



Severity of Childhood Asthma Among Normal, Overweight and Obese Children - A Comparative Study

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ABSTRACT

Aim: To determine the severity of asthma among asthmatic children with a) normal body mass index (BMI), b) and those who are overweight or obese. To compare the severity of asthma among children with normal BMI, and those who are overweight and obese.

Materials and Methods: One hundred and fifty asthmatic children meeting the diagnostic criteria were enrolled onto this study. Thorough clinical and anthropometric examinations were carried out. The children were then categorized into two groups based on their BMI as either those with normal BMI or those who were overweight/obese. They were then followed up over 12 months and the information collected was analyzed.

Results: Of the 150 children, 72% were male and 45.3% belonged to the age group of 6-11 years. In 46.7%, asthma was diagnosed <5 years. 50% of the children missed school for between 1 and 5 days per year. The majority (63.3%) of the asthmatic children were able to perform the same level of physical activity as their peers. 54% of the asthmatic children had mild persistent asthma. Overweight/obesity was present in 19.3% of the participants. The majority (72.4%) of the obese asthmatic children were diagnosed <12 years and had moderate-severe persistent asthma. Those asthmatic children who were overweight or obese had more frequent night awakenings and missed more school days at enrolment and during follow-up. The overweight/obese asthmatic children visited the emergency department, required rescue medications and received steroids more often than those children with normal BMI.

Conclusion: Obese asthma is a well-defined phenotype of childhood asthma, characterized by higher disease burden and poor response to treatment. Hence, a two-pronged strategy to tackle being overweight or obese and also to manage the asthma in this group is warranted with strategies directed towards reductions in obesity at an early age in order to help reduce the severity of their asthma.

Keywords: Asthma, BMI, correlation, severity, obesity

Introduction

Asthma is a global health problem with increasing prevalence in most countries, especially among children. The mean prevalence of childhood bronchial asthma among Indian

children was $7.24 \pm$ standard deviation 5.42 with a median prevalence of 4.75% (2.65-12.35%) (1). Apart from being the leading cause of hospitalization, it is one of the most important chronic conditions causing elementary school absenteeism (2,3).

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Being overweight or obese have become increasingly common in children around the world (4). Over the past four decades, the mean body mass index (BMI) and obesity rate in the pediatric population have increased significantly worldwide (5). The worldwide prevalence of obesity increased three fold between 1975 and 2016. An estimated 38.2 million children under 5 years of age were overweight or obese in 2019. The prevalence of being overweight or obese rose dramatically from just 4% in 1975 to just over 18% in 2016 among those aged 5-19 (6). The prevalence of obesity among 5- to 19-year-old Indian children ranged between 3.6 and 11.7% (7). The levels of physical activity in this age group have declined due to increased access to various modern conveniences. Besides causing metabolic consequences, obesity, along with a sedentary lifestyle, can affect multiple organ systems within the body negatively including the respiratory system. Of the various complications in patients induced by obesity, asthma is one of the major ones.

Asthma and obesity are growing epidemics in both the developing and the developed world. The prevalence of asthma increases at both extremes of BMI, and findings regarding this have been seen not only in western populations but also in Indian and Chinese children. The significant parallel of increases in the prevalences of obesity and asthma have led to a hypothesis of causality of obesity in development of asthma (8). Obesity has been associated with an increased risk of developing new cases of objectively defined asthma. However; there are conflicting results in the studies available on this subject. Hence, this study was undertaken in order to compare the severity of asthma among normal weight, overweight and obese children.

Materials and Methods

All children aged 1 to 18 years meeting the diagnostic criteria for asthma as per the 2019 Global Initiative for Asthma guidelines were enrolled onto this comparative study after obtaining informed consent from their parents and assent from the children themselves. A detailed history was obtained regarding their age, gender, family history of asthma and obesity, past history, treatment history and symptoms of asthma for the prior 12 months to their enrolment onto this study. A thorough clinical examination including general, systemic and anthropometric examinations was carried out. Their weight was checked using a digital weighing scale with an accuracy of ± 100 g. Recumbent length was recorded in children < 2 years, using an infantometer, to the nearest 0.1 cm. Height was recorded in older children by means of a stadiometer with an accuracy of ± 0.1 cm. BMI was calculated using

the formula $BMI = \text{weight (kg)} / \text{Height squared (m}^2\text{)}$. The children were then categorized based on the BMI 2007 World Health Organization reference charts as being obese, overweight or having normal BMI. For this study, the children were classified into two groups i.e. (1) those with normal BMI and (2) those who were overweight/obese. They were followed up for 12 months and their symptom severity was assessed based on their number of exacerbations, their number of emergency department visits, any escalations of their therapy or limitations on their activity. The data were analyzed in order to compare the severity of asthma in the overweight/obese group vs. the normal BMI asthmatic children and to assess the relationship between BMI and the severity of childhood asthma.

Ethical Consideration

Ethical approval was received from the Employees' State Insurance Corporation Medical College and Post Graduate Institute of Medical Sciences and Research Rajajinagar, Bengaluru (approval no: 532/L/11/12/Ethics/ESICMC&PGIMSR/Estt.Vol..IV, date: 15.11.2019).

Statistical Analysis

The information collected was entered into Microsoft Excel and analyzed using SPSS version 21 software. Comparison of variables were calculated by using chi-squared test. Values of $p < 0.05$ were considered as statistically significant.

Results

Of the 150 asthmatic children enrolled in this study, the majority (72%) were male. Most children belonged to the age group of 6-11 years (45.3%), followed in decreasing order of frequency by children aged ≥ 12 years (49%) and ≤ 5 years (33%), as seen in Table I.

Family history of asthma was present in 44% of the children. Among those who had a positive family history, 12.7%, 6.7% and 5.3% had a history of treated or untreated asthma in their mother, father and brother, respectively.

Age and sex	Number	%
≤ 5 years	33	22
6-11 years	68	45.3
≥ 12 years	49	32.7
Male	108	72
Female	42	28

Forty-six percent of the asthmatic children in our study were diagnosed with asthma before 5 years of age, while 42% and 11.3% of the asthmatic children were diagnosed between 6-11 years and after 12 years of age, respectively (Table II).

Forty-six percent of the children were on controller medications prior to enrolment. Of these, 94.2% received inhaled medications (Table III).

Over the 12 months preceding enrollment into this study, the majority of the children missed school due to symptomatic asthma with 49.3% and 38% having missed 1-5 school days and 6-10 school days in the previous year, respectively (Table IV). 55.3%, 25.3% and 17.3% of the children had visited the emergency room for symptoms of asthma once, twice or 3 or more times respectively. 44.7% of the children had received rescue medications >2 days per week, and 40.7% and 12.7% of the asthmatic children had used rescue medications ≤2 days per week or daily, respectively, while 2% of the children reported no use of any rescue medications. 45.3% of the asthmatic children had received oral or intravenous steroids during acute exacerbations.

Age at first diagnosis (years)	Number	%
≤5	70	46.7
6-11	63	42
≥12	17	11.3

(n=150)		Number	%
On medications	Yes	69	46
	No	81	54
Inhaled/Oral	Inhaled	65	94.2
	Oral	4	5.8

		Normal BMI		Overweight/Obese		p-value
		n	%	n	%	
Cough	Yes	96	79.3	20	69.0	0.231
	No	25	20.7	9	31.0	
Breathlessness	Yes	17	14.0	12	41.4	0.001*
	No	104	86.0	17	58.6	
Chest tightness	Yes	5	4.1	6	20.7	0.006*
	No	116	95.9	23	79.3	
Wheezing	Yes	42	34.7	2	6.9	0.003*
	No	79	65.3	27	93.1	

*P-value of <0.05, i.e., a value of significance.
BMI: Body mass index

Among the study participants, 54.7%, 21.3%, 22.7% and 1.3% had mild persistent asthma, moderate persistent asthma, intermittent asthma or severe persistent asthma, respectively (Figure 1).

The majority of the asthmatic children in the present study had a normal BMI. However, 19.3% of the asthmatic children were overweight or obese.

Breathlessness and chest tightness were more often seen in those asthmatic children who were overweight or obese than in those with normal BMI (p<0.05) (Table V).

When compared to those children with normal BMI, a higher number of overweight/obese children had moderate

Missed school days in a year	At enrolment	
	Number	%
1-5 days	74	49.3
6-10 days	57	38
≥11 days	4	2.7
None	15	10

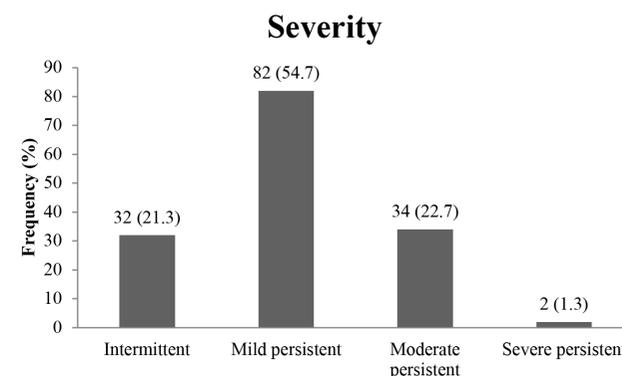


Figure 1. Severity of asthma

Table VI. Comparison of the treatment of exacerbations among the two groups

At enrolment		Normal BMI		Overweight/Obese		Likelihood ratio	p-value
		n	%	n	%		
Emergency room visits	1 time	66	54.5	17	58.6	1,903	0.593
	2 times	32	26.4	6	20.7		
	≥3 times	20	16.5	6	20.7		
	None	3	2.5	0	0.0		
Rescue medicine used	<2 days/week	55	45.5	6	20.7	8,002	0.046
	>2 days/week	52	43.0	15	51.7		
	Daily	12	9.9	7	24.1		
	None	2	1.7	1	3.4		
Steroids received	1-2 times	48	39.7	17	58.6	4,134	0.127
	3-4 times	2	1.7	1	3.4		
	None	71	58.7	11	37.9		

BMI: Body mass index

persistent asthma (44.8% vs. 17.4%) or severe persistent asthma (3.4% vs. 0.8%) with $p=0.015$.

Asthmatic children who were overweight/obese had more frequent night awakenings and a higher number of missed school days ($p=0.005$). The level of physical activity was less in those with higher BMI compared to those with normal BMI (54% vs. 32%), however this was not statistically significant ($p=0.63$).

When the treatment received for exacerbations prior to enrolment was compared among the two groups, it was found that there was a significant association between being overweight/obese and the use of rescue medication ($p=0.046$) (Table VI).

Asthmatic children who were overweight/obese had significantly higher numbers of night awakenings, school absenteeism, emergency department visits, need for rescue medications for symptom control and steroid use when compared to those asthmatic children with normal BMI on follow-up ($p<0.005$).

Discussion

The association between obesity and asthma has been a topic of much interest owing to the rising prevalence of both these chronic health conditions among the pediatric population across the globe. Mechanisms which might explain this association include lower lung volumes due to increased weight on the chest wall and/or pro-inflammatory mediators released by adipocytes (9,10).

The present study was undertaken in order to compare the severity of asthma among children with normal BMI vs.

those who were overweight/obese among 150 asthmatic children aged 1-18 years. The majority ($n=108$, 72%) of the asthmatic children in this study were male and the most common age group was 6-11 years (45.3%), which is similar to the findings noted in the study by Gürkan et al. (3).

Most children in the present study were diagnosed with asthma before 5 years of age (46.7%). This supports the observation made by Radhakrishnan et al. (11) who examined trends in the age at diagnosis of asthma in eight consecutive birth cohorts and found that there was a steady decline in the age of diagnosis from 4.7 ± 1.5 years in the year 1993 to 2.6 ± 2.0 years in 2000.

Asthma is an important cause of school absenteeism. As many as 90% of the children in the present study missed school for one or more days due to symptoms of asthma, with most children having missed 1-5 school days in a year (49.3%). Meng et al. (12) in their study on asthma related school absenteeism found that 23% of the asthmatic children aged 4-17 years missed school for at least 1 day per year.

The levels of physical activity of the asthma sufferers when compared to their peers was relatively unaffected in most asthmatic children in the present study. The majority (63.3%) of children reported the ability to perform at the same level of physical activity as their peers, a finding consistent with that of the study by Nystad (13) who concluded that asthmatic children in their study were as physically active as their peers.

Before enrolment into this study, 52% of the children had been hospitalized for asthma exacerbation once and 8%

of the children had had more than one hospital admission. Gürkan et al. (3) noted that, of the 140 children in their study, 30 (21.4%) had more than one admission per year.

The prevalence of being overweight/obese among asthmatic children was 19.3%. This was similar to the finding by Chen et al. (14) who found a 19.7% prevalence of obesity among asthmatic children.

When the treatments received for exacerbations prior to enrolment were compared among the two groups, it was found that there was a significant association between being overweight/obese and the use of rescue medication ($p=0.046$), as was also observed by Lang et al. (15) who found that overweight/obese children had three times more frequent use of rescue treatment than normal weight children.

Overweight/obese asthmatic children visited the emergency department, required rescue medications for symptom control and received steroids more often than children with normal BMI. Quinto et al. (16) observed that overweight/obese asthmatic children had higher oral corticosteroid use than those children with normal BMI.

Study Limitations

This was a single center study. And the sample size was small.

Conclusion

Obese asthma is a well-defined phenotype of childhood asthma characterized by higher disease burden and poor response to treatment. Hence, a two-pronged strategy to tackle being overweight/obese and to manage asthma in this group is warranted. Children with asthma who are overweight/obese have a higher number of emergency room visits, hospitalizations and a greater use of rescue medications and steroids. Hence, strategies directed towards the reduction of obesity at an early age may help to reduce the severity of asthma.

Ethics

Ethics Committee Approval: Ethical approval was received from the Employees' State Insurance Corporation Medical College and Post Graduate Institute of Medical Sciences and Research Rajajinagar, Bengaluru (approval no: 532/L/11/12/Ethics/ESICMC&PGIMSR/Estt.Vol..IV, date: 15.11.2019).

Informed Consent: The informed consent was obtained from their parents and assent from the children themselves.

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Authorship Contributions

Concept: N.U.R., P.K., Design: N.U.R., P.K., Data Collection or Processing: N.U.R., V.S.B., Analysis or Interpretation: N.U.R., V.S.B., Literature Search: N.U.R., P.K., Writing: N.U.R., V.S.B.

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