ORIGINAL ARTICLE

Prevalence of bronchial asthma among school-going children in Mangalore, South India

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Abstract

Background: Asthma in childhood is a major public health issue. Objective: To estimate prevalence and associated housing environment factors of asthma among school children. **Material & Methods**: We conducted a cross sectional study among school children aged six to fifteen years. Standard ISAAC (International Study of Asthma and Allergies in Children) Core Questionnaire for Asthma was used for determining the prevalence of wheezing and asthma. Demographic, housing and indoor pollution factors were collected. Data were analyzed by SPSS version 15. **Results**: Prevalence of 'wheeze ever' and 'current wheezers' was 10% and 9% respectively. Physician diagnosed asthma was seen in 6.3 %. Severe asthma was noted in 28.6% of current wheezers' with 84.6% and 8.8% having one to two and four to 12 wheezing attacks per year respectively. Wheezing was present post exercise in 5.4%, nocturnal cough in 6.1%, sleep disturbance less than one night/week (40.7%), one or more nights/week (3.3%) and wheezing limiting speech to few words between breaths (20.9%). Prevalence was greater among boys (9.8%) than girls (7.5%) and maximal in age group eight to nine years. On multiple logistic regression presence of overcrowding and absence of smoke outlet were significantly associated with current wheeze. Socio-economic status, beedi rolling practices and absence of separate kitchen was statistically significant with severe asthma. **Conclusions**: Current wheezer prevalence was9% and more in boys. Adoption of improved housing conditions and avoiding environmental tobacco exposure may aid in reducing childhood asthma attacks in this developing city.

Keywords)

Asthma, Child, Hypersensitivity, Prevalence, Public Health

Introduction

Asthma is one of the most common chronic diseases of childhood (1). Asthma limits child's daily activities including sleep, academics and play. Thus, it is essential to recognize the condition. Inappropriate management may cause life threatening situations.

Asthma currently affects 300 million people in the world (2). Although the prevalence is more in developed countries, the developing countries have a higher total burden of the disease due to differences in population. Estimated burden in India is presumed to be greater than 15 million (1). In 2004, India accounted for 277 disability adjusted life years(DALYs) lost per one lakh population and 57000 deaths. The prevalence of asthma in children in the Indian subcontinent as per the ISSAC study has increased in phase III as compared to phase I by 0.02% per year in age groups 13-14 years and by 0.06% for age groups 6-7 years(3).

Since the 1970s, bronchial asthma prevalence has shown a steady rise and affects an estimated 4 to 7% of the people Worldwide. Childhood bronchial asthma varies widely from country to country. The prevalence ranges from 4 to 32%, at the age of six to seven years and also holds good for ages 13 and 14years (4). In a systematic review of studies on prevalence of asthma among Indian children, the mean prevalence was 7.24 ± SD 5.42. The median prevalence was 4.75% (with IQR = 2.65 – 12.35%) and the childhood asthma among children 13 – 14 years of age was lower than that in younger children (6 – 7 years of age) (1).

Various Indian studies have documented the prevalence of asthma in children to be ranging between 0.2 to 16.6% with recent studies having a prevalence to be higher than what was previously thought of (1).This could probably be due to environment, lifestyle changes and increasing urbanization and industrialization in the developing countries. Urbanization and rapid development processes are occurring in the city of Mangalore, setting it to be one of the future targeted smart cities of the state.

Aim & Objective

To estimate prevalence of asthma among school children

Material & Methods

A cross sectional study was conducted over two months (1/07/2013 to 1/09/2013) in two private schools (both Kannada and English medium), which were non-randomly selected based on convenience of travel, from a list of private schools in Mangalore. Permission was obtained from the Block Education Officer (BEO) and the respective School Authorities, after explaining the details of the study. All children aged between 6 to 15 years, studying in classes I-X, and present in class on the day of distribution, were given the questionnaire and included in the study. Subjects who refused to participate in the study and if they submitted incomplete questionnaires were excluded. International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used to determine the prevalence of bronchial asthma symptoms (3).

Sample size was calculated at 1216 assuming asthma prevalence at 8% (5), at 95% confidence interval (C.I.), 80% power, and 10% non-response rate. ISAAC asthma Core Questionnaire (3) was used for the study. All questionnaires with enclosed informed consent sheets were taken home by the participants. The informed consent form and questionnaire were filled by the parent/guardian for their children. Primary language of the questionnaire was English. However, translated Kannada version of the same questionnaire was given to children who requested the same in case they/their parents had difficulty understanding the English version. The questionnaires in Kannada were translated back into English to ensure reliability and validity. While filling the questionnaires, if any parent had difficulties in understanding and filling the questionnaire, they had been asked to contact author 2 in the study for clarifications. The answered questionnaires were collected within the next three days from the respective class-teachers.

Operational definitions:(6,7)

Wheeze ever: child with symptom of Wheezing / whistling anytime in the past.

Current wheezers: child with symptom of wheezing / whistling in the past 12 months.

Asthma ever: Ever had asthma that is diagnosed by a medical professional / Physician diagnosed asthma at some point.

Severe asthma: Anybody with >4 attacks of wheeze in the past 12 months, or one/ more than one night per week sleep disturbance, or speech limitation because of wheeze in the past 12 months, is categorized as having Severe asthma categories (6,7).

Analysis was done using SPSS (Statistical Package for Social Sciences) version 15. The results were expressed as means of rates and proportions. The prevalence values were compared with socio-economic standings as per modified Kuppuswamy scale (2012) (8). Significant, associations were determined by applying the Chi-square test. Logistic regression analysis was used to determine the

associations between the housing environment and the demographic factors with current wheezing episodes. p value <0.05 was taken as statistically significant. The Institutional Ethics Committee had approved the study.

Results

Of a total of 1216 questionnaires distributed, 1011 responses (83.14% response rate) were included for final analysis. The maximum responses (320, 31.7%) were from the 14-15 years' age group of which majority (653; 64.6%) were males. Majority (960, 95%) belonged to the Hindu religion and 448 (44.3%) were from upper middle class (Table 1). Adverse environmental conditions noted were overcrowding (39.2%), absence of smoke outlet in the kitchen (29%), no separate kitchen (7.8%), practice of beedi rolling by family member(4.1%), and usage of solid fuels like firewood for cooking (3.5%).

Based on the ISAAC Core Questionnaire, the prevalence of Wheeze ever', 'Current wheeze' and 'Asthma ever' were 10%, 9% and 6.3% respectively. Also, among the study participants, 5.4% and 6.1% experienced wheezing after physical activity and had troublesome cough at night in the past 12 months respectively.

Among the current wheezers, severe symptoms were present in 28.6%. Table 2 shows severity of asthma based on responses of current wheezers about their experience on number of attacks, sleep disturbance and compromised speech due to wheezing in the past 12 months.

Among 91 current wheezers, variables such as presence of overcrowding and absence of smoke outlet were found to have a statistically significant association (Table 3). These variables were selected based on risk factors which are responsible for asthma as per review of literature.

Those variables which had p value less than 0.2 in univariate analysis were considered for logistic regression analysis. Using logistic regression model, presence of overcrowding (OR: 1.936; CI: 1.242-3.017), and absence of smoke outlet (OR: 1.967; CI: 1.251-3.091) were found to be statistically significant ($p < 0.05$) (Table 4). When the socioeconomic status III and IV were grouped together, it had adjusted odds ratio of 0.534 indicating the association to be weak even though the p value was significant.

With respect to severe asthma, socioeconomic status, absence of separate kitchen and beedi rolling practice at home were significantly associated (Table 5).

Discussion

Prevalence of asthma varies among different ages and population groups. Pathogenic mechanisms of asthma being intricate, differ in presentation from child to child, and are influenced by innumerable factors, both genetic and environmental.

The prevalence of current wheezing in this study was in agreement with the previous studies showing higher prevalence in urban areas and in the upper socioeconomic class (1,9). In addition, it was higher in males (9.8%) versus 7.5% in females and was in concurrence with previous studies (1, 10,11,12). However, Kumar GS*et al* (13), had found equal prevalence of asthma between both genders.

The prevalence rates of 'Wheeze ever', 'Current Wheeze' and 'Asthma ever' were consistent with study done by Sharma BS*et al* (5).The fact that diagnosed asthma is less than current asthma probably indicates under-diagnosis. Study by Jain A *et al* (10) on rural children had current asthma prevalence of 10.3% and is nearly concurrent with our values, in-spite of rural urban differences in the lifestyle and risk factors. Ever bronchial asthma was 5.3%, of which 4.2% had current episode of asthma as per Kumar GS *et al* (13). A study in Shimla (12) with a slightly different methodology, described an overall asthma prevalence of 2.3%, which is very low as compared to various studies. Intraregional variations in asthma prevalence may be attributed to differing levels of air pollution; allergens exposure and climatic conditions. Pal R *et al* (1) reviewed fifteen epidemiological studies on asthma and gave a mean prevalence of 7.24 ± SD 5.42. A hospital based study by Paramesh H *et al* (14), showed increasing prevalence of asthma in children from Bangalore, from 9% in 1979 to 29.5% in 1999 which correlated well with demographic changes. Among a cohort of twelve schools (with n= 6550 children, 6-15 years); differences in prevalence from 19.34% in heavy traffic areas versus 11.15 % in low traffic areas ($p< 0.001$) were noted (14).

Exercise induced wheeze was documented as 8.4% (5,10) and 2.8% (15), while asthma induced dry cough at night occurred in 5.3% (5), 4.1% (10) and 2.3% (15), all the prevalence's being different from our study. Frequency of attacks of wheezing, speech limitations and sleep disturbances as result of wheezing found in our study deferred from others

(10,16). Though the climatic conditions in our place and in the rural town where Narayana PP *et al* (16) had conducted their study was almost similar, fewer (16.7%) of children had one to three episodes of wheezing in a year in their study in contrast to our study where most (77/91; 84.62%) had nearly one to three episodes of wheezing per year. The higher frequency of wheezing episodes in our study could possibly be related to urbanization with increasing pollution in the location with both the selected schools being located in heavy traffic areas. In our study, current wheezers had severe symptoms in 28.6%, indicating severe asthma is seen in 2.6% of the whole study population. As per phase III ISAAC study, severe asthma was seen in 0.1% in Pune (India) to 16% in Costa Rica in 13-14 years old and from 0% to 20.3% in the same two centres, respectively, in the 6–7 year olds (7).

The Demographic and housing environment factors were studied with respect to current wheezers. Children from the 8-9 years age group had the highest prevalence of current wheeze (13.1%), and it was in the range of 7.8-8.86% in the remaining age groups. Previous studies, (1,10,11,13,17) had similar results with prevalence being significantly higher among younger age group and decreasing with increasing age. Males were significantly more affected than females in our study and it was concordant with other studies (1,10,11,12).

On comparing with socioeconomic strata, the highest prevalence was seen in the Upper Middle Socioeconomic class (10.5%), and least in the Lower Middle Socioeconomic class (6.5%). Socioeconomic classes III and IV together were significantly associated with current wheezing by logistic regression analysis. However, since the adjusted odds ratio was 0.534, it indicated that the association was weak. These values are probably because of the higher proportion of upper socioeconomic class children involved in the study. These observations are also consistent with the study by Jain A *et al*(10), even though different scales were used to determine the socioeconomic status. The study by Chhabra SK *et al* (15), showed no significant association with any economic class.

The condition of living in overcrowded surroundings and absence of smoke outlet was significant in current wheezers ($p<0.005$). Similar, to our study, asthma prevalence was significantly associated with the absence of smoke outlet in the house by Kumar GS *et al* (13). No, significant association was found among current wheezers living in homes not having a separate kitchen in our study; however, it was significantly associated with asthma as per Cheraghi M *et al* (11). Beedi rolling is practiced by lower socioeconomic strata along the coastal area. Our study found beedi rolling by family member(s) in less than 5% of the surveyed population and had no significant association with current wheezers. Studies on tobacco smoke exposure and asthma attacks have been documented in the past (18,19). The studies by Agarwal S *et al* (20) and Paramesh H I (14), significantly associated asthma occurrence with solid fuel usage whereas it was not found in Kumar GS *et al* (13) and our study. Indoor pollution, i.e. smoke produced from cow-dung, kerosene, wood, kitchen smoke etc, were present in 72% cases in a study by Verma R *et al* (21). As per the study by Cheraghi M *et al* (11), use of biomass fuel for cooking, absence of separate kitchen, dampness at home, male sex, and parental smoking were significantly associated with asthma.

Following this, we studied the demographic, pollution and housing factors in severe asthmatics, who were 26 in number. The highest prevalence of severe asthma was observed in the 10-11 years age group of current wheezers, at 53.8%, and the lowest in the 6-7 year (0%) age groups. However, there was no statistical significance. Males had a higher prevalence of 31.3%, and so did Muslims, at 57.1%, among the current wheezers, with no statistical significance observed for either. This male predominance was also observed by Jain A (10), who explained it as being possibly related to a greater degree of bronchial lability in males.

Socioeconomic standings of the current wheezers on comparison with prevalence of severe asthma showed statistically significant association $p<0.005$ in our study. Cesaroni G *et al*(22), found lower socioeconomic status was significantly associated with severe asthma. A study by MielckA *et al*(23), in Germany, correlating socioeconomic status and asthma severity, showed that children from lower socioeconomic standings had a greater risk of severe asthma than the children with higher standings do. However, they also concluded that no association could be found if severity grades are not considered. As this is a cross-sectional study, we were unable to estimate the risk, but an association depending on prevalence was found, all the same. As per Lal A *et al* (24), total socioeconomic burden score correlated

with asthma severity (p<0.001) and socioeconomic status of the family (p <0.01).

In current wheezers coming from houses practicing beedi rolling, the prevalence of severe asthma was found in all of them and was statistically significant (p<0.001). Even though there are not many studies conducted on beedi rolling being a risk factor, probably because it is practiced only in a few areas, it does cause considerable indoor air pollution, tobacco exposure and irritant dust. Rajasekhar D *et al* reported asthma prevalence to be 6.3% in women involved in beedi rolling (25). As this is a cross sectional study, the risk cannot be ascertained, and the results could have been affected by the very small number of people practicing beedi rolling in our study population.

Nearly two-thirds (63.6%) of severe asthmatics lived in homes without a separate kitchen. The absence of a separate kitchen may contribute to indoor air pollution. The association was statistically significant (p<0.01). A similar significant association was obtained in Puducherry study (13). There was no significant association of absence of separate smoke outlet in the kitchens, using firewood as fuel, residing in overcrowded homes with severe asthma.

Conclusion

This is the first school-based survey of asthma in the city and found a prevalence of asthma similar to other Indian studies. Overcrowding and absence of smoke outlet were significantly associated with current wheezers. Severe asthma was significantly associated with absence of separate kitchen, beedi rolling practices and socio-economic status.

Recommendation

The prevalence of bronchial asthma among school children in Mangalore is high and this being the first such study, it is recommended to carry out more such studies with larger sample. Given the high prevalence of asthma, it is recommended to create awareness among students, teachers and parents regarding the symptoms as well as the management of the disease.

Limitation of the study

The study had few limitations. causal association could not be ascertained as this was a cross sectional study. Since the questionnaire involved questions in the past, the responses might have been affected by recall bias. Comprehension of questions will not be uniform in the study population. Asthma is considered a social stigma, leading to underreporting and underestimation. Confirmation by physical examination, PEFR, and spirometry were not done. This study was conducted in purposively selected schools owing to convenience and logistics, hence the results cannot be generalized. A large number of children need to be assessed covering a larger number of schools within the city for a more conclusive strategy.

Relevance of the study

This study being the first of its kind in Mangalore, (to the best of our knowledge), adds to the evidence as well as tells us about the situation in this city. This study also shows that the prevalence as well as the factors for childhood asthma in Mangalore are similar to studies done elsewhere in India.

Authors Contribution

SP Kamath, SS Kumar, A Jain conceived and designed the study. SS Kumar collected the data. SBBaliga, A Ramakrishna helped SP Kamath, SS Kumar and A Jain in analysis and interpretation of data. All authors participated in drafting the manuscript, reviewing and revising it and approved the final version of the manuscript.

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Tables

TABLE 1 CHARACTERISTICS OF THE RESPONDENTS

Variables	Frequency (%)
Gender	
Male	653(64.6%)
Female	358(35.4%)
Age in years	
6-7	127 (12.6%)
8-9	137(13.6%)
10-11	155(15.2%)
12-13	268(26.5%)

14-15	320(31.7%)
>15	4(0.4%)
Religion	
Hindu	960(95%)
Christian	17(1.7%)
Muslim	22(2.2%)
Others	12(1.2%)
Socioeconomic class	
Upper	246(24.3%)
Upper middle	448(44.3%)
Middle/lower middle	231(22.8%)
Lower/upper lower	86(8.5%)
Lower	0

TABLE 2 SEVERITY OF DISEASE IN CURRENT WHEEZERS (N=91)

Question	Frequency (%)
Number of attacks of wheezing in the past 12 months?	
None	6(6.6%)
1 to 3	77(84.62%)
4 to 12	8(8.8%)
>12	0
How often has sleep been disturbed due to wheezing in the past 12 months?	
Never	51(56.04%)
Less than once/week	37(40.66%)
Once /more per week	3(3.3%)
Has wheezing limited speech to only one or two words at a time between breaths?	
Yes	19(20.88%)
No	72(79.12%)

TABLE 3 RELATIONSHIP BETWEEN DEMOGRAPHY, HOUSING AND ENVIRONMENT VARIABLES WITH CURRENT WHEEZERS

Variable	Current wheezers (n=91)(%)	Not current wheezers (n=920)(%)	Total (n=1011)	Chi-square Values (p value)
Age				
6-7	10(7.9)	117(92.1)	127	3.37
8-9	18(13.1)	119(86.9)	137	p=0.499
10-11	13(8.4)	142(91.6)	155	
12-13	23(8.6)	245(91.4)	268	
14-15	27(8.3)	297(91.7)	324	
Gender				
Male	64(9.8)	589(90.2)	653	1.441p=0.230
Female	27(7.5)	331(92.5)	358	
Socio-economic Status				
Upper (I)				
Upper middle(II)	21(8.5)	225(91.5)	246	3.062
Middle/Lower Middle (III)	47(10.5)	401(89.5)	448	p=0.382
Lower/Upper Lower (IV)	15(6.5)	216(93.5)	231	
Lower (V)	8(9.3)	78(90.7)	86	
	0	0	0	
Overcrowding				
Present	49(12.4)	347(87.6)	396	9.041
Absent	42(6.8)	573(93.2)	615	p=0.003*
Beedi rolling				
Present	6(14.6)	35(85.4)	41	1.656

Absent	85(8.8)	885(91.2)	970	p=0.198
Separate kitchen				
Present	80(8.6)	852(91.4)	932	2.536
Absent	11(13.9)	68(86.1)	79	p=0.111
Smoke outlet				
Present	52(7.3)	664(92.7)	716	9.054
Absent	39(13.2)	256(86.8)	295	p=0.003*
Fuel used			976	
LPG/gas	90(9.2)	886(90.8)	35	1.671
Firewood	1(2.9)	34(97.1)		p=0.196

*Statistically significant **

TABLE 4 ASSOCIATION OF DEMOGRAPHIC AND HOUSING FACTORS WITH CURRENT ASTHMA: MULTIPLE LOGISTIC REGRESSION ANALYSIS

Variable	Odds ratio(adjusted)	95% Confidence interval (pvalue)
Age group		
6-11a	1	0.562-1.390 (0.593)
>12	0.884	
Sex		
Male	1.339	0.828-2.164 (0.234)
Female a	1	
Socioeconomic group		
Middle/lower middle and Lower/upper lower	0.534	0.307- 0.931 (0.027)*
Upper and Upper middle a	1	
Overcrowding		
Yes	1.936	1.242-3.017 (0.004)*
No a	1	
Beedi rolling at home		
Yes	2.199	0.821-5.886 (0.117)
No a	1	
Separate kitchen		
Yes a	1	
No	1.470	0.710-3.042 (0.299)
Smoke outlet in kitchen		
Yes a	1	1.251-3.091(0.003) *
No	1.967	

*Reference categories a, Statistically significant **

TABLE 5 RELATIONSHIP BETWEEN DEMOGRAPHY, HOUSING AND ENVIRONMENT VARIABLES WITH SEVERE ASTHMA

Variable	Severe asthma		Total	Chi-square Values (p value)
	Yes (n=26) (%)	No (n=65)(%)	(n=91)	
Age				
6-7	0(0)	10(100)	10	9.970
8-9	4(22.2)	14(77.8)	18	p=0.076
10-11	7(53.8)	4(46.2)	11	
12-13	6(26.1)	17(73.9)	23	
14-15	9(36)	18(64)	27	
Gender				
Male	20(31.3)	44(68.8)	64	0.758
Female	6(22.2)	21(77.8)	27	p=0.384

Socio-economic Status				
Upper (I)	8(38.1)	13(61.9)	21	17.359
Upper middle(II)	5(10.6)	42(89.4)	47	p=0.001*
Middle/Lower Middle (III)	8(53.3)	7(46.7)	15	
Lower/Upper Lower (IV)	5(61.5)	3(37.5)	8	
Lower (V)	0(0)	0(0)	0	
Overcrowding				
Present	16(32.7)	33(67.3)	49	0.867
Absent	10(23.8)	32(76.2)	42	p=0.352
Beedi rolling				
Present	6(100)	0(0)	6	18.059
Absent	20(23.5)	32(76.2)	52	p<0.001*
Separate kitchen				
Present	19(23.8)	61(76.3)	80	7.539
Absent	7(63.6)	4(36.4)	11	p=0.006*
Smoke outlet				
Present	15(28.8)	37(71.2)	52	0.004
Absent	11(28.2)	28(71.8)	39	p=0.947
Fuel used				
LPG/gas	25(27.8)	65(72.2)	90	2.528
Firewood	1(100)	0(0)	1	p=0.112

*Statistically significant **