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RESEARCH ARTICLE

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A comparative study of clinical profile and symptom control in overweight and normal weight school-age children with mild persistent asthma

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Abstract

Objectives: To find out the proportion of children with poor symptom control in overweight/obese and normal weight children with mild persistent asthma and to know the sociodemographic and clinical correlates of poor symptom control in them.

Materials and Methods: Children aged 6 to 12 years with mild persistent asthma with BMI *Z* score for age and sex more than +1 *Z* score on WHO BMI *Z* score chart for age and sex formed the cases. Age- and sex-matched asthmatics with BMI *Z* score for age and sex between −2 *Z* and +1 *Z* score formed the controls. FEV1, FEV1/FVC were measured in both groups using Care Fusion Jaeger spirometer. Symptom control was assessed by ACT score. Statistical analysis was done using SPSS version 19 and Vassarstats.

Results: The proportion of children with poor control was 19.1% in the overweight/obese group and 23.4% in the normal weight group. There was no significant correlation between BMI and symptom control as assessed by the ACT score. Overweight/obese children with good control showed a slightly lower FEV1/FVC ratio and higher median eosinophil count compared to children with normal weight. Gastroesophageal reflux and allergic rhinitis were more commonly seen in overweight/obese children. In the poor control group, FEV1, FEV1/FVC, and median eosinophil counts were not significantly different between overweight/obese and normal weight group but were less when compared to good control group.

Conclusion: The proportion of poor symptom control was not high in overweight/obese asthmatic children compared to normal weight asthmatic children. No significant risk factors for poor symptom control could be identified in our study for either of the groups.

KEYWORDS

asthma, child, obesity, overweight, symptom control

1 | INTRODUCTION

Bronchial asthma is the most common noncommunicable disease and chronic respiratory disorder in children.[1] The increasing prevalence of asthma also parallels the rising prevalence of overweight and obesity. Recent studies indicate that a substantial subgroup of children with asthma are also at risk of being overweight/obese and conversely children with overweight/obesity are more likely to present with symptomatic asthma compared to healthy controls.[2] It is also being recognized as one of the common comorbidities associated with severe asthma.[3] According to recent studies among adults, obese asthmatics have been found to have lower disease control and increased symptom severity due to several factors like genetics, mechanical restriction of the chest, adipokines, and leptin.[4] There has been a dearth of studies related to asthma in obese and overweight Indian children. Asthmatic children with overweight constitute a unique "at risk" population for two reasons. If symptom control is inadequate in them, there may be a tendency to escalate therapy and therapy-related weight gain that can quickly progress to obesity. Poor symptom control could also result in decreased physical exertion, which could lead to more weight gain. Hence it is necessary to know the level of symptom control in children with overweight and factors that predict poor symptom control in such children so that these children can be monitored with the tailoring of therapy to achieve good control and at the same time prevent obesity.

2 | OBJECTIVES

To compare the level of symptom control in overweight/obese children with that of normal weight school-aged children with mild persistent asthma. To find out the proportion of children with poor symptom control in the above groups and to know the sociodemographic and clinical correlates of poor symptom control in them.

3 | MATERIALS AND METHODS

This cross-sectional comparative study was conducted in the Department of Pediatrics, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Pondicherry between August 1, 2015 and April 30, 2017. This study was approved by the JIPMER postgraduate research monitoring committee and informed consent was obtained from parents. Children (6-12 years of age) with mild persistent asthma diagnosed based on global initiative for asthma GINA guideline with BMI *Z* score for age and sex more than +1 SD score on WHO BMI *Z* score chart for age and sex and who are on recent follow-up for a minimum period of 3 months consecutively at the childhood asthma clinic were categorized as group A. Age- and sex-matched controls with BMI *Z* score for age and sex between −2 SD and +1 SD score with mild persistent asthma and on follow-up for a similar period were categorized as group B. Children with clinical features suggestive of endogenous obesity (onset of obesity in infancy, lack of satiety, poor linear growth or short stature, dysmorphic features, developmental delay, or cognitive dysfunction), children with incomplete data, children not accompanied by at least one responsible parent, children unable to perform a satisfactory spirometry were excluded from the study.

Assuming the proportion of obese asthmatics with poor control to be 0.61 compared to 0.38 in nonobese asthmatics (based on the literature review),[5] with a confidence interval of 0.95, power of 0.8, and 1:1 cases and controls, and one-sided tail, the sample required for each group would be 66. But we were able to recruit only 47 cases and controls due to lack of adequate number of overweight/obese children under follow-up.

In the above groups, history was obtained using allergy asthma case sheet exploring nature of symptoms, duration of symptoms, parental atopy, comorbidity, family history, socioeconomic history, and medication history. A brief and relevant general examination and examination of respiratory system were carried out. Forced expiratory volume in 1 second was measured in both groups using Care Fusion Jaeger spirometer according to American Thoracic Society guidelines for reproducibility. The treatment details of the child were noted, and symptom control was assessed using asthma control test (for children 4-11 years and for teens 12 years and older) questionnaire and symptom diary based on symptoms in the past 4 weeks. Good asthma control was defined as ACT score ≥ 20. Compliance to therapy and inhaler technique was noted and scored as good compliance if the child had taken medicines for more than 80% of the time and good technique if the child scores 5 out of 5 on inhaler device assessment tool (developed by the Nursing Best Practice Research Unit, University of Canada, Ottawa), which was modified in our study to assess the use of rotahaler. This is an observation tool, and the assessment was done by the first author for all patients to ensure uniformity.

Chi-square test was conducted for categorical variables (BMI based weight groups, level of asthma control, compliance to therapy, and technique of device use). Student *t* test or Wilcoxon test were used for variables that were normally and nonnormally distributed (FEV1, duration of illness, duration of treatment, and BMI), respectively. Linear correlation was used to assess symptom control and BMI as well as BMI and FEV1. Odds ratio was used for assessing the factors affecting symptom control and expressed with 95% confidence intervals. Regression analysis was not performed as none of the factors were found to significantly predict symptom control.

All the abovementioned parameters and tests were performed both in the case and control group and were systematically recorded in Microsoft excel 2010, and the statistical analysis was done at the end of the study period using Statistical Package for Social Sciences (SPSS) version 19 and Vassarstats.

4 | RESULTS

The total number of children assessed to be eligible for recruitment in the study was 115. Out of the 115 children, 15 children were

excluded due to current upper respiratory tract infections and acute asthma exacerbations. After performing PFT, six children were found to have poor reproducibility and were excluded from the study. Therefore, a total of 94 children were recruited in the study with 47 in each arm (Figure 1). The general characteristics of our study population are given in Table 1. Our study population consisted of predominantly males drawn from rural areas. The Median BMI was 21.77 in overweight/obese group and 15.37 in normal weight group. Overweight/obese children belonged to upper middle and upper lower social class predominantly, whereas normal weight children predominantly belonged to lower middle and upper lower social class. Parental atopy was found in equal proportions among overweight/obese and normal weight children with asthma. More children in the overweight/obese group reported disease onset beyond 6 years of age. Almost all children in the overweight/obese group showed good compliance to therapy. Gastroesophageal reflux was significantly more in children with overweight/obese compared to children with normal weight (Table 1). The proportion of children with poor control was 19.1% in the overweight/obese group and 23.4% in the normal weight group (Table 2). Overweight/obese children with good control showed a slightly lower FEV1/FVC ratio compared to children with normal weight. The FEV1 values were almost the same in both groups. Overweight/obese children also had a slightly higher median eosinophil count compared to children with normal weight. In the poor control group, FEV1, FEV1/FVC, and median eosinophil counts were not significantly different between overweight/obese and normal weight group but were less when compared to good control group. Compliance was generally good (>80% in both groups) but almost all children in the overweight group had good compliance (97.87%), the difference being statistically significant. Mean treatment duration was significantly more in normal children with poor control compared to overweight/obese children with poor control. There was no correlation between either BMI and FEV1 (R^2 = 0.0033), or the BMI and ACT score (R^2 = 0.0005). There were no significant factors associated with poor control in overweight as well as the normal weight group (Tables 3 and 4).

5 | DISCUSSION

Most participants in our study were males. This finding is similar to other studies on asthmatics, most of which had higher number of male participants. A study conducted by Shaaban et al[6] also reported asthma to be more common in boys and this can be attributed to the narrower airway and increased airway tone in boys. The children included in our study were mostly from rural background in both cases and control and there was no significant difference in the place of residence. This is in accordance with the study by Yawn et al[7] who reported a higher incidence of asthma in rural background and attributed it to the greater exposure of allergens from seasonal crops, wild flowers, and weed growth in rural areas.

Most children were from upper lower (Kuppuswamy class IV) socioeconomic status. This is in accordance with a recent meta-analysis of published studies on socioeconomic status and asthma in which it was found that lower socioeconomic status was associated with higher prevalence of asthma.[8] The higher compliance seen in overweight/obese group in our study might be responsible for the increased weight gain in our study group but, as this was a cross-sectional study, the direction of causality could not be commented upon.

In our study, the ACT score was used to assess symptom control. Few studies have reported poor asthma control in children with overweight/obesity.[9,10] However, in our study, we could not demonstrate significant correlation between BMI and symptom control as assessed

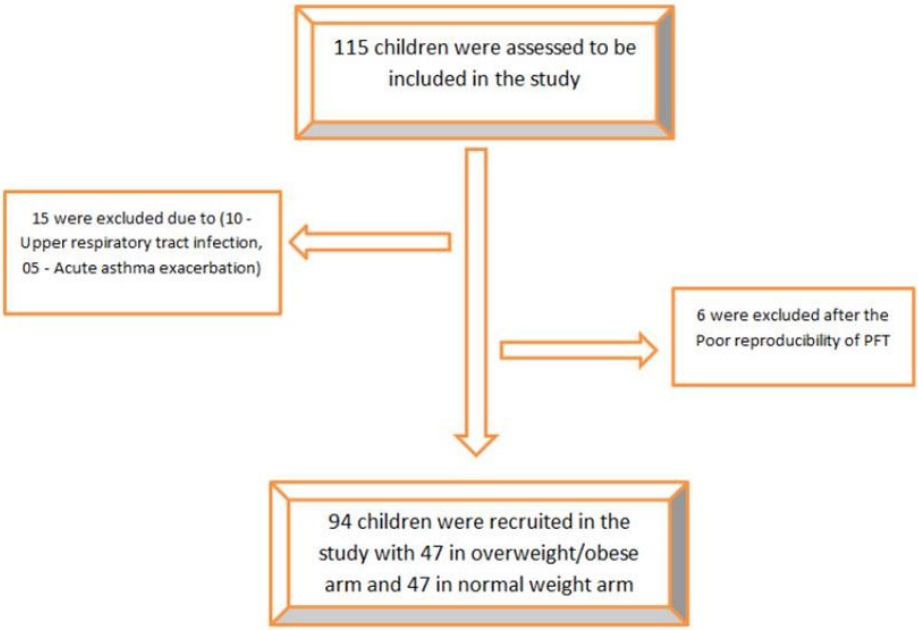

FIGURE 1 STROBE flowchart depicting the inflow of study subjects into the study

TABLE 1 Distribution of disease/treatment related factors affecting symptom control in study groups

S. No.	Factors		Overweight/Obese (*n* = 47)	Normal (*n* = 47)	*P* value (chi-square test)
1.	Disease onset	<3 years	9(19.1)	19(40.4)	.067
		3-6 years	11(23.4)	10(21.2)	
		>6 years	27(57.4)	18(39.2)	
2.	Mean Rx duration (years)		1.88 ± 2.3	1.99 ± 2.2	.795[a]
3.	Drugs used	ICS	43(91.5)	46(97.8)	.17
		ICS + montelukast	4(8.5)	1(2.1)	
4.	Compliance to therapy	Good	46(97.9)	38(80.9)	.007
		Poor	1(2.1)	9(19.2)	
5.	Device technique	Good	33(70.2)	31(65.9)	.658
		Poor	14(29.8)	16(34.0)	
6.	Comorbidities	None	28(59.6)	38(80.9)	.033
		AR/rhinosinusitis	12(17.0)	8(17.0)	
		GER	7(14.8)	1(2.1)	

[a]*P* value is calculated using Wilcoxon rank sum test.

TABLE 2 Comparison of symptom control in the study groups

Symptom control	Overweight/Obese (*n* = 47)	Normal weight (*n* = 47)	*P* value[a]
Good control (ACT ≥ 20)	38	36	.25
Poor control (ACT < 20)	9	11	.065

[a]*P* value calculated using chi-square test.

TABLE 3 Odds ratio for selective variables associated with poor control in overweight/obese group

			Poor control			
S. No.	Variables		Yes (*n* = 9)	No (*n* = 38)	Odds ratio (95% confidence interval)	*P* value
1	Male sex	Yes	6	28	0.7 (0.1-3.4)	.69
		No	3	10		
2	Rural	Yes	7	25	1.8 (0.3-10.0)	.69
		No	2	13		
3	UL social class and below	Yes	5	12	2.7 (0.6-11.9)	.25
		No	4	26		
4	Atopy	Yes	3	18	0.6 (0.1-2.6)	.48
		No	6	20		
5	Disease onset >6 years	Yes	5	22	0.9 (0.2-3.9)	1
		No	4	16		
6	Good compliance	Yes	8	38	0	.19
		No	1	0		
7	Appropriate technique	Yes	5	28	0.4 (0.1-2)	.41
		No	4	10		
8	Comorbidities	Yes	4	15	1.2 (0.3-5.3)	1
		No	5	23		

by the ACT score. Like ours, few other studies also could not find any significant correlation between symptom control and overweight/obese status of the children.[11,12] The lung function tests performed in our study population revealed a mean FEV1 (% of predicted) of around 75% in both groups of children with good control. This relates to the mild obstructive lung dysfunction in our study population. For those kids with poor control, the mean FEV1 (% of predicted) was around 67% in both the groups. Several studies on well-phenotyped pediatric cohorts have also found very little difference in symptom control between overweight/obese and normal weight children with

TABLE 4 Odds ratio for selective variables associated with poor control in normal weight group

S. No.	Variables		Poor control		Odds ratio (95% confidence interval)	*P* value
			Yes (*n* = 11)	No (*n* = 36)		
1	Male sex	Yes	7	27	0.6(0.1-2.5)	.70
		No	4	9		
2	Rural	Yes	9	25	1.9 (0.4-10.7)	.48
		No	2	11		
3	UL social class and below	Yes	10	22	6.4 (0.7-55)	.07
		No	1	14		
4	Atopy	Yes	4	16	0.7 (0.1-2.9)	.73
		No	7	20		
5	Disease onset >6 years	Yes	4	14	0.9 (0.2-3.6)	1
		No	7	22		
6	Good compliance	Yes	9	29	1.1 (0.2-6.2)	1
		No	2	7		
7	Appropriate technique	Yes	6	25	0.5 (0.1-2.1)	.47
		No	5	11		
8	Comorbidities	Yes	1	8	0.4 (0.0-3.2)	.35
		No	10	28		

asthma.[13-16] In our study, most children were on inhaled corticosteroids in both groups. There was no significant difference in symptom control based on drugs that were administered to overweight/obese or normal weight groups. This is in contrast to other studies in which a blunted response to ICS has been found in overweight/obese asthmatic children compared to normal weight children with asthma.[17,18]

6 | STRENGHTS AND LIMITATIONS AND IMPLICATIONS FOR FUTURE STUDIES

To the best of our knowledge, ours is the first Indian study that had compared symptom control in overweight/obese and normal weight asthmatic children. However, the results of this study must be interpreted with caution as our study is underpowered due to inability to recruit more overweight/obese children. Further studies are needed with adequate sample size to find out whether the lack of significant difference in the proportion of poorly controlled asthma in overweight/obese children is realistic or not. The results of our study have implications to plan future longitudinal studies that can look at interventions that limit excessive weight gain like physical exercise, dietary intervention, or pharmacological measures that promote good symptom control with minimal weight gain.

7 | CONCLUSIONS

The proportion of poor symptom control in overweight/obese children with mild persistent asthma is not significantly different when compared to normal weight children with mild persistent asthma as assessed by the ACT score and lung function measurements. No significant risk factors for poor symptom control could be identified in both overweight/obese group as well as normal weight group in our study.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Conceptualization: Sharmila Manivannan, Venkatesh Chandrasekaran
Formal analysis: Sharmila Manivannan, Venkatesh Chandrasekaran
Investigation: Sharmila Manivannan, Venkatesh Chandrasekaran, Nandheeswari Subramanian
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Writing - review and editing: Sharmila Manivannan, Venkatesh Chandrasekaran, Nandheeswari Subramanian

All authors have read and approved the final version of the manuscript.

The corresponding author, Venkatesh Chandrasekaran, had full access to all of the data in this study and takes complete responsibility for the integrity of the data and the accuracy of the data analysis.

TRANSPARENCY STATEMENT

The corresponding author, Venkatesh Chandrasekaran, affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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