

Original Research Article

A cross sectional observational study about the relationship between body mass index and severity of asthma in children aged 6 to 14 years

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ABSTRACT

Background: The effects of obesity on asthma severity, diagnosis and control are increasingly recognized. Primary objective of our study was to find out the relationship between BMI and severity of asthma in children. Secondary objectives were to study associated co-morbid conditions viz., atopic eczema and allergic rhinitis in children with asthma and the relationship between family history of asthma, atopy and allergic rhinitis with severity of asthma.

Methods: This cross-sectional study was done in the tertiary care centre in Thrissur, Kerala. Children of age 6 to 14 years diagnosed as asthma according to Global Initiative for Asthma (GINA) guidelines were included. One hundred children qualified for the study during the stipulated time period. Children with symptoms and signs of asthma, were classified to intermittent and persistent based on GINA guidelines. BMI was calculated in all. Preliminary details and details on the risk factors were collected.

Results: Mean age of the study population is 8.8 years. The study group had male predominance (57%). 39% had mild intermittent, 33% had mild persistent, 22% had moderate persistent and 6% had severe persistent asthma. Intermittent, mild persistent and moderate persistent were grouped as non-severe. 50% children had normal BMI, 28% were overweight and 22% underweight. Family history of asthma and atopic dermatitis was 47% and 38% respectively. Maximum children belonged to low socioeconomic status.

Conclusion: Did not find any statistically significant association between severity and duration of asthma with obesity or overweight in children with asthma ($p>0.05$).

Keywords: Asthma, BMI, Obesity, Atopy

INTRODUCTION

Asthma is a chronic inflammatory condition of lung airways. The first hypothesis to explain the increasing prevalence of asthma began with the observation that an increasing proportion of the U.S. population is overweight or obese and that this trend parallels the increasing prevalence rate of asthma.^{1,2} Also, in the past two decades there has been a significant increase in the prevalence of obesity among children worldwide.² The prevalence of asthma among school-age children has been rising in many regions of the developed world due to various reasons.³⁻⁷ A combination of environmental exposures and inherent biological and genetic

vulnerabilities are implicated in the etiology of asthma. Based on the frequency of symptoms the GINA classifies asthma severity as mild intermittent, mild persistent, moderate persistent or severe persistent.⁸

In many parts of the world obesity rates are increasing. Obesity is now a serious public health problem and has been identified as an area of needed focus in order to improve the nation's health.⁹ The exact cause of why obese children is more prone to asthma is unknown. However, there are some explanations that include airway smooth muscle dysfunction, mainly from thoracic restriction, obesity-related circulating inflammation priming the lung, and obesity-related co-morbidities

mediating asthma symptom development. The other possible causes including: (a) dietary characteristics that might lead to both obesity and asthma; (b) reductions in physical activity; and (c) genetic alterations that increase the propensity to both obesity and asthma together. Body weight is reasonably correlated with body fat, but is also highly correlated with height. Therefore, weight adjusted for height squared (BMI in kg/m²) is a useful index to assess overweight and is a fairly reliable surrogate for adiposity.¹⁰ The BMI was found to be the single best predictor of body fat in children.¹¹

The objective was to study the relationship between BMI and severity of asthma in children. The presence and extent of co-morbid conditions in children with asthma were also studied in detail.

METHODS

Patients attending the paediatric outpatient, inpatient, emergency department and asthma clinic in Jubilee Mission Medical College and Research institute formed the study group. After getting institutional ethics committee approval, 100 children of either gender in the age group of 6-14 years diagnosed with asthma as per GINA guidelines were included in this cross-sectional study. The Exclusion criteria were those children with evidence of active concomitant pulmonary disease other than bronchial asthma, concomitant severe systemic disease and those on oral corticosteroids for conditions other than asthma were excluded. The study period was from September 2015 to August 2016.

The patients and their parents were interviewed as per the proforma. Details of demographic data, asthma symptoms, severity and treatment, allergic rhinitis & eczema symptoms (as per ISAAC questionnaire) were collected. Family history of asthma, allergic rhinitis, eczema & tobacco smoking were also collected. The details of asthmatic symptoms were analysed and were classified into mild intermittent, mild persistent, moderate persistent or severe persistent asthma as per the GINA guidelines 2016.

Detailed general and systemic examinations were performed on all patients. Weight was checked in standing position with head straight with minimal clothing and without footwear using a standard weighing scale (Krupps). Standing height was measured using standard method. BMI was derived from the measured height and weight using the standard formulae [weight in kilogram/ (height in meter)²] and was approximated to two decimals. BMI was classified as per CDC chart. BMI ≤5th percentile was considered underweight and ≥85th percentile was considered overweight for this study. Features of allergic rhinitis and eczema were looked for and noted. The collected data were coded and entered in Microsoft excel to make a spread sheet and was analysed using SPSS for windows version 21. All variables were categorical and they were summarised in percentages.

Statistical tests were chi-square test and Fischer’s exact test to compare proportions. Graphical summarisations of the data were done by using bar and pie diagrams.

RESULTS

The mean age of the study population was 8.8 years. The study group had a male predominance with 57%. Among the study group, 48% had history of preterm birth. Twenty-eight children had history of respiratory distress in the new born period. In this study, 39% had intermittent, 33% had mild persistent, 22% had moderate persistent and 6% had severe persistent asthma (Table 1). Intermittent, mild persistent and moderate persistent were grouped together as non-severe asthma.

Table 1: Distribution of patients according to the grading of asthma.

Grading of asthma	No. of patients
Intermittent	39
Mild persistent	33
Moderate persistent	22
Severe	6
Total	100

Out of the total study group, 50% children were of normal BMI, 28% were overweight and 22% were of underweight (Table 2). Compared the BMI status of the children with severe and non-severe asthma. In this study 39 patients were in intermittent asthma group. Among the intermittent group, ten patients were in >85th centile group. In mild persistent group out of a total of 33 patients, nine patients had BMI of >85th centile.

Table 2: Distribution of patients according to BMI (n=100).

BMI centile	No. of patients
<5 th	22
5-10 th	13
10-25 th	3
25-50 th	11
50-75 th	17
75-85 th	6
85-90 th	7
90-95 th	9
>95 th	12

In moderate persistent group out of 22 patients 7 were overweight, and in severe asthma group among the 6 patients, 2 were overweight, 26 out of 94 of the non-severe asthmatics were overweight as compared to 33.3% (2 out of 6) of the severe asthma. The difference in the proportion of children who were overweight between the two groups was not significant (Table 3). No correlation was found between BMI and severity of asthma.

Table 3: BMI centile versus asthma severity.

BMI centile	Asthma type				Total	
	Intermittent	Mild persistent	Moderate persistent	Severe		
<5th	No. of patients	5	7	8	22	
	within BMI centile (%)	22.7	31.8	36.4	9.1	100.0
5-10th	No. of patients	3	7	2	13	
	within BMI centile (%)	23.1	53.8	15.4	7.7	100.0
10-25th	No. of patients	2	1	0	3	
	within BMI centile (%)	66.7	33.3	0.0	0.0	100.0
25-50th	No. of patients	5	4	1	11	
	within BMI centile (%)	45.5	36.4	9.1	9.1	100.0
50-75th	No. of patients	10	4	3	17	
	within BMI centile (%)	58.8	23.5	17.6	0.0	100.0
75-85th	No. of patients	4	1	1	6	
	within BMI centile (%)	66.7	16.7	16.7	0.0	100.0
85-90th	No. of patients	1	3	3	7	
	within BMI centile (%)	14.3	42.9	42.9	0.0	100.0
90-95th	No. of patients	6	0	1	9	
	within BMI centile (%)	66.7	0.0	11.1	22.2	100.0
>95th	No. of patients	3	6	3	12	
	within BMI centile (%)	25.0	50.0	25.0	0.0	100.0
Total	No. of patients	39	33	22	6	100
	within BMI centile (%)	39.0	33.0	22.0	6.0	100.0

Table 4: Severity of asthma versus BMI.

BMI >85 th Centile	Severe Asthma	
	No	Yes
Yes (n=28) (%)	26	2
No (n=72) (%)	68	4
	94.4	5.6

Out of the 28 overweight children, two of them had severe asthma. In the remaining 68 children who had BMI less than 85th percentile, four had severe asthma (Table 4).

Also, the hypothesis, that a low BMI is a risk factor for asthma in the Indian population emerges. The height, weight and BMI were noted. Spearman’s rank correlation coefficient (rho) is -0.263 (p=0.008), -0.162 (p=0.108) and -0.136 (p=0.176) for the 3 variables respectively (Table 5). An adequately powered case control study would be of value in addressing this issue.

In this study 47% had family history of asthma, 38% had family history of atopy, 32% had family history of allergy rhinitis. Family history is a known risk factor. A history of exposure to tobacco smoke exposure was observed in 43% of asthmatic children.

Among the total 100 patents, six had severe asthma (Table 4). Among them four had family history of allergic rhinitis, one had family history of asthma and atopy and one had family history of allergic rhinitis and

atopy. Whereas, among 94 the non-severe asthmatic patients, 19 had no family history, 26 had family history of asthma alone, while the rest had varied manifestation of allergic rhinitis or atopy either as a single or combined manifestation with asthma (Table 6).

Table 5: Correlations with severity of asthma-Spearman's rho.

Variables	Height centile	Weight centile	BMI
Rho	-0.263	-0.162	-0.136
P value	0.008	0.108	0.176
N	100	100	100

Lower socio-economic groups tended to have a higher prevalence and incidence of asthma. In this study maximum children were from lower socioeconomic status (34%) (Table 7).

Among the total asthmatic children, 46 children had exposure to pets at their home. History of atopic dermatitis was seen in 53 children.

No association was found with preterm and low birth weight babies. In this study, most of the children were term babies. However, a positive association between early exposure to pets and lower incidence of asthma was seen. It is advocated that exclusive breastfeeding protects from asthma, but in this study 67% asthmatics were exclusively breastfed. The results of this study highlight the importance of looking for associated co-morbidities in children with asthma.

Table 6: Family history versus severity of asthma (n=100).

Family history	Non-severe asthma	Severe asthma patients	Total
None	19	0	19
Asthma only	26	0	26
Allergic rhinitis only	9	4	13
Atopy only	11	0	11
Asthma+allergic rhinitis	4	0	4
Asthma+atopy	11	1	12
Allergic rhinitis+atopy	9	1	10
Asthma+allergic rhinitis+atopy	5	0	5
Total	94	6	100

Also, a statistical analysis to identify relationship between severity of asthma and the anthropometric measurements was conducted and there was no positive relationship between them.

Table 7: Distribution of asthmatic children based on their socio-economic status.

Socio economic status	No. of patients
Lower	34
Lower middle	26
Upper lower	21
Upper middle	19
Total	100

DISCUSSION

In study, 50% children were of normal BMI. 28% were overweight and 22% were of underweight. Compared the BMI status of the children with severe and non-severe asthma. In this study 39 of patients were in intermittent asthma group. Among the intermittent group, 10 patients were in >85th centile group. In mild persistent group out of a total of 33 patients, 9 patients have BMI >85th centile. In moderate persistent group out of 22 patients 7 were overweight, and in severe asthma group among the 6 patients, 2 were overweight. 27.6% (26 out of 94) of the non-severe asthmatics were overweight as compared to 33.3% (2 out of 6) of the severe asthma. The difference in the proportion of children who were overweight between the two groups was not significant.

The majority of asthmatic children (50%) in this study were of normal BMI. There was no significant difference in the proportion of children who were either underweight or overweight with severe asthma as compared to children with non-severe asthma (Table 4). No correlation was found between BMI and severity of asthma.

Arbes et al in their study found that male sex is a risk factor for asthma.¹² In this study also there was a male preponderance. Of this study groups, 48% were born preterm. However, there was no statistically significant association between prematurity and asthma. Escobar et

al, using a large cohort from Kaiser Permanente, did find a statistically significant association between late prematurity and recurrent wheeze in third year of life.¹³

In this study, 28% had history of respiratory distress in newborn period. In a community-based study done in London by Dezateux et al confirmed that impaired premorbid airway function precedes and predicts wheezing in the first year. In this study, among 100 children with asthma, 27% had low birth weight. According to a meta-analysis of Auckland University, children with birth weight lower than 2.5 kg carried a higher risk of developing asthma symptoms in age group 6-7 years.¹⁴ In a cross-sectional study, done in Japan, they studied the relationship between asthma and history of preterm birth/low birthweight. There were no significant associations between LBW, preterm birth, or SGA and the prevalence of wheeze, asthma, eczema.¹⁵ These findings were similar to this study. In study, asthma incidence was less in low birth weight group.

In this study 67% children who are exclusively breastfed developed asthma. Breastfeeding is widely advocated to reduce risk of atopy and asthma, but the evidence for such an effect is conflicting. In a study done by Oddy et al in West Australia found out that exclusive breastfeeding has protection from asthma.¹⁶ Another longitudinal study done in New Zealand by Sears et al found that breastfeeding does not protect children against atopy and asthma and may even increase the risk.¹⁷ Most of the findings in this study were comparable with previous studies. In this study, 39% had mild intermittent, 33% had mild persistent, 22% had moderate persistent and 6% had severe persistent asthma. Intermittent, mild persistent and moderate persistent were grouped together as non-severe asthma.

In this study 53% had history of atopy which is similar to study done by Schachter et al.¹⁸ A study done by Chris et al about the natural history of atopic dermatitis and its association with other allergic conditions, concluded that infants at high risk of asthma were at increased risk for early-onset persistent AD.¹⁹ In this study, 47% had family history of asthma and 38% had family history of atopy.

Family history of allergic rhinitis was seen in 32%. In a study done by Tiebin et al in USA assessed the association between family history of asthma and prevalence of asthma. In their study they divided respondents in to three high, moderate and average based on degree of closeness of relatives. In this study they concluded that family history is an important riskfactor.²⁰

The relation between socioeconomic status and asthma in adults is not well understood. Studies have shown increased asthma severity in low social class groups.²¹ In this study more asthmatics were in lower socioeconomic class (34%), compared to 19% in upper middle, 21% in upper lower and 26% in lower middle. There was statistically significant association between severity of asthma and socio-economic status indicated by increased prevalence of asthma in low socio-economic status. This is similar to the study by Aggarwal et al.²²

In this study 46% of the study population had pets in family. Mandhane et al provides further evidence that exposure to the most common pets, cats and dogs, lowers the risk of developing allergic sensitization, not only in children but also in young adults.²³

A history of exposure to tobacco smoke was observed in 43% of asthmatic children in this study. Carta et al reports the significant role of tobacco smoking, active and passive, particularly if derived from maternal smoking during pregnancy, in increasing the prevalence of respiratory disorders and lowering lung function in children.²⁴ Children who were not exposed to second hand smoke also had fewer days requiring quick relievers and were less likely to have 3 or more acute care visits for asthma.²⁵ There was no statistically significant correlation between exposure to cigarette smoke and severity of asthma in this study.

The limitations of this study include the limited sample size and the narrow age group of the participants which was actually designed so to get a uniform study group. The power of the study was not adequate enough to give conclusive evidence on the relationship between severity of asthma and the BMI. Majority of patients are in lower socioeconomic class, which also contribute to low BMI. A case-control study with a larger number of subjects would be beneficial in a developing country like India where underweight is still a bigger threat than obesity.

CONCLUSION

Most of the studies about asthma were undertaken in developed societies of western countries and their findings may not be applicable in a country like India where majority of population belongs to lower socioeconomic status. No conclusive evidence was obtained on the association of BMI with asthma in the present study. A community-based case control study is needed. Asthma was found to be more prevalent with children who were exclusively breastfed than those who

were not. More studies need to be done to evaluate factors responsible for this. Children with early exposure to pets were found to have low incidence of asthma, probably due to early sensitization, however more studies are needed in this aspect. More awareness about asthma and its risk factors are needed even at the level of primary care. Children with risk factors are to be kept under regular follow up.

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