

Prevalence of Asthma and Sleep-Related Breathing Disorder in School-Going Children

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Abstract

Objective: The main objective of the study was to determine the prevalence of asthma and sleep-related breathing disorder (SRBD) in school-going children. **Methods:** This school-based, cross-sectional study was conducted among children of age groups of 6–7 and 13–14 years from 31 public and private schools in rural and urban areas of Jodhpur. A pretested and validated questionnaire in Hindi for childhood asthma, International Study of Asthma and Allergies in Childhood questionnaire and 22-item pediatric SRBD scale were used to collect data. **Results:** A total of 2245 children were screened for asthma and SRBD. The overall prevalence of asthma and SRBD in school children in Jodhpur was 8.0% (95% confidence interval [CI]: 6.9%–9.2%) and 9.5% (95% CI: 8.4–10.8), respectively. Asthma was found to be significantly associated with SRBD in school-going children in Jodhpur (odds ratio: 4.8; 95% CI: 3.3–6.8) on multiple logistic regression analysis. **Conclusion:** There is a significantly high prevalence of asthma and SRBD with a good association between them in school-going children.

Keywords: Asthma, International Study of Asthma and Allergies in Childhood, sleep-related breathing disorder, children

INTRODUCTION

Asthma is one of the most common non-communicable diseases of childhood characterized by recurrent attacks of wheezing, breathlessness, chest tightness, or coughing with varying frequency and intensity. The global prevalence of asthma in children is increasing due to urbanization, air pollution, and environmental tobacco smoke.^[1] The prevalence of asthma has a wide variation in various geographical areas of India, ranging from as low as 2.4% to as high as 29.9%.^[2–6]

Sleep-related breathing disorder (SRBD) is characterized by a spectrum of habitual snoring, upper airway resistance syndrome, obesity hypoventilation, obstructive sleep apnea (OSA), and central sleep apnea. The global prevalence of SRBD in the pediatric population ranges from 1% to 11%.^[7,8] Around 30%–40% of asthmatic children tend to have SRBD, and children with poorly controlled asthma are more likely to have these disorders. Sleep-related factors such as supine posture, nocturnal increase in airway inflammation and bronchial responsiveness, and higher airway resistance

cause worsening of nocturnal symptoms in asthmatic children.^[9,10]

Both asthma and SRBD have nocturnal symptoms and airway obstruction. Both of these conditions cause daytime sleepiness, tiredness, reduced activity level, poor academic performance, school and work absenteeism, and impaired quality of life in children. They are often underdiagnosed and undertreated. These conditions are responsible for significant social and economic impact and should be diagnosed early and treated promptly.^[11,12]

There is a paucity of studies on the prevalence of asthma and SRBD and their association. Therefore, this study was undertaken to determine the prevalence of asthma and SRBD and association between them.

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METHODS

It was a school-based, cross-sectional study conducted from March 1, 2019, to May 31, 2019, in the urban and rural areas of Jodhpur. The study participants comprised children of age groups of 6–7 and 13–14 years from 31 public and private schools in rural and urban areas of Jodhpur. Schools were selected by simple random sampling but were stratified with disproportionate allocation between urban and rural areas. After contacting the head of the school, the purpose of the study was explained and after seeking permission, the school was included.

The sample size was estimated for an infinite population using the formula: $N = Z^2 PQ/l^2$ where $Z = 1.96$, $P =$ prevalence, $Q = 100 - P$, and $l =$ precision. Considering the prevalence of asthma 5% in Jodhpur^[2] and required precision was set at 20%, the sample size was estimated to be 1822. After adding nonresponse to 10%, an additional 200 children were included. Thus, a minimum of 2000 children were required for this study.

Pretested questionnaires were used for collecting the data: the Hindi version of the International Study of Asthma and Allergies in Childhood (ISAAC) for asthma and a 22-item pediatric SRBD scale for sleep disorders.^[12,13] The questionnaires were used after taking due permission from the concerned authority.

The ISAAC questionnaire consists of eight and nine core questions on asthma for ages 13–14 and 6–7 years, respectively. The presence of a wheeze in the past 12 months (i.e., current wheeze) was defined as asthma, according to the questionnaire. Participants with severe asthma were defined as asthmatics with more than four episodes of wheezing in the past 12 months, more than one night of sleep disturbed by wheezing, or speech affected by wheezing according to the questionnaire.

The SRBD scale consists of three subscales on snoring, sleepiness, and attention or hyperactivity. It is a 22-item scale related to sleep problems. Parents respond to the questions in this scale as “yes = 1,” “no = 0,” or “don’t know = missing.” The mean response from nonmissing items is calculated, which ranges from 0 to 1. A score >0.33 has been considered useful in screening children for pediatric SRBD.^[14]

The questionnaires were distributed in each class with the help of a class representative and teacher after explained to the students beforehand. Parents of 6–7 years of children completed the questionnaire, whereas children of 13–14 years themselves completed the questionnaire. All anthropometric measurements were taken in the school using the standard method by the first investigator with the help of school teachers.

Ethical approval was taken from the Institutional Ethics Committee, AIIMS, Jodhpur. Permission was also taken from the district education officer for conducting the study in government schools and from the administration of various private schools of urban and rural areas of Jodhpur for conducting the study in their schools. Information was obtained after taking written informed consent and assent from the parents and children.

Statistical analysis

Data were entered in Microsoft Excel and analyzed using Statistical package for social science program version 23 (SPSS Inc., NY, USA). The demographic characteristics of the respondents were described according to gender, area, and school. The demographic characteristics of the participants and symptoms related to asthma and SRBD were summarized using frequencies and proportions. A Chi-square test was applied to test the association between asthma and SRBD. Multiple logistic regression was used to determine the association between asthma and SRBD. The results were expressed in the form of an adjusted odds ratio (OR) with a 95% confidence interval (CI). $P < 0.05$ was considered statistically significant.

RESULTS

The parents of 380 children in the age group of 6–7 years and 1865 children in the age group of 13–14 years completed the questionnaires. The demographic data of the respondents are presented in Table 1. The overall prevalence of asthma and SRBD was 8% and 9.5%, respectively, in school-going children in Jodhpur. The prevalence of SRBD in asthmatic children was 29.5%. The proportion of severe asthma was 36.2%.

On univariate analysis, children from rural areas, male gender, and children having sleep disorders were statistically significantly associated with asthma. On multiple logistic regression, the prevalence of asthma was significantly higher among male children as compared to females (10.2% vs. 5.5%, OR: 1.9; 95% CI: 1.91–2.6). The overall prevalence was significantly higher in rural areas as compared to urban areas (11.6% vs. 7.2%, OR: 1.8; 95% CI: 1.3–2.6). On multiple logistic regression analysis, asthma was found to be significantly associated with SRBD (OR: 4.8; 95%

Table 1: Sociodemographic attributes of the total respondents (n=2254)

Variables	6-7 years (n=380) (%)	13-14 years (n=1865) (%)
Gender		
Male	47.9	55.7
Female	52.1	44.3
Area		
Urban	79.8	82.4
Rural	20.2	17.6
Type of school		
Government	36.8	47
Private	63.2	53
Asthma status		
Asthmatic	6.6	8.3
Nonasthmatic	93.4	91.7
SRBD category		
Positive	4.7	10.5
Negative	95.3	89.5
Mean BMI Z score (SD)	-0.9 (1.3)	-0.6 (1.5)

BMI: Body mass index, SRBD: Sleep-related breathing disorder

Table 2: Multiple logistic regression analysis for the association of asthma

Determinants	6-7 years (n=380)			13-14 years (n=1865)			Total (n=2245)		
	aOR	95%CI	P	aOR	95% CI	P	aOR	95%CI	P
Gender (male)	0.5	0.2-1.4	0.20	1.8	1.3-2.7	0.001*	1.9	1.4-2.6	<0.001*
Area (rural)	0.8	0.2-2.5	0.77	2.0	1.3-3.0	<0.001*	1.8	1.3-2.6	0.003*
School (government)	0.5	0.2-1.4	0.24	1.1	0.7-1.5	0.48	1.0	0.7-1.4	0.68
SRBD	6.6	2-21.5	0.02*	4.6	3.1-6.8	<0.001*	4.8	3.3-6.8	<0.001*

*Statistically significant. SRBD: Sleep-related breathing disorder, aOR: Adjusted odds ratio, CI: Confidence interval

CI: 3.3–6.8), male gender (OR: 1.9; 95% CI: 1.4–2.6), and rural area (OR 1.8; 95% CI: 1.3–2.6) [Table 2].

DISCUSSION

In this sizeable school-based survey in western Rajasthan, we found an 8.0% overall prevalence of asthma and a 9.5% prevalence of SRBD in school-going children. The present study reported a significant association of asthma with SRBD.

There are various tools to estimate the prevalence of asthma in children. ISAAC questionnaire for asthma is a validated tool available in multiple languages, including Hindi. We used standard ISAAC questionnaires for screening of asthma, which have been used by many authors in the past, who reported a wide range of asthma prevalence from various parts of India, varying from 2.3% to 22.9%.^[2,3-6]

Phase 3 of the ISAAC study in India reported an overall age-wise prevalence of 5.4% in 6–7 year and 6.1% in 13–14-year age groups, respectively.^[2] However, they reported a lower prevalence (2.4%) of asthma among 6–7-year-old children in Jodhpur, which appears to have increased to 6.5%, as seen in the current study. This may be attributed to the poor air quality due to progressively increasing industrialization and traffic pollution. The WHO Global Ambient Air Quality Database (update 2018) has found the annual mean of concentration of PM_{2.5} and PM₁₀ of Jodhpur to be 180 and 98 µg/m³, respectively, contributing to various lung diseases and heart diseases.^[15]

Asthma was more commonly found among male children in the present study, which mirrors the findings of other authors.^[3-5] They have attributed this male predominance to higher bronchial lability in males.^[16] We found a significantly higher prevalence of asthma in rural areas of Jodhpur. Many authors in the past had reported a similar higher prevalence in rural areas in India and worldwide. Due to less forest cover, the rural areas of Jodhpur are more dry and dusty, and the frequent sand storms in the desert area further worsen the situation. This fact is supported by a study conducted in Toyama, Japan, where the researchers found that massive dust events during dust storms in the desert areas were significantly associated with the increased risk of hospital admission for children with asthma.^[17] The presence of mining industries in the rural areas of Jodhpur exposes the residents to fine dust and predisposes them to chronic respiratory diseases. These factors might be responsible for

a significantly higher prevalence of asthma in rural areas observed in our study.

SRBD is an emerging condition in asthmatic children. There are many questionnaires available for the screening of SRBD in children. SRBD scale, which is a subset of the Pediatric Sleep Questionnaire, is validated and available in Hindi. In this study, we used this scale, and the observed prevalence of SRBD was 9.5%, while it was significantly high in asthmatic children. Other studies from different regions of the world also showed a positive association between asthma and SRBD in children. A retrospective cohort study from Taiwan on 305,094 children with asthma and 305,094 without asthma found that the overall incidence rate ratio of OSA was 3.56-fold higher in the asthma cohort than that in the nonasthma cohort.^[18] A large multicentric epidemiological study in China involving 22,478 children aged 5–12 years demonstrated that SRBD was significantly associated with asthma in children (OR = 1.6, 95% CI: 1.4–1.8).^[19] Zandieh *et al.* studied asthma and SRBD in 9565 adolescents and found that adolescents with probable asthma had 2.63 higher odds of reporting SRBD symptoms.^[20] There is a lack of data in India on population-based studies in asthma and SRBD.

The strength of our study was that it was a population-based study in schoolchildren, which determined the prevalence of asthma and SRBD and their association in both rural and urban populations in India using validated questionnaires. The major limitation of this study was pulmonary function tests with bronchodilator reversibility and polysomnography were not performed, which are the gold standard for diagnosis of asthma and SRBD, respectively. Moreover, to study the association between asthma and SRBD, a different study design might be better.

To conclude, asthma is a manageable disease; however, its early identification, especially in the pediatric age group, remains a challenge. School-based surveillance using simple validated tools can add in the early diagnosis and prompt management of cases. The current study provides robust estimates of prevalence and association between asthma and SRBD in urban and rural school children. Future studies are required to confirm this association with extensive epidemiological studies and gold-standard diagnostic tests.

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Conflicts of interest

There are no conflicts of interest.

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