Screening for asthma and associated risk factors among urban school boys in Abha city

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ABSTRACT

Objective: The objective of the present study was to measure the prevalence of asthma and asthma-related symptoms among male school children in Abha City and to determine some of the possible risk factors influencing its occurrence.

Methods: A randomly selected sample of 4300 male school children aged 7 to 15 years in Abha were subjected to a previously validated questionnaire for asthma to be completed by parents. Asthma was identified based on the Rush Medical College and International Study of Asthma and Allergies in Children questionnaire. Information of asthma family history, asthma related symptoms, and other atopic conditions, smokers in the family, pets ownership and monthly family income were collected.

Results: The overall prevalence of asthma was 9% (95% Confidence Interval: 7.73%-9.67%). Doctor-diagnosed asthma was reported by 4%, exercise-induced asthma by 4% and wheeze in the past year by 8%. Multiple logistic regression analysis showed that positive family history of atopic condition (Odds Ratio=437.11, P<0.001), pets ownership (Odds Ratio=2.91, p<0.001), and lower monthly family income (Odds Ratio=2.00, P<0.02) were significant factors influencing the development of asthma.

Conclusion: In conclusion, the screening methodology adopted in this study could be applied for all children at the beginning of the school year, being simple and non-invasive measure. The prevalence of asthma in school children in Abha is greater than that reported from most developing countries and closer to the rates reported in developed countries. Avoidance of pets ownership at home, improving social class and premarital counselling for atopic persons are all recommended.

Keywords: Asthma, school, wheeze, prevalence.

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Asthma, the most common chronic illness in children is responsible for more school absenteeism than any other single chronic childhood condition.[1] Acute asthma attacks while at school can cause considerable disruption to scheduled school activities, broadening its impact on school participation.[2] Children with asthma face multiple challenges that encompass learning how to cope with and manage the unique demands of this illness. These demands can involve monitoring peak flows, administering medications and treatments, modifying the environment to limit exposure to asthma triggers, and dealing with the potential side effects of their medications.[3] An increase in the prevalence and severity of bronchial asthma all over the world in both children and adults has been noted in recent

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years.[4] Subsequently, hospital admissions are increasing steadily.[5,6] During the last few decades, profound changes have occurred in the environments of most societies, including urbanization, an enormous increase in motor vehicles and factories, changes in life styles, and exposure to new allergens. These factors in addition to familial tendency and history of respiratory infections, have been shown to lead to development of asthma.[7,8] The prevalence of asthma cannot be measured in terms of lung function abnormalities since most asthmatic children have normal lung function.[9,10] There is no agreed definition of asthma that is suitable for use in epidemiological surveys. However, if people are simply asked whether they (or their children) have ever had asthma, the answers are remarkably specific, as screening test for the disease.[11] Thus, the aim of the present study was to measure the prevalence of asthma among urban school boys in Abha City, Asir region, using a simple, validated measure and to determine some risk factors of childhood asthma.

Methods. ***Sampling procedure.*** Abha, capital city of Asir province (population 1,200,000) in southwestern Saudi Arabia, lies about 2250 feet above sea level and approximately 200 km from the northern border of neighboring Yemen. It has the lowest mean annual temperature of any of the southern urban areas and has high annual rainfall with rain falling mainly in winter and spring. Because of the abundance of water and the fertile soil, agriculture is the main occupation in the Abha region. Industrial activity in the region includes construction materials and timber processing, maintenance workshops, and other secondary industries. As an urban population, people enjoy many modern facilities but retain the basic dietary and social habits of rural communities. Meat, chicken and rice constitute the major dietary items. Health services are provided by primary health care centers. There are five education areas in Asir. The one in Abha is responsible for the supervision of 41 primary, 29 intermediate and 11 secondary schools for boys. A two stage stratified random sample of 4300 children was selected out of the primary and intermediate schools for boys, representing about one-third of the original target school population (N=12860). Their ages ranged from 7 to 15 years.

At the first sampling stage, the schools were classified into 3 groups according to geographical location and socio-economic level (roughly categorized into high, moderate and low social classes based on an expert opinion). Using the equal allocation method of sampling, 5 primary and 3 intermediate schools were randomly selected from each of the 3 groups. Thus, total of 24 schools were selected.

In the second sampling stage, 6 classes and 3 classes were selected from each of the selected primary and intermediate schools, to represent all educational grades. Thus, a total of 117 classes were identified in the sample. Each class was considered as a cluster and all children in the selected classes constituted the target group of the present study.

All children were screened for asthma by a questionnaire[2] on the lines of the Rush Medical College[12] and the International Study of Asthma and Allergies in Children (ISSAC)[13] questionnaire. This questionnaire has been previously validated, with a sensitivity of 94% and a specificity of 96%. The prevalence of asthma was estimated based on the presence of any of the following; (1) current asthma; (2) wheeze in the past 12 months; (3) wheeze or cough after active playing; and (4) attacks of coughing during sleep. Children with current asthma are those who had both a diagnosis of asthma and a history of wheezing during the past 12 months.[14] To avoid over diagnosis, a child who may have been diagnosed with asthma as a younger child, but who has been symptom free over the past 12 months was considered as case of past asthma. The questionnaire included also information about the following; (1) demographic data such as age and area of residence; (2) family history of asthma and other atopic conditions; (3) family pets (cat, bird, poultry, etc); (4) the presence of smokers in the family; and (5) monthly family income. A 3000 Saudi Riyals income was considered as a cut off point to categorize low and high income groups. A total of 4300 questionnaires were distributed. Only questionnaires with no missing responses were considered satisfactory and represented the sample upon which estimation of the prevalence of asthma was based. A total of 3274 questionnaires representing 76% of the target were used.

Data analysis. The data was analyzed on the Statistical Package for Social Sciences (SPSS) version 9.0 and the Epi-Info (version 6.02) softwares, on IBM computer of the College of Medicine at King Khalid University, Family and Community Medicine Department. Student's t-test and chi-square test were used as tests of significance. Odds ratios (OR) with the corresponding 95% confidence interval (CI), were calculated for risk factors having a significant association with prevalence. Multivariate logistic regression analysis, was used to model the presence of asthma as a function of some risk factors. The odds ratios for occurrence of the disease in association with one variable in the simultaneous presence of other variables were computed. The 5% level was chosen as the level of significance.

Results. ***Prevalence of asthma and asthma-related symptoms.*** Doctor-diagnosed asthma was reported by the respondents in 4% of the sample, 9% of the respondents reported that their child had wheezed in the past year, 4% had exercise-induced

Table 1 - Prevalence of asthma and asthma-related symptoms among 3274 schoolboys in Abha City.

Symptoms/Diagnosis	No.	%	95% CI (%)
Doctor diagnosed asthma			
Ever	123	4	(3.15 – 4.45)
Current asthma (a)	117	4	(2.96 – 4.24)
Wheezed			
Ever	300	9	(8.21 – 10.19)
Past year (b)	276	8	(7.45 – 9.35)
Coughing during sleep			
Ever	302	9	(8.21 – 10.19)
Past year (c)	274	8	(7.45 – 9.35)
Wheeze or cough after active playing			
Past year (d)	139	4	(3.51 – 4.89)
Overall prevalence	285	9	(7.73 – 9.67)

(a)Children with current asthma are those who had both a diagnosis of asthma and a history of wheezing during the past 12 months.
Note: Prevalence of asthma was estimated based on the presence of: (a) and/or, (b) and/or, (c) and/or (d)
CI=Confidence Interval

wheezing, and 9% reported a dry cough at night (Table 1). Based on these asthma-related symptoms, the overall prevalence of asthma was estimated as 9%. Table 2 shows the prevalence of asthma in different age groups. The overall prevalence of asthma was 9%. As age increased, the prevalence of asthma decreased. However, there was no significant association between prevalence and age (Chi-square test for linear trend = 0.792, P=0.37).

Possible risk factors for asthma. Table 3 shows the prevalence of some asthma risk factors among students. The history of atopic condition among children, first degree relatives was positive in 44% of children. Allergic rhinitis was the commonest condition (36%), followed by bronchial asthma (22%) and eczema (18%). History of smoker in the family was positive among 9% of children. Pets ownership was among 5.5%. Lower monthly family income as a risk factor for asthma was evident in 4% of children. In the unadjusted analysis (Table 4) a strong association was found between a family history of atopic disorders and the prevalence of asthma (P<0.001). The odds ratio for the occurrence of asthma in children with a family history of atopic conditions was 458.67 (95% CI: 64.30 - 3271.90). Similarly, a significant association was found between the presence of smokers in the family and prevalence of asthma (P<0.01). The odds ratio for the occurrence of asthma in the presence of smokers in the family was 1.66 (95% CI:1.16 – 2.39). A significant association was observed between the prevalence of asthma and family income per month (P<0.01). The highest prevalence was in the lowest income group (OR=2.02, 95% CI:1.26 - 3.24). The prevalence of asthma among those who owned a mammal or bird and those who did not was 23% and 7% (OR=3.54, 95% CI:2.45 – 5.13, P < 0.001).

Multiple logistic regression was then carried out with asthma as the dependent variable and these identified as having a significant association with it during univariate analysis as the independent variables. The strong association between smokers in the family and asthma rate disappeared after adjustment (P = 0.09). On the other hand, the association between asthma rate and positive family history, pets ownership, and lower income remained significant after adjustment. Table 5 contains the estimated coefficients from the logistic regression model that predicts childhood asthma from a constant and the variables; family history of atopy (1 for positive), pets ownership (1 for yes), smokers in the family (1 for yes), and monthly income (1 for low income). The model chi-square is 528.153, and is significant at the 0.0001 level, indicating that the probability of obtaining the result by chance is less that 1 in 10,000. Family history of atopy is the best predictor of childhood asthma (P<0.001). Pets ownership (P<0.001) and monthly family income (P < 0.02), both favour the occurrence of childhood asthma, while smokers in the family does not (P=0.09).

Given these previous coefficients, the logistic regression equation for the probability of occurrence of childhood asthma can be written as follows: $P(\text{asthma}) = 1/1 + e^{-z}$, where e stands for exponential, z = -7.65 + 6.08 (family history of atopy) + 1.07 (pets ownership) + 0.34 (smokers in family) + 0.69 (monthly family income). Applying this to a child with positive family history of atopy (value of 1) and the value of zero for all other independent variables,

Table 2 - Prevalence of asthma according to different age groups among 3274 schoolboys in Abha.

Age group (yr.)	Total No. of Children	Asthmatic children	
		N %	95% CI (%)
6 – 8	1050	96 9	8.11 – 10.09
9 – 11	1275	113 9	7.34 – 10.46
12 – 15	949	76 8	6.27 – 9.73
Total	3274	285 9	7.73 – 9.67

CI=Confidence Interval, *Chi-squared test for linear trend was applied.

Table 3 - Prevalence of some childhood asthma risk factors.

Risk Factors	No. %	95% CI (%)
Family history of atopic conditions		
Bronchial asthma	716 (22)	20.48 – 23.32
Allergic rhinitis	1185 (36)	34.65 – 37.95
Eczema	576 (18)	16.30 – 18.90
Total	1427 (44)	41.90 – 45.30
Smoker in the family	299 (9)	8.11 – 10.09
Pets ownership	181 (5.5)	4.72 – 6.28
Low monthly income	141 (4)	3.61 – 4.99

CI=Confidence Interval

we find: z = - 7.65+6.08(1) = -1.57, the probability of childhood asthma is then estimated to be $1/1 + e^{-(-1.57)}$ = 0.17. Based on that, we could predict that childhood asthma is 17% likely to occur. Following the same procedure as before for a child and adding a value of 1 for pets ownership (yes): and a value of 1 for smoking in the family (positive), the estimated probability of occurrence of childhood asthma is 0.46, indicating higher probability. Furthermore, if that same child comes from a family of low monthly income the probability will again rise to 0.63, that is to say, asthma is more likely to occur.

Discussion. A variety of labor-intensive, physiologic methods for identifying asthma have been developed, including lung function tests, inhalation tests, exercise tests, and skin prick tests. Yet, no single and reliable test can be used in a school screening program.[11] Therefore, in the present study, the use of a simple previously validated questionnaire[2] has provided a non-invasive and convenient method to identify children with asthma or symptoms of asthma. In addition to being simple and relatively inexpensive to administer, the questionnaire approach was viewed as more desirable than other physiologic screening methods in that it would not require the participation of the students being screened.

In the present study, children with current asthma, i.e. those who had both a diagnosis of asthma and a history of wheezing during the past 12 months constituted 4% of all children. On the other hand, "asthma ever" was prevalent among 9%, and this figure constitutes both current asthmatics and those who may have been diagnosed with asthma as younger children, but have been symptom-free over the past 12 months. Given the concern about under-

Table 4 - Childhood asthma rate (%) and odds ratios according to some possible risk factors among 3724 schoolboys in Abha city.

Risk factors	Asthma rate No	%	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Family history of atopy				
Negative	1	0.1	1@	1@
Positive	284	19.9	458.67 (964.30 – 3271.90)	437.11 (62.38 – 3062.97)
X^2, P-Value	399.04	<0.001		
Smoking in the family				
No	264	8.3	1@	1@
Yes	39	13.0	1.66 (1.16 – 2.39)	1.41 (0.95 – 2.09)
X^2, P-Value	7.20	<0.001		
Pets ownership				
No	243	7.9	1@	1@
Yes	42	23.2	3.54 (2.45 – 5.13)	2.91 (1.91 – 4.42)
X^2, P-value	48.77,	<0.001		
Social class				
High	263	8.4	1@	1@
Low	22	15.6	2.02 (1.26 – 3.24)	2.00 (1.16 – 3.46)
X^2, P-Value	7.94	<0.01		

@=Reference category, CI=Confidence Interval, X^2=Chi-squared test.

Table 5 - Variables that predict childhood asthma and their coefficients using logistic regression model.

Variable	Coefficient (B)	SE	P-value
Family history of atopy (1=positive)	6.08	0.99	<0.001
Pets ownership (1=yes)	1.07	0.21	<0.001
Smokers in family (1=yes)	0.34	0.20	0.09
Monthly income (1=low)	0.69	0.28	<0.02
Constant	-7.65	1.02	<0.001

SE=Standard error

diagnosis, the questionnaire could identify children diagnosed with asthma by a doctor, as well as those without diagnosis but who have experienced asthma-related symptoms in the past year. These were prevalent in the forms of wheezing (8%), coughing during sleep (8%), and exercise-induced wheezing (4%). Such asthma-related symptoms have been included in the definition of asthma for other epidemiological studies.[15,16]

Based on the stated definition of asthma, the rate of asthma in urban school boys in Abha in the present study was 9% (95% CI: 7.73% - 9.67%). This rate is less than that described for some developed countries,[15,17-19] but higher than the frequency observed in other developing countries.[5, 20,21] In other parts of Saudi Arabia, the reported prevalence ranged from 7% in Dammam, 12% in Riyadh, and 13% in Jeddah.[22] However, direct comparison of these studies is limited by the fact that different surveying methods were used, and children of different age groups were studied.

Most of the family studies on asthma, wheeze and chronic cough suggest that there is a considerable genetic component in the etiology of these illnesses.[23,24] Our findings of higher prevalence of asthma among children of parents with atopic disorders (20% vs. 1%) might support this hypothosis. A child with positive family history of atopy had a probability of 17% to be asthmatic. Such probability means that this child is about 437 times (Odds ratio) more likely to contract asthma, as compared to a child with no family history of atopy.

A strong association between asthma rate and pets ownership has been reported in many studies[14,25-28] up to 40% of asthmatic children are allergic to cats or dogs.[27] This finding of the present study is in agreement with such studies. Children whose families own pets were 3 times more vulnerable to suffer from asthma as compared to those families who do not (P<0.001). Brunekruf et al[28] reported that parents of asthmatic children tend to give up keeping pets, but animal antigens spread readily from home to classroom.[27] In consequence, the exposure of allergic children to animal antigens may be determined by the local prevalence of pet ownership than by their personal pet ownership.

Passive exposure to cigarette smoke has been associated with a number of adverse health consequences in normal children including increased occurrence of respiratory illness emergency room visits and increased hospitalization rate.[29] It has been suggested that asthma may be more common in families where parents were smokers.[30-32] However, in this present study, the strong association observed in the unadjusted analysis between asthma rate and smokers in the family was no longer present, suggesting that this relationship might be mediated by other factors. Parents of asthmatic children may be particularly careful not to smoke if their children wheeze.

A significant association was observed in the present study between the prevalence of asthma and the monthly family income, with asthma being more common in the lower income group families. This finding was in agreement with the results of Schwartz et al.[33] However, there are other confounding factors that may interact with poverty, including crowding, educational status, health services availability and utilization, and the environment at the place of residence. None of these factors has been investigated by the present study.

In conclusion, the screening methodology adopted in this study resulted in a fairly simple and non-invasive approach for identifying children with asthma in school setting. By adding the simple asthma screening questions to the standard health information collected for all children at the beginning of the school year, any school could have the data necessary to monitor the approximate prevalence and morbidity of asthma over time. The prevalence of asthma among urban school boys in Abha City is higher than that in developing countries, while it is still lower than that in other developed countries. Positive family history of asthma and or any atopic disorder, pets ownership and lower family income were significant factors influencing the development of asthma. Health education for parents to give up keeping pets at home, premarital counselling for atopic persons and improving social class are all recommended.

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