropriate. Computation of the prevalence ratio was likewise performed. $P \leq .05$ was used as the cutoff for significance. The study was approved by the institutional review board of the hospital.

Results

We reviewed a total of 303 medical records of children seen for acute asthma exacerbations who fulfilled the inclusion and exclusion criteria. Chief concerns reported for all the ED visits were asthma attack, difficulty of breathing, or shortness of breath. There were more boys than girls, and most patients were between 5 and 10 years of age (Table 1). Almost half of the patients seen (145 [49%]) were overweight ($n = 58$) or obese ($n = 87$) (Table 1).

Consistent clinical findings as written in the medical records at the time of ED visit included respiratory rate and heart rate, use of

accessory muscles, presence of wheeze, and oxygen saturation. Unfortunately, there were inconsistent recording of PEF measurements and no recording of other parameters, such as number of words spoken and presence or absence of pulsus paradoxus. Likewise, there was no information on the exact triggers of the asthma exacerbation.

Following the GINA guidelines for severity of asthma exacerbation, 214 patients (71%) were classified as having moderate exacerbation and 43 (14%) as having a severe exacerbation. Only 3 patients (1%) necessitated ICU admission (Table 2). Asthma control indicators, such as length of time since last exacerbation and history of ICU admissions, were not different between normal BMI and overweight and obese patients (Table 1). No significant difference was found between the severity of asthma exacerbation of those overweight and obese patients from the children with normal BMI (Pearson $\chi^2 = 9.066$) (Table 3). Stratifying this group by age as defined by the American Academy of Pediatrics into preadolescent (5–10 years old) and adolescent (11–18 years old) yielded similar findings.

A comparison was also made between the nonobese groups (underweight and normal) and the overweight-obese groups. No significant difference was found in the severity of asthma exacerbations between the 2 groups, with 82.9% of the nonobese group being classified as having moderate to severe exacerbation vs 86.8% of the overweight-obese group (likelihood ratio, 0.879; 95% CI, 0.42–0.41; $P = .88$) (Table 4). Similarly, analyzing by different age groups (preadolescent and adolescent) did not reveal significant differences. Of these patients, 3 patients with severe exacerbation were admitted to the ICU. One of those had a normal BMI, and 2 were obese.

Discussion

The global prevalence of combined overweight and obesity has increased in all regions. Worldwide, the proportion of adults with a BMI of 25 or greater increased between 1980 and 2013 from 28.8% to 36.9% in men and from 29.8% to 38% in women. Prevalence has increased considerably in children and adolescents in developed countries; 23.8% of boys and 22.6% of girls were overweight or obese in 2013. Even in developing countries, the prevalence of overweight and obesity has also increased in children and adolescents, from 8.1% to 12.9% in 2013 for boys and from 8.4% to 13.4% in girls.¹⁸ In fact, the World Health Organization reports that most of the world's population now live in countries where overweight and obesity kill more people than being underweight.¹⁹

In our group of patients presenting to the ED with acute asthma exacerbation, the obese and overweight group comprised almost half of the population. This prevalence is certainly higher than the worldwide prevalence for obesity in the general population and even higher than the general prevalence in the Philippines, where this study was conducted. The Eighth National Nutrition Survey in 2013 reveals that the prevalence of overweight among Filipino children is 5% and 9.1% among children 0 to 5 years old and 5 to 10 years old, respectively. The 2011 Global School-based Health Survey also found that approximately 13% of adolescents in the Philippines are overweight and obese.²⁰

There is substantial evidence that obesity and asthma are related. Several cohort studies indicate that increased BMI has been associated with an increased incidence of asthma in children.^{21–24} In prior studies that assessed the association between obesity and asthma in children, the prevalence of obesity was found to be 1.5 to 2.5 times higher in those with physician-diagnosed asthma compared with those without asthma.¹⁶ A meta-analysis performed by Beuther et al²⁵ found an increased odds ratio for incident asthma of 1.92 (95% CI, 1.43–2.59) in those with obesity vs normal

Table 1
Demographics and Characteristics of the Study Patients

Variable	No. (%) of patients				
	Underweight (n = 20)	Normal weight (n = 138)	Overweight (n = 58)	Obese (n = 87)	Total (N = 303)
Sex					
Male	10 (50)	76 (55.1)	31 (53.4)	72 (82.8)	189 (62.4)
Female	10 (50)	62 (44.9)	27 (46.6)	15 (17.2)	114 (37.6)
Age					
5–10 years	15 (75)	90 (65.2)	28 (48.3)	62 (71.3)	195 (64.4)
11–18 years	5 (25)	48 (34.8)	30 (51.7)	25 (28.7)	108 (35.6)
Family history of asthma					
Yes	14 (70)	99 (71.7)	45 (77.6)	63 (72.4)	221 (72.9)
No	6 (30)	39 (28.3)	13 (32.4)	24 (27.6)	82 (27.1)
Other atopic disease					
None	20 (100)	132 (95.7)	55 (94.8)	183 (95.4)	290 (95.7)
Allergic rhinitis	0 (0)	4 (2.9)	2 (3.4)	4 (4.6)	10 (3.3)
Atopic dermatitis	0 (0)	2 (1.4)	1 (1.7)	0 (0)	3 (1.0)
Asthma control indicators					
History of ICU admission					
Yes	4 (20)	13 (9.5)	6 (10.4)	11 (12.6)	34 (11.2)
No	16 (80)	125 (90.5)	52 (89.6)	76 (87.4)	269 (88.8)
Prior intubation					
Yes	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
No	20 (100)	138 (100)	58 (100)	87 (100)	303 (100)
Length of time since last exacerbation					
<6 months	4 (20)	44 (31.9)	18 (31)	25 (28.7)	91 (30.0)
6 months to 1 year	11 (55)	55 (39.9)	26 (44.9)	28 (32.2)	120 (39.6)
>1 year	3 (15)	26 (18.9)	10 (17.2)	18 (20.7)	57 (18.8)
None	0 (0)	1 (0.7)	0 (0)	1 (1.1)	2 (0.7)
Not known	2 (10)	12 (8.6)	4 (6.8)	15 (17.2)	33 (10.9)
Medications taken before exacerbation					
BA	10	61	20	44	
LABA and ICS	2	7	7	9	
BA and AL	0	8	2	7	
BA, LABA, ICS, and AL	0	4	5	2	
AL	0	6	4	1	
None	13	41	27	23	

Abbreviations: AL, antileukotriene; BA, β -agonist; ICS, inhaled corticosteroid; ICU, intensive care unit; LABA, long-acting β -agonist.

weight and concluded that the odds of incident asthma increased by 50% in overweight and obese individuals.²⁵ Almost half of the patients with asthma in our study were either overweight or obese.

Our study design, however, does not allow us to ascertain the temporal relation between the 2 (if obesity preceded or followed the onset of asthma).

Table 2
Patient Symptoms and Severity Classification

Variable	No. (%) of patients				
	Underweight (n = 20)	Normal weight (n = 138)	Overweight (n = 58)	Obese (n = 87)	Total (N = 303)
Tachypnea					
Yes	20 (100)	138 (100)	58 (100)	87 (100)	303 (100)
No	0 (0)	0 (0)	0 (0)	0 (0)	0
Tachycardia					
Yes	20 (100)	138 (100)	58 (100)	87 (100)	303 (100)
No	0 (0)	0 (0)	0 (0)	0 (0)	0
Use of accessory muscles					
Usually	14 (70)	84 (60.9)	36 (62.1)	58 (66.7)	192 (63.4)
Usually not	6 (30)	54 (39.1)	22 (37.9)	29 (33.3)	111 (36.6)
Wheezes					
Moderate	3 (15)	29 (21)	10 (17.2)	8 (9.2)	241 (79.5)
Loud	17 (85)	104 (75.4)	47 (81)	73 (83.9)	50 (16.5)
Absent	0 (0)	5 (3.6)	1 (1.7)	6 (6.9)	12 (3.9)
Oxygen saturation at room air					
>95%	9 (45)	55 (39.9)	26 (44.8)	25 (28.7)	115 (37.9)
91%–95%	6 (30)	66 (47.8)	26 (44.8)	48 (55.2)	146 (48.2)
<91%	5 (25)	17 (12.3)	6 (10.3)	14 (16.1)	42 (13.9)
Severity of asthma exacerbation (GINA)					
Mild	3 (15)	25 (18.1)	13 (22.3)	5 (5.7)	46 (15.2)
Moderate	11 (55)	97 (70.3)	39 (67.3)	67 (77)	214 (70.3)
Severe	6 (30)	16 (11.6)	6 (10.4)	15 (17.2)	43 (14.5)
Need for intensive care admission					
Yes	0 (0)	1 (0.7)	0 (0)	2 (2.3)	3 (1)
No (ward admission)	20 (100)	137 (99.3)	58 (100)	85 (97.7)	300 (99)

Abbreviation: GINA, Global Initiative for Asthma.

Table 3
Cross Tabulation of Nutritional Status and Severity of Asthma Exacerbation

Nutritional status	Severity of asthma exacerbation, No. (%)			
	Mild (n = 46)	Moderate (n = 214)	Severe (n = 43)	Total No. (N = 303)
Underweight	3 (6.5)	11 (5.1)	6 (14)	20
Normal	25 (54)	97 (45.3)	16 (37.2)	138
Overweight	10 (21.7)	41 (19.1)	7 (16.3)	58
Obese	8 (17.3)	65 (30.4)	14 (32.6)	87

The association between BMI status and asthma control and exacerbations in children is less well defined. Studies have found that being overweight or obese as a child is associated with poorly controlled asthma and increased asthma exacerbations,^{14,26,27} yet others have not found this association.^{28–30} The children in our cohort did not differ across BMI distribution in terms of asthma control indicators, such as length of time since last exacerbation, history of ICU admissions, prior intubation, or use of asthma medications.

After the GINA guidelines for severity of asthma exacerbation, most of our patients were classified as having moderate exacerbation at the time they were seen in the ED. However, the nutritional status of the children did not affect the severity of their exacerbation, with almost the same number of overweight-obese patients having moderate to severe asthma as the nonobese group.

Our results are consistent with the findings of Ginde et al.³¹ who specifically looked at children with acute asthma exacerbations in the ED setting. They found that BMI was not associated with acute asthma severity and that asthma exacerbations among obese children were similar to those experienced by other children.¹⁶ A similar study performed by Thomson et al.³¹ on adults likewise found that asthma exacerbations among obese and nonobese adults were remarkably alike.³⁰

Two studies^{15,32} of patients presenting to the ED with acute asthma exacerbation, however, reached different conclusions. Rodrigo et al.³² found an association between BMI and acute asthma severity in patients who had severe asthma seen in their ED in Uruguay. Overweight-obese patients had significant increases in length of ED stay and were admitted to the hospital more frequently. They surmised that this may reflect a difference in severity of asthma attacks.³² Carroll et al.¹⁵ also found an association between obesity and asthma severity in critically ill children with status asthmaticus. Obese children had significantly longer ICU and hospital lengths of stay, received longer courses of supplemental oxygen, and received continuous albuterol and intravenous steroids.¹⁵ These 2 studies, however, do not specifically look at classifying asthma exacerbation severity; instead, they use indicators, such as length of stay and hospital admission, to suggest that the exacerbation could have been more severe and hence the admission and longer stay.

The limitations of our study are inherent in all studies that use a retrospective method. Some information regarding asthma control

measures, such as ICU admissions and time of last exacerbation, were not available in the medical records of some patients. There was also a lack of detailed information on specific triggers, such as physical activity or environmental exposures or behaviors known to exacerbate asthma symptoms, that could have been analyzed and correlated with the BMI. There was inconsistent documentation in the medical records of more objective parameters for exacerbation severity, such as PEF, for most of the patients; therefore, we were unable to use this at all for analysis. Medical record review also relied on self-reporting of physician diagnosis of asthma. There was no opportunity to probe further previous symptoms and medications or to perform objective pulmonary function testing to ascertain asthma in our patients. Aaron et al.³³ found in a Canadian adult population that approximately one-third of obese and nonobese individuals with self-reported physician-diagnosed asthma did not have objective evidence of asthma and were presumably overdiagnosed.³³ Misdiagnosis in our patients with asthma would certainly affect our interpretation.

A significant limitation of our study is that we did not measure the prevalence of obesity or the severity of exacerbations in the ED children who were not admitted to the hospital for asthma exacerbation. Granted that this number would have been low and might not have affected the eventual result because most patients seen in our institution for asthma exacerbations get admitted. Still, the appropriate data comparison between normal, overweight, and obese children with acute asthma exacerbation who were admitted compared with those not admitted group and the severity of the exacerbations itself needs to be performed for future, prospective studies. It should not be assumed that the severity is less just because these patients were not admitted, as was done in previously cited studies. Neither did we determine the number of obese children who were seen in the ED for diseases other than asthma. Is it possible that obese children in general just visit the ED more? This needs to be addressed prospectively as well. All these data would have complemented our comparison with the national survey data that we used to estimate obesity in the general population.

Notwithstanding the negative association found in our study for severity of exacerbations, the high prevalence of children presenting to our ED with comorbid obesity and asthma is an important issue to address. With all the other acknowledged influence of obesity on asthma, ED physicians should be aware of this because they are an important source of care for these patients. Particular attention should be paid to the obese asthma patient because short-term ED management can be complicated by challenges in airway management and altered or reduced beneficial response to asthma medications.^{34–36} The ED physician is also an untapped resource for screening and early referral for obesity management programs.

Asthma and obesity exhibit a well-established association with evidence in multiple studies pointing toward a more severe and difficult-to-control obese asthma phenotype. These patients are likely to have more asthma symptoms, more exacerbations, more hospital admissions, increased use of rescue medications, and worse quality of life. However, there is a scarcity of studies on the association of obesity and the severity of the exacerbation itself. Our findings suggest that in this study of children with asthma presenting to the ED and subsequently admitted, the severity of acute exacerbations was not affected by increased BMI.

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Table 4
Nutritional Status (Nonobese and Overweight-Obese) and Severity of Asthma Exacerbation (Mild and Moderate-Severe)

Nutritional status	Severity of asthma exacerbation, No. (%)		Total No.	PR (95% CI)	P value ^a
	Mild	Moderate-severe			
Underweight-normal	18 (12.4)	127 (87.6)	145	0.95 (0.42–0.41)	.88
Overweight-obese	28 (17.7)	130 (82.3)	158		

Abbreviations: CI, confidence interval; PR, prevalence ratio.

^a χ^2 test.

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