Epidemiology of Bronchial Asthma among School boys in Al-Khobar City, Saudi Arabia: Cross-sectional Study

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Aim. To determine the prevalence of bronchial asthma among Saudi Arabian school boys living in Al-Khobar city.

Methods. Parents of 1,482 randomly selected boys in preparatory and elementary schools included in this cross-sectional study filled out a questionnaire on asthma signs in their sons. Number of Questionnaire-Diagnosed Asthmatics was compared with the number of Physician-Diagnosed Asthmatics.

Results. The prevalence rates of questionnaire-diagnosed asthma (QDA) and physician-diagnosed asthma (PDA) were 9.5% and 8.1%, respectively. Rates of allergic diseases were significantly higher among QDA school boys and their parents. They reported to be more exposed to allergenic environmental factors (pets at home, passive smoking) than non-QDA.

Conclusion. The prevalence of QDA among school boys in Al-Khobar city is higher than the prevalence of QDA in other Arabian, developing, or European countries, but still lower than in other parts of Saudi Arabia. A combination of genetic and environmental factors may explain this finding.

Key words: asthma; bronchial asthma; cough; cross-sectional studies; health behavior; lifestyle; Saudi Arabia; smoking; social environment; wheezing

Bronchial asthma is a common chronic lung disease in children worldwide (1-3). Wheezing is present in almost 11.5% of the children in Saudi Arabia (4), and the prevalence of bronchial asthma is continually rising (5), with a consequent increase in morbidity and mortality (1,6). Epidemiological research has shown that the prevalence of bronchial asthma varies from region to region within a country, which can be explained by the variability in the environmental factors. Since the extrinsic allergens play a major role in the etiology of the disease (4), the prevalence of bronchial asthma is higher in industrialized than in developing countries (1). Likewise, the prevalence of bronchial asthma among Saudi school children is higher in industrial, agri cultural, and urban areas than in desert or rural areas (7,8). In general, genetic factors are considered to be of less importance than the environmental factors in the etiology of bronchial asthma (4).

In Saudi Arabia, several studies were conducted to investigate different aspects of this disease, including its prevalence among children (1,4-15) but none investigated the prevalence of bronchial asthma among Saudi school boys in Al-Khobar city. That was the main objective of this study. Another aim was to investigate the prevalence of other allergic diseases and environmental factors associated with bronchial asthma in asthmatic school boys and their families and compare them with their non-asthmatics counterparts. Measuring the magnitude of this health problem will help design appropriate health control measures.

Patients and Methods

Al-Khobar city is located on the Gulf Coast of Saudi Arabia. The subjects of this cross-sectional study were Saudi Arabian boys in elementary and preparatory schools in Al-Khobar city. Schoolgirls were not included in this study because of difficulties in gaining access to girls' school, all limitations also imposed to other investigators (7). Of 22,077 school boys of elementary (15,829; 71.7%) and preparatory (6,248; 28.3%) schools in Al-Khobar city, 7% were selected. This percentage was calculated on the basis of the previously reported prevalence rate of bronchial asthma among school children in the region (1). The total sample of 1,550 school boys, 1,110 (71.6%) at elementary and 440 (28.4%) at preparatory school, was chosen from 7% of the schools. The sample was drawn evenly and randomly from different school grades.

A self-administered pre-tested and pre-coded questionnaire for parents was used as the method of investigation. The questionnaire, previously validated and standardized for the Saudi Arabian commu-
nity (7), was checked by a reliability test based on psychometric analysis.

In this study, asthma definition modified by Medical Research Council (17) was used. Each school boy whose parents responded to the following questions with “Yes” was considered a Questionnaire-Diagnosed Asthmatic (QDA):

1. Has your child ever had an attack of wheezing (whistling noise that comes from the 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 who did not fit the criteria of QDA were considered questionnaire-diagnosed non-asthmatics (non-QDA). School boys (QDA or non-QDA) whose parents stated that a physician (based on a disease history, physical examination, and standard tests when needed) confirmed the diagnosis were considered physician-diagnosed asthmatics (PDA).

Each family was classified into upper, middle, or lower socioeconomic class, according to the aggregate score of father’s education, occupation, and income (18). The questionnaire required general data (the boy’s age, area of residence, and father’s education, occupation, and income) and data on the health status of a subject as well as family health history, present smoking habit of any household member, especially parents, and the presence of family pets at home (birds, cats, etc.) were also inquired about. SPSS/PC statistical program was used for data analysis, and chi-square differences and odds ratios for the assessment of statistical significance of contingency tables.

Results

Sample Characteristics

A total of 1,550 school boys and their parents were included in the study. Out of these, 1,482 questionnaires were filled out and returned, which makes a response rate of 95.6%. Twenty one pupils (1.4%) were excluded from the study because they were not living in Al-Khobar city, whereas 47 (3.0%) declined to participate for different reasons not related to the study.

The age of the boys in the sample ranged from 6-15 years (mean age 10.7±3.1 years). There was no statistical difference in the mean age between questionnaire-diagnosed asthmatics and healthy boys (non-QDA). Two hundred and twenty three (15.0%) school boys belonged to upper socioeconomic class families, whereas 756 (51.0%) and 503 (34.0%) were from the middle and lower socioeconomic class families, respectively. No statistically significant difference regarding their socioeconomic class was found between questionnaire-diagnosed asthmatics and questionnaire-diagnosed non-asthmatics (Table 1).

Prevalence of Bronchial Asthma

The cumulative prevalence of questionnaire-diagnosed asthmatics in the total sample was 9.5%. The highest prevalence of questionnaire-diagnosed asthmatics (21.2%) was found among school boys aged between 12-15 years. There was no statistically significant difference in the prevalences of questionnaire-diagnosed asthmatics among the different age groups, per se because of the relatively small sample size. The overall prevalence of physician-diagnosed asthmatics was 8.1% (120/1,482). The mean age at diagnosis was 4.2±1.2 years. A total of 102 (85%) boys were diagnosed as asthmatics before the age of 5 years. There was no statistically significant difference in age at diagnosis among the different age groups.

Association between Questionnaire-Diagnosed Asthmatics and Factors in Patient’s Characteristics

Table 2 shows significant association between asthma in the questionnaire-diagnosed asthmatic boys and respiratory symptoms and allergic histories they or their family members have, especially when compared to healthy (non-QDA) boys. Prevalence of these respiratory symptoms (cough, dyspnea, and dyspnea after exercise) was more than 3 times higher in questionnaire-diagnosed asthmatics than in questionnaire-diagnosed non-asthmatics. Prevalence of allergic diseases (rhinitis, eczema, and asthma) among the parents of questionnaire-diagnosed asthmatic school boys, when compared to parents of questionnaire-diagnosed non-asthmatics, ranged from 1.7 to 3.7. The frequency of asthma and other allergic diseases among parents was similar to that seen in the children. With the exception of bronchial asthma, this did not apply to other siblings in the same family.

Compared to healthy (non-QDA) boys, the prevalence of rhinitis and eczema among questionnaire-diagnosed asthmatic school boys was also common (2.1 vs. 3.9 folds, respectively). Other important environmental factors, such as pets at home and passive smoking, were significantly higher among questionnaire-diagnosed asthmatic school boys than among questionnaire-diagnosed non-asthmatics.

Comparison between Questionnaire and Physician-Diagnosed Bronchial Asthma

Assessed against physician-based diagnosis, the questionnaire-based diagnosis showed sensitivity rate of 78.5%. The specificity of the questionnaire was 97.1%, with false negative rate of 2.5% and false positive rate of 2.9%. McNemar test between QDA and PDA was not statistically significant (Table 3).

Discussion

The prevalence of questionnaire-diagnosed asthma in this study (9.5%) is moderate according to the range of 5.3%-18% reported by different investigators who used the similar definition of asthma (7,19-21).

Table 1. Sample characteristics of Questionnaire-Diagnosed Asthmatics (QDA; n=141) and healthy boys (non-QDA; n=1,341)

<table>
<thead>
<tr>
<th>Variable</th>
<th>QDA</th>
<th>Healthy</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years, mean±SD)</td>
<td>10.3±2.1</td>
<td>10.3±2.2</td>
<td>0.92</td>
</tr>
<tr>
<td>Socio-economic class (n, %)</td>
<td>Z-test</td>
<td>Chi-square test</td>
<td></td>
</tr>
<tr>
<td>upper (n=223)</td>
<td>22 (15.6)</td>
<td>201 (15.0)</td>
<td>0.31</td>
</tr>
<tr>
<td>middle (n=756)</td>
<td>62 (44.0)</td>
<td>694 (51.8)</td>
<td></td>
</tr>
<tr>
<td>lower (n=503)</td>
<td>57 (40.4)</td>
<td>446 (33.2)</td>
<td></td>
</tr>
<tr>
<td>Total (N=1,482)</td>
<td>141 (100.0)</td>
<td>1,341 (100.0)</td>
<td></td>
</tr>
</tbody>
</table>
How ever, it is above the range of 0.43%-9% reported in European (22), developing (22,23), and Arabian countries (8). Our rate is different from the rate reported among 7 to 12-year-old children in Jeddah and Riyadh (12.6% and 11.9%, respectively) (1). These variations in the prevalence among different studies on bronchial asthma may be misleading (24). The reason for this could be related to the availability of a universally accepted definition.

Table 3: Comparison of Questionnaire-Diagnosed Asthma and Physician-Diagnosed Asthma (No., %)

<table>
<thead>
<tr>
<th>Variable</th>
<th>QDA (n=1,141)</th>
<th>non-QDA (n=1,341)</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dyspnea</td>
<td>51 (36.2)</td>
<td>172 (12.8)</td>
<td>3.2</td>
<td>(2.9-3.7)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Dyspnea after exercise</td>
<td>45 (31.9)</td>
<td>150 (11.2)</td>
<td>3.1</td>
<td>(2.7-3.6)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Cough</td>
<td>39 (27.7)</td>
<td>113 (8.4)</td>
<td>3.3</td>
<td>(2.8-3.9)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Rhinitis</td>
<td>11 (7.8)</td>
<td>45 (3.4)</td>
<td>2.15</td>
<td>(1.6-2.8)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Eczema</td>
<td>25 (17.7)</td>
<td>53 (4.0)</td>
<td>3.9</td>
<td>(3.1-4.9)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Pets at home</td>
<td>72 (51.1)</td>
<td>274 (20.4)</td>
<td>3.4</td>
<td>(3.0-3.8)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Smoking by family member</td>
<td>52 (36.9)</td>
<td>415 (31.0)</td>
<td>1.3</td>
<td>(1.1-1.5)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Smoking by mother</td>
<td>11 (7.8)</td>
<td>51 (3.8)</td>
<td>1.9</td>
<td>(1.5-2.5)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Smoking by father</td>
<td>76 (53.9)</td>
<td>402 (30.0)</td>
<td>2.5</td>
<td>(2.3-2.8)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Father with asthma</td>
<td>50 (35.5)</td>
<td>147 (11.0)</td>
<td>3.6</td>
<td>(3.1-4.2)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Mother with asthma</td>
<td>39 (27.7)</td>
<td>101 (7.5)</td>
<td>3.7</td>
<td>(3.1-4.4)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Father with rhinitis</td>
<td>26 (18.4)</td>
<td>87 (6.5)</td>
<td>2.7</td>
<td>(2.3-3.3)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Mother with rhinitis</td>
<td>21 (14.9)</td>
<td>95 (7.1)</td>
<td>2.1</td>
<td>(1.75-2.5)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Father with eczema</td>
<td>13 (9.2)</td>
<td>72 (5.4)</td>
<td>1.7</td>
<td>(1.4-2.1)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Mother with eczema</td>
<td>17 (12.1)</td>
<td>56 (4.2)</td>
<td>2.6</td>
<td>(2.1-3.3)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Other sibling with asthma</td>
<td>11 (7.8)</td>
<td>41 (3.1)</td>
<td>2.3</td>
<td>(1.8-3.0)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Father with asthma</td>
<td>11 (7.8)</td>
<td>41 (3.1)</td>
<td>2.3</td>
<td>(1.8-3.0)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Other sibling with rhinitis</td>
<td>9 (6.4)</td>
<td>94 (7.0)</td>
<td>0.9</td>
<td>(0.75-1.1)</td>
<td>N.S.</td>
</tr>
<tr>
<td>Other sibling with eczema</td>
<td>6 (4.2)</td>
<td>64 (4.8)</td>
<td>0.9</td>
<td>(0.7-1.1)</td>
<td>N.S.</td>
</tr>
</tbody>
</table>

McNemar test 1.8, p<0.1.

The absence of a positive association between asthma and socioeconomic conditions (27,34,35). The absence of any association with socioeconomic class has been reported in the United States, England and Wales, New Zealand, and Australia (26). In 1996, Mielck et al (30) reviewed 24 studies conducted in industrialized countries and published after 1960s. They found that the majority of these studies (16 out of 24) revealed no association between asthma and socioeconomic class. In their review, 5 out of 10 studies conducted in the United States showed no such an association. On the other hand, some evidence shows that severe asthma is more prevalent in lower socioeconomic class (20,26,30-38), but they probably did not grade the severity of asthma (26,30), which might account for these conflicting results. Differences in methodology, designs of studies, and the pop-
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ulation under study, as well as the unavailability of a universally accepted definition of both asthma and socio-economic class, may have contributed to the differences among studies.

Associated respiratory symptoms, allergic diseases (questionnaire-diagnosed asthmatics and their families) and other environmental factors in Saudi Arabia (smoking and pets at home) were described earlier (1,8,10,12,13,15,39). However, our study indicated that the association among these factors in Al-Khobar was stronger than what was described earlier. Questionnaire-diagnosed asthmatic children and their parents were at significantly higher risk of developing allergic diseases (rhinitis, eczema, and asthma) than questionnaire-diagnosed non-asthmatics. This finding should be taken into consideration when designing health care programs for this group of patients. Moreover, it should be the basis of any screening program for asthma among children. The rates of asthma and rhinitis in the Saudi Arabian population were significantly higher among parents of QDA-children than among other populations. This finding strongly suggests that asthma may be an inherited condition, but more research is needed to determine the mode of inheritance (10). The degree of association of these allergic diseases (asthma, rhinitis, and eczema) between parents and their child may indirectly indicate the influence of genetic factors involved. On the other hand, our study supports the hypothesis that lifestyle and environmental factors (e.g., passive smoking and pets at home) are associated with questionnaire-diagnosed asthma, which is important in patient managing. Dose-effect relationship between the number of cigar/pipe smokers at home and the prevalence of bronchial asthma among the children of school age has been reported (10). This is especially so in the communities where the prevalence of smoking in creases over time (40). Moreover, it was found that the people in Al-Khobar city who smoked were usually heavy and long-time smokers (40). This finding supports the hypothesis that changes in the lifestyle and environment influence the expression of the allergic disease (8).

The limitations of this study may be related to the limitations of the use of Physician-Diagnosed Asthmatic method as a golden standard, but it has been commonly used (1,7,10,13,15,30). A universal, more acceptable, easy, and reliable method of diagnosing asthma in children is still not available. Nevertheless, the questionnaire used in this study proved to be of high reliability, specificity, and moderate sensitivity in determining the prevalence of asthma among school children. This questionnaire could be an appropriate tool for such screening purposes in the future.

Acknowledgment

I thank all the children, their parents, and the school authorities in the region for their cooperation in this study.

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