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Co-Relation of Body Mass Index with the Prevalence and Severity of Asthma in Urban Children Aged 7-12 Years

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Abstract

A cross-sectional study was undertaken to assess the co-relation of BMI with the prevalence and severity of asthma in 23 school children aged 9.13 2.20 and the BMI of 16.27 3.11. Automated spirometer was used to assess the lung function tests of the children. We used mainly PEF as a guideline to make the diagnosis of asthmatic or non-asthmatic based on the spirometric results. Reversibility of airway obstruction was done by repeating spirometry after two puffs of salbutamol inhaler. The results indicate that BMI, which is a measure of body fat, has a strong co-relation with the lung function tests. A significant decrease was observed in the values of Pre-PEFR and FEV1 with an increasing BMI indicating that body fat has a bearing on the severity of asthma (p=0.001). No significant relationship was identified between % FEV1 and BMI. Per-PEFR showed a trend towards becoming significant (p=0.187). This study supports the view that there is a definite trend co-relating severity of asthma symptoms and body weight.

Keywords: BMI; Asthma; Spirometry; PEFR; % FEV_1; Salbutamol; Lung function test

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Introduction

The incidence of asthma especially acute, moderate to severe has increased since the last decade in children [1]. Prevalence in Bangalore in India has increased from 9 % in 1979 to 29.5% in 1999 [2]. The last two decades have also demonstrated increase in obesity and decreased activities in children[3]. Obesity is a definite risk factor for asthma [4,5] but it is unclear whether body weight affects the risk of incident childhood asthma.

Obesity leads to alterations in respiratory mechanics, airway resistance, pattern of breathing, respiratory drive, and gas exchange. In developed nations, the increase in prevalence of childhood asthma has been paralleled by an increase in childhood obesity [6,7]. Obesity has been recognized as a significant factor contributing to the prevalence and severity of asthma in children [8,9]. However, there is a need to study their association in the Indian context.

Need for the study

Studies conducted among children, have produced conflicting results thus far, and further elucidation is necessary of how an association between asthma and body mass index (BMI) may differ by population characteristics, such as age, gender, and race/ethnicity. In addition, many studies among children have failed to assess the potential effect across the full range of BMI percentiles, including those who are underweight [8].

Studies have been conducted amongst children to co-relate BMI and asthma. Some of the important ones are:

- Kwon HL et al. [10] conducted a cross-sectional study to co-relate BMI and asthma. They were able to demonstrate an association between BMI percentile and asthma among children 2–11 years in Central Harlem.
- Peter F Belamarich et al. [11] tested whether obesity is associated with decreased peak expiratory flow rates (PEFR), increased asthma symptoms, and increased health service use.
- Vargas PA et al. also conducted a study which was more clinically based. They concluded that having an increased BMI was associated with more asthma morbidity. Data suggest that an increased BMI significantly affects the well-being of young asthmatic patients and should be further addressed.
- A study conducted by Luder E et al. [12] also helped establish this co-relation. The prevalence of overweight was significantly higher in children with moderate to severe asthma.

BMI as a measure of body fat and obesity in children

BMI has been found to be a sensitive indicator for obesity [13]. It can be used to categorize the normal, overweight and obese as done by Kwon HL et al. [10], Peter F Belamarich et al. [13] and Wendy H Oddy et al.

Aims and Objectives

To co-relate BMI with the prevalence and severity of asthma in children aged 7-12 yrs.

Materials and Methods

Details of the study

Study Design-A cross-sectional study

Study Site - The study was conducted in 2 urban schools in Bengaluru

Duration of Study - 2 months (July 2009 to September 2009)

Sample size-800 school children in the age group 7-12 were screened for asthma

Screening tools-The parent-filled ISAAC core questionnaire for wheezing and asthma. The questions were designed to elicit the relevant history from the parents which would help us make a preliminary diagnosis of asthma based on the inclusion criteria stated below.

Inclusion criteria

- Children aged 7-12 yrs
- History of recent wheeze
- History of recent asthma

Exclusion criteria

- History of recent respiratory infection
- History of any acute or chronic significant illnesses

Method of obtaining data

Questionnaires

800 school children in the age group of 7-12 years in 3 urban schools were screened. Each child was given a questionnaire along with a separate letter to the parents seeking their consent to include their child in the study along with all the information regarding the study.

The completed questionnaires were then assessed and based on the inclusion and exclusion criteria; a group of 23 students were identified their anthropometrical measurements were taken and BMI was determined. Their Pulmonary Function Tests were conducted using spirometry.

Analysis of the data

The diagnosis was made using the GINA (Global Initiative for Asthma) criteria [14].

We used mainly PEF as a guideline to make the diagnosis of asthmatic or non-asthmatic based on the spirometric results.

Reversibility

Reversibility of airway obstruction was done by repeating spirometry after two puffs of bronchodilator. Here, we used salbutamol as inhaler (2 puffs) and repeated the test after 15 min [15]. 'Significant' reversibility is defined as an improvement of 15 % or more and 200 ml or more in $FEV_{1.}$

Study Design

A Cross-sectional study consisting of 23 asthmatic children is undertaken to study the correlation between asthma and BMI [16].

A total of 755 aged 7-12 years who were students of 2 urban schools were screened using the ISAAC questionnaire. 734 questionnaires were returned with consent. Based on the questions answered, 42 were identified to be asthmatic. After spirometry, 23 were diagnosed to be asthmatic based on the GINA guidelines. Their anthropometric measurements were taken as described previously [17,18].

From the **Table 1**, we can conclude that there is a strong co-relation between BMI and Pre-PEFR as well as BMI and FEV1 **(Figures 1 and 2)**.

From the **Table 2**, it is clear that it is possible to predict the values of PEFR and FEV1 using BMI and age. However the accuracy is 47.7 % and 27.7 % respectively. The two sets of values however have a moderately significant relationship when it comes to predicting the same **Table 3**.

Statistical software

The Statistical software namely SPSS 15.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Table 1 Comparison of study parameters according to BMI.

Study parameters	BMI (kg/m²)				P value
	11-15	16-20	>20	Total	
Pre-PEFR	208.88 ± 54.42	152.60 ± 34.04	97.50 ± 25.0	165.04 ± 57.64	0.001**
Per-PEFR	69.55 ± 8.81	67.76 ± 12.01	55.40 ± 20.96	66.31 ± 13.19	0.187
FEV1	0.98 ± 0.25	0.75 ± 0.18	0.59 ± 0.22	0.81 ± 0.25	0.015*
% FEV1	53.02 ± 12.27	51.06 ± 9.23	46.38 ± 22.47	51.01 ± 12.80	0.709

Pre- PEFR = The PEFR before administering the bronchodilator
FEV1 = The FEV1 before administering the bronchodilator
The expected values are generated by the automated spirometer based on the age and height of each subject

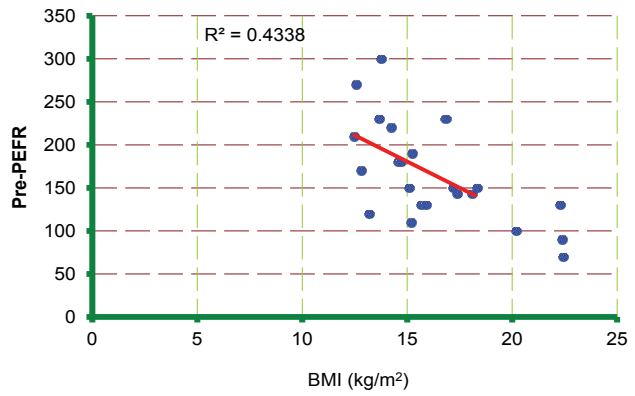

Figure 1 This graph indicates that there is a strongly significant relationship between Pre-PEFR and BMI (p=0.001**). The co-relation co-efficient (r = 0.659) indicates a large co-relation.

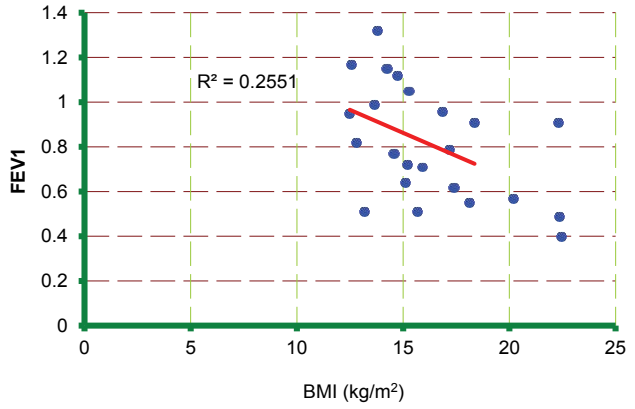

Figure 2 Looking at the above graphs we can conclude that there is a moderately significant relationship between BMI and FEV1 (p=0.014*). The co-relation co-efficient (r = 0.505) indicates a large co-relation between the two values.

Table 2 Pearson correlation of BMI and Spirometry parameters.

PAIR	r value	P value
BMI vs Pre-PEFR	-0.659	0.001**
BMI vs FEV1	-0.505	0.014*

Table 3 Regression analysis to correlate age and BMI to predict PEFR and FEV1.

Sl No	Prediction equation	R^2	Significance
1	Pre-PEFR=5.457*Age-11.785*BMI+307.08	47.7	F=9.113;P=0.002**
2	FEV1=0.017*Age-0.040*BMI+1.302	27.7	F=3.834;P=0.039*

Discussion

The results indicate that a significant decrease was observed in the values of Pre-PEFR and FEV_1 with an increasing BMI indicating that body fat has a bearing on the severity of asthma. However, percentage FEV_1 and Per-PEFR are more accurate to obtain a comparison as they take into account the expected values of FEV_1 and PEFR generated based on the age, race, gender and height of the child. No significant relationship was identified between percentage FEV_1 and BMI. Per-PEFR showed a trend towards becoming significant (p=0.187).

One of the limitations of the study is the small sample size. Of the 755 students screened, only 23 were identified as asthmatic, first based on ISAAC questionnaire which has a low sensitivity, and then further filtered based on GINA guidelines. As the initial diagnosis is based on parent-reported details, some amount of discrepancy may have crept in.

Thus, we can conclude that BMI has a definite bearing on the symptoms of asthma. However, the basis of this relationship is still unclear. Moreover, this relationship is not absolute as there is no significant relationship with percent FEV_1 and only a trend with Per-PEFR.

A gender-based co-relation is also required.

Conclusion

This study has demonstrated that there is a definite trend co-relating severity of asthma symptoms and body weight. A longitudinal study is required to monitor the variation in severity of the symptoms with loss in weight. This would provide more conclusive proof towards relationship of BMI and severity of asthma.

As mentioned before, other markers of asthma severity need to be analyzed along with BMI. There is a lot of scope of further research on this topic. The role of body fat needs to be analyzed in detail, its role in production of inflammatory substances needs to be evaluated, apart from the mechanical effects on lung volume and dyspnea related to excess weight. Other modalities of body fat measurement such as skin-fold thickness and the calculation of percentage body fat can be undertaken to conclusively determine the role of body fat in asthma.

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