

# Epidemiology of bronchial asthma among school boys in Al-Khobar city, Saudi Arabia

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## ABSTRACT

**Objective:** The objective of this cross-sectional study was to determine the prevalence of bronchial asthma among Saudi School boys at Al-Khobar city.

**Methods:** This is a cross-sectional study. The methodology included the distribution of a self administered questionnaire which was filled by the parents of 1482 school boys who satisfied the selection criteria of the study.

**Results:** The prevalence rate of Questionnaire Diagnosed Asthma and Physician Diagnosed Asthma were 9.5% and 8%. Questionnaire Diagnosed Asthma school boys and their parents suffered significantly higher rates of allergenic diseases and environmental factors (pets at home, passive smoking) than non Questionnaire Diagnosed Asthma.

**Conclusions:** The prevalence of Questionnaire Diagnosed Asthma among schoolboys in Al-Khobar city was more than that which was described earlier. However, this rate was less than those reported from other parts of the Kingdom but higher than the ones reported from Arab, developing and European countries. There is evidence that a combination of genetic and environmental factors play a major role in the etiology of this disease. Based on the results of this study, appropriate and practical measures need to be taken to identify causes and initiate control programs.

**Keywords:** Childhood asthma, Saudi Arabia.

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Worldwide, bronchial asthma during childhood is a common lung disease.<sup>1-3</sup> Wheezing among children was estimated to be up to 11.5% in Saudi Arabia.<sup>4</sup> There is enough evidence to suggest that prevalence of this disease is increasing.<sup>5</sup> Consequently, morbidity and mortality of bronchial asthma continue to increase.<sup>1,6</sup> Epidemiological researches showed that variation of prevalence from region to region within the same country may be explained by variability in the extrinsic allergens.<sup>4</sup> It is thought that such environmental factors play a major role in the etiology of bronchial asthma.<sup>4</sup> Therefore, prevalence of bronchial asthma was found to be more in industrialized countries compared to developing countries.<sup>1</sup> Likewise, prevalence of bronchial asthma among Saudi school children was found to be more in industrial, agricultural and urban

areas as compared to desert and rural areas.<sup>7,8</sup> On the other hand, genetic factors were considered to be of less importance than environmental factors in the etiology of bronchial asthma.<sup>4</sup>

In Saudi Arabia, a reasonable number of studies were conducted to investigate certain aspects of this disease, including prevalence of this health problem among children.<sup>1,4-15</sup> However, and to the best of the investigator's knowledge, no study was conducted to study the prevalence of this disease among school children in Al-Khobar City. Such a study is essential as measuring the magnitude of this health problem will help in designing the appropriate control measures. The objective of this study was to determine the prevalence of bronchial asthma among Saudi school boys at Al-Khobar City. Another

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**Table 1** - Sample characteristics of QDA and non-QDA.

Variable	Questionnaire Diagnosed Asthma (n=141)	Non Questionnaire Diagnosed Asthma (n=1341)	P Value
Age (mean $\pm$ SD) year	10.3 $\pm$ 2.1	10.3 $\pm$ 2.2	Not significant
<b>Socio-economic class</b>			
Upper (n=223)	22 (16%)	201 (15%)	Not significant
Middle (n=756)	62 (44%)	694 (52%)	
Lower (n=503)	57 (40%)	446 (33%)	
Total	141 (100%)	1341 (100%)	

objective was to study and compare the prevalence of other allergenic diseases and environmental factors associated with bronchial asthma among asthmatic school boys and their families with their non-asthmatics counterparts.

**Methods.** The Saudi boys in elementary and preparatory schools at Al-Khobar City were the subjects of this cross-sectional study. Al-Khobar City is located on the Arabian Gulf coast in the Eastern part of the Kingdom of Saudi Arabia. A total of 22077 school boys were identified at elementary (15829 (72%)) and preparatory (6248 (28%)) schools in Al-Khobar City. A sample of 7% were selected of the total number of pupils to be our sample. This was based on the prevalence rate of bronchial asthma among school children reported earlier in the region.<sup>1</sup> The total sample of 1550 school boys (elementary = 1110 (72%) and preparatory = 440 (28%)) was drawn from 7% of schools selected by simple random sampling (4 elementary + 2 preparatory schools). The total number of sample students in each school was in accordance with the ratio they represent in relation to the total number of students in all schools (in each level of education). In each school the sample was drawn evenly and randomly from different academic classes. The methods used included a self administered pre-tested and pre-coded questionnaire directed to parents. This questionnaire was previously standardized and validated to the Saudi community.<sup>7</sup> The questionnaire used in this work was subjected to a reliability test which was based on psychometric analysis using the split-halves method and the general Spearman-Brown formula,<sup>16</sup> which indicated a reliability of 95%.

The definition of asthma used in this study was modified from the Medical Research Council (MRC) definition.<sup>17</sup> The criteria selected to identify asthmatic children were as follows: Any school boy

whose parents responded to all of the following questions with "Yes" was considered to be a Questionnaire Diagnosed Asthmatic (QDA): 1) Has your child ever had an attack of wheezing? (whistling noise that comes from chest); 2) Did your child get attacks of shortness of breath with wheezing? 3) Does the breathing of your child become normal in between attacks? School boys, whose parents diagnosed asthma in their child and had the diagnosis confirmed by a physician (based on history, physical examination and formal tests when needed) were considered Physician Diagnosed Asthmatics (PDA). Each family was classified into upper, middle and lower socio-economic class based on aggregate score of the father's education, occupation and income.<sup>18</sup> The boys and their parents were requested to give details of personal data such as age, area of residence, father education, occupation and income. Data included the subject or any family member with current or history of bronchial asthma including (dyspnea, dyspnea after exercise, wheeze or whistle), allergic rhinitis, eczema, cough and past doctor diagnosis. Histories of smoking by any household member and more specifically parental smoking habit, presence of family pets at home (bird, cat etc.) were enquired about. Data were analyzed using an IBM compatible personal computer. The Statistical Program SPSS/PC was used to calculate chi-square differences, McNemar test and odds ratios to assess the statistical significance of contingency tables.

**Results. Sample characteristics.** A total of 1550 school boys were included in this study. The total returned filled questionnaires was 1482 with response rate of 96%. Twenty one pupils (1%) were excluded from the study because they were not living in Al-Khobar City. The remaining 47 students (3%) declined to participate for different reasons not related to the study subject. The ages of the boys

**Table 2** - Prevalence rate of respiratory symptoms, allergenic and environmental factors among QDA and non-QDA school boys.

Variable	(n=141) QDA No. (%)	(n=1341) Non-QDA No. (%)	Odds Ratio	95% Confidence Interval	P
Dyspnea	51 (36)	172 (13)	3.2	2.8,3.7	<0.05
Dyspnea after exercise	45 (32)	150 (11)	3.1	2.7,3.6	<0.05
Cough	39 (28)	113 (8)	3.3	2.8,3.9	<0.05
Rhinitis	11 (8)	45 (3)	2.15	1.6,2.8	<0.05
Eczema	25 (18)	53 (4)	3.9	3.1,4.9	<0.05
Pets at home	72 (51)	274 (20)	3.4	3.0,3.8	<0.05
Smoking by family member	52 (37)	415 (31)	1.3	1.1,1.5	<0.05
Smoking by mother	11 (8)	51 (4)	1.9	1.5,2.5	<0.05
Smoking by father	76 (54)	402 (30)	2.5	2.3,2.8	<0.05
Father with asthma	50 (35.5)	147 (11)	3.6	3.1,4.2	<0.05
Mother with asthma	39 (28)	101 (7.5)	3.7	3.1,4.4	<0.05
Father with rhinitis	26 (18)	87 (6.5)	2.7	2.3,3.3	<0.05
Mother with rhinitis	21 (15)	95 (7)	2.1	1.75,2.5	<0.05
Father with exzema	13 (9)	72 (5)	1.7	1.4,2.1	<0.05
Mother with exzema	17 (12)	56 (4)	2.6	2.1,3.3	<0.05
Other sibling with asthma	11 (8)	41 (3)	2.3	1.8,3.0	<0.05
Other sibling with rhinitis	9 (6)	94 (7)	0.9	0.75,1.1	NS
Other sibling with eczema	6 (4)	64 (5)	0.9	0.7,1.1	NS

ranged from 6-15 years. The mean age of the school boys in the total sample was  $10.7 \pm 3.1$  years. There was no statistical difference in mean age among Questionnaire Diagnosed Asthmatics (QDA) and non-QDA (Table 1). A total of 223 (15%) school boys were found to belong to upper socio-economic class families compared with 756 (51%) and 503 (34%) in the middle and lower socio-economic classes. Similarly, no statistically significant difference was found among QDA and non-QDA regarding their socio-economic class (Table 1).

**Prevalence of bronchial asthma.** The cumulative prevalence of QDA in the total sample was 9.5%. The highest prevalence of QDA (21%) was among school boys aged between 12-15 years. There were no statistically significant differences in the prevalence of QDA in different age groups. The overall prevalence of PDA was 8% (120/1482). The mean age at diagnosis was  $4.2 \pm 1.2$  years. A total of 102 (85%) PDA were known to be asthmatics before the age of 5 years. There was no statistically significant difference in comparing the age at diagnosis in the different age groups.

**Association between Questionnaire Diagnosed Asthma and factors in patient's characteristics.** Table 2 shows that boys with QDA are significantly associated with certain respiratory symptoms and allergic histories (in them and in their family members) compared to non-QDA. Prevalence of these respiratory symptoms (cough, dyspnea and dyspnea after exercise) were more than 3 times higher among QDA compared to non-QDA boys. Compared to non-QDA, prevalence of allergic

diseases (rhinitis, eczema, asthma) among parents of QDA school boys ranged from 1.7 - 3.7 folds. The frequency of asthma and other allergenic diseases among parents were found to be similar to the pattern seen in their children or more. With the exception of bronchial asthma, this did not apply to other siblings in the same family.

Compared to non-QDA, prevalence of rhinitis and eczema among QDA school boys was also found to be common (2.15 and 3.9 folds). Other important environmental factors such as presence of pets at home and passive smoking were found to be significantly higher among QDA school boys compared to non-QDA.

**Comparison of Bronchial Asthma as diagnosed by Questionnaire and Physician Diagnosis Asthma.** Validation of the questionnaire against that of physician diagnosis yielded a sensitivity rate of 78.5%. The specificity of the questionnaire was

**Table 3** - Comparison of QDA and PDA.

		PDA		Total
		Yes	No	
QDA	Yes	102 (78.5%)	39 (3%)	141 (9.5%)
	No	28 (21.5%)	1313 (97%)	1341 (90.5%)
Total		130 (100%)	1352 (100%)	1482 (100%)

PDA - Physician Diagnosed Asthma, QDA - Questionnaire Diagnosed Asthma, McNemar test=1.8, P-value >0.1

97% with false negative rate of 21.5% and false positive rate of 3%. McNemar test between QDA and PDA was found to be statistically not significant, P-value >0.1 (Table 3).

**Discussion. Responses.** The response rate of 96% in this study is an encouraging observation. This was probably due to the ease of the method being non-invasive and to cooperation of school teachers and families. This is supporting previous reported successes of using self administered questionnaires in the field of bronchial asthma.<sup>1,7,10-13,15</sup> Similarly, this study supports other reports that diagnosis of bronchial asthma is usually made early in life in Saudi Arabia where 85% of asthmatic school boys were diagnosed to be so before the age of five years.<sup>7</sup>

**Association between asthma and socio-economic class.** The fact that there was no significant difference in mean age between QDA and non-QDA made it easier to compare the two groups in relation to other important factors. For example, socio-economic class was not found to be associated with presence or absence of QDA. In this regard, our finding is consistent with earlier similar studies from Saudi Arabia,<sup>7,8</sup> Arab<sup>19</sup> and other countries.<sup>20-23</sup> However, it varies with some other studies which found negative (i.e. increasing prevalence with decreasing socioeconomic class)<sup>24-26</sup> or positive association.<sup>27-29</sup> The lack of any association with socioeconomic class has been widely reported from the United States, England, Wales, New Zealand and Australia.<sup>23</sup> Mielck et al in 1996 reviewed 24 studies from industrialized countries published since 1960s and found that majority of these studies (16 out of 24) showed no association.<sup>22</sup> In that review, 5 out of the 10 studies that were conducted in United States (US) showed no association. There is evidence that severe asthma is most prevalent in lower socioeconomic class<sup>22,23,29-33</sup> and that ignorance of the distinction between grades of asthma severity may have resulted in these conflicting results between studies in relation to the association with socioeconomic class.<sup>22,23</sup> Differences in the methodologies and design of the studies, nature of population under study and the unavailability of a universally acceptable definition of both asthma and socioeconomic class, may have contributed in making comparisons between studies difficult to interpret.

**Prevalence rates.** The prevalence rate of QDA in this study (9.5%) is modest in a range of 5.3% - 18% reported by different investigators using similar definition to ours.<sup>7,21,33,34</sup> However, this rate is higher than a range of 0.43%-9% reported from European, developing and Arab countries using some other definitions.<sup>8,35,36</sup> Our rate varies with the rate of 6.6% reported in Dammam in 7-12 years old children but less than the rate of 13% and 12% reported from

Jeddah and Riyadh.<sup>1</sup> Inference from comparison of prevalence studies in bronchial asthma may be misleading.<sup>37</sup> This is because of unavailability of a universally acceptable definition and due to the variation in designs, methodologies, age groups of subjects included in these prevalence studies.<sup>1,37</sup> However, this study indicates that prevalence of QDA and PDA among Al-Khobar school boys is more than what was reported earlier in Dammam (6.6%) amongst 7-12 years old children.<sup>1</sup> In this study the prevalence of asthma was higher when using the questionnaire (QDA) compared with the physician diagnosis (PDA). This supports earlier similar findings that prevalence studies using physician diagnosed asthma will only and most likely underestimate the prevalence of the disease.<sup>7</sup> In Saudi Arabia, the prevalence of childhood asthma was in the range of 6.5%-12.6% and 4.5%-9.5% among boys and girls, respectively and with predominance to boys over girls in ratio of 1.5:1 in majority of studies.<sup>1,4,5,7-9,11,12</sup> This finding is consistent with studies from elsewhere.<sup>20,23,27</sup> In one study from Saudi Arabia, male boys with asthma attended almost twice in the emergency department and were admitted to hospital significantly more than girls.<sup>38</sup>

**Associated conditions.** The association between asthmatics and increasing susceptibility towards respiratory symptoms, allergic diseases and other environmental factors e.g. smoking and pets at home, were described earlier in Saudi Arabia.<sup>1,8,10,12,13,15,39</sup> However, this study indicates that the magnitude of association in Al-Khobar is more than what was described earlier. Children with QDA and their parents are at significantly higher risk of allergic diseases (rhinitis, eczema and asthma) than non-QDA. A finding that should be taken into consideration when designing health care for this group of patients and should form the basis in any screening program for this condition among children. The rate of asthma and rhinitis were significantly higher among parents compared to their off spring (QDA) and siblings. This finding strongly suggests that asthma may be an inherited condition in the Saudi population. More research work is needed to determine the mode of inheritance.<sup>10</sup> The degree of association of occurrence of these allergic diseases (asthma, rhinitis and eczema) among parents and their children may indirectly indicate the influence of genetic factors involved. On the other hand, this study supports the hypothesis that change in life style and environmental factors (i.e. passive smoking, pets at home) are significantly associated with QDA subjects. This has its important implication when managing patients. Dose-effect relationship was established between number of cigarettes smoked at home by a parent and prevalence of bronchial asthma among school children.<sup>10</sup> This is especially so, in a community where prevalence of smoking is increasing over time.<sup>40</sup> Moreover, it was found that

the prevailing trend of smoking in Al-Khobar City would seem to be a combination of more than one form of smoking.<sup>40</sup>

**The value of Questionnaire in diagnosing asthma.** To validate QDA, PDA was used in this work as a gold standard. PDA as a reference method may have its own limitations (inability to diagnose the disease by physician in some cases) but this method was commonly used before.<sup>1,7,10-13,15,22</sup> This is because of the non-availability of a universally acceptable method of diagnosing asthma in children. Because the questionnaire used in this study proved to be reliable, specific and moderately sensitive in determining the prevalence of asthma in school children, it could be used as an appropriate tool for screening purposes.

This study may be considered a base line for further and larger studies in the same area in the future including wider age group and female children. Based on the results of this study, authorities in the Ministry of Health (MOH) may consider taking more steps towards addressing this health problem by identifying potential causes and by initiating appropriate control measures. While some progress has been made in this field,<sup>41</sup> there is evidence that the ultimate goal has not yet been achieved.<sup>42</sup> More emphasis should be put on screening and early discovery so that primary and secondary prevention could be made effective.

**Acknowledgment.** The investigator expresses his thanks and gratitude to all children and their parents who participated and to the school authorities in the region for their cooperation in this study.

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The study may be considered a pilot for further and larger studies in the same area in the future including wider age group and female children. Based on the results of this study, authorities in the Ministry of Health (MOH) may consider taking more steps towards addressing this health problem by identifying potential cases and by initiating appropriate control measures. While some progress has been made in this field, there is evidence that the ultimate goal has not yet been achieved. More emphasis should be put on screening and early discovery so that primary and secondary prevention could be made effective.

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