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## Epidemiology of bronchial asthma among children in Jazan Region, Saudi Arabia

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## Abstract

**Context:** Asthma is a global problem, its prevalence varies among different countries and cities and age groups. In children, asthma is one of the most common chronic diseases and one of the leading causes of morbidity and mortality. **Aims:** This study was conducted to estimate the prevalence of asthma among children in Jazan Region (JR), Saudi Arabia. **Settings And Design:** This is study conducted in Jazan region, Saudi Arabia among school age children. It is a cross-sectional study used a modified international study on asthma and allergy in children questionnaire. **Subjects And Methods:** The target study population were school age, with sample size of 1200 distributed to all geographical areas. **Statistical Analysis Used:** The data had been entered and analyzed using Statistical Package for Social Sciences software version 22.0. Descriptive statistics (e.g., number, percentage) and analytic statistics using Chi-square tests ( $\chi^2$ ) to test for the association and/or the difference between two categorical variables will be applied. A  $P < 0.05$  was considered statistically significant. **Results:** The total study population was 1400, most of them were Saudi (1273, 90.9%). Male students were 840 (60.0%), and female students were 560 (40.0%). According to the residency, 811 (57.9%) students were lived in rural, 64.7% of them were male, and 589 (42.1%) of participants lived in urban area. Most of the students lived in plain area (840, 60.0%), and only 16.4% of them lived in mountain area in which 63.5% of them were male. Elementary school students account 54.1% of total students; about 63% of them were male. The prevalence of life-long wheezes was 17.7%. The prevalence of exercise-induced wheeze and wheeze during the last 12 months was 206 (14.7%) and 159 (11.4%), respectively. Students with the past medical history of bronchial asthma were 212 (15.1%), with no clear statistical significant difference in frequency between male and female ( $P = 0.161$ ). Asthma was confirmed by doctor in 10% of participants. **Conclusions:** The prevalence of asthma among children in JR is slightly higher than those reported from local and regional reports.

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## Full Text

### Introduction

Bronchial asthma (BA) is the most common chronic disease that characterized by airway limitation due to bronchospasm and airway inflammation associated with excessive mucus secretion from agitated mucus gland that occurs due to airway hyperresponsiveness. The prevalence of BA had been increased during the last decades, with some 300 million people currently suffer from asthma. Most asthma-related deaths occur in low- and lower-middle income countries. Asthma has a relatively low fatality rate compared to other chronic diseases. Urbanization has been associated with an increase in BA, but the exact nature of this relationship is not well understood.[1] It is the most common chronic illness in children, which lead to more school absenteeism than any other chronic childhood conditions. Acute asthma attacks while at school can cause considerable disruption to scheduled school activities, broadening its impact on school participation.[2] There have not been reliable data to define the magnitude of the problem in developing countries, but the rate range between 3% and 30% depends on location and method of surveys.[3] Recently, the prevalence and severity of BA increased in both children and adult worldwide.[4] Subsequently, hospital admissions are increasing steadily.[5],[6] During the last few decades, the environmental factors changed markedly worldwide, including urbanization, tremendous increase in motor vehicles and factories, changes in lifestyles, and exposure to new allergens. In addition, genetic susceptibility and history of respiratory infections have been shown to increase occurrence of BA.[7],[8]

Local reports in Saudi Arabia (SA) suggest that the prevalence of asthma is increasing.[9],[10],[11] Poor knowledge, fear of the use of new drugs, and the lack of awareness of the importance of disease control are common among primary care physicians who care for asthma patients in SA. In addition to these important factors, there are other attributes to the magnitude of disease burdens such as socioeconomic status, number of siblings, knowledge of caregivers, and income.[12],[13],[14],[15],[16],[17] Consequently, many asthma patients continue to be underdiagnosed, undertreated, and at risk of acute exacerbations resulting in work or school missing days, increased use of costly acute healthcare services, and decrease quality of life.[18],[19],[20]

The prevalence of asthma among Saudi schoolchildren was found to be 10% in Riyadh, compared to 13% in Jeddah and Qassim, and 17% in Abha.[21] The prevalence of asthma in two population of schoolchildren aged between 8 and 16 years was studied using the International Study of Asthma and Allergies in Childhood (ISAAC) designed protocol in 1986 and 1995. [21] Data from Riyadh versus Hail and Jeddah versus Jazan revealed that the prevalence of asthma in similar population increased significantly from 8% in 1986 to 23% in 1995.[22] The study also revealed that there was increased exposure to environmental factors such as tobacco smoke and indoor animals in Saudi houses, which may have contributed. The prevalences in industrial and nonindustrial areas were 13.9% and 8%, respectively, in the study conducted in industrial city of Yanbu.[23]

In SA, a reasonable number of studies were conducted to investigate certain aspects of this disease, including the prevalence of this health problem among children. The objective of this study was to determine the epidemiology of BA among school-age children at Jazan Region (JR), SA.

## Subjects and Methods

### Study area

This study conducted in Jazan (also called Gizan) region is one of the thirteen regions of the SA. It is located on the tropical Red Sea coast in southwestern SA. Jazan covers an area of 11,671 km<sup>2</sup>, including some 5000 villages and towns with a total population of 1.5 million. Geographically, JR divides into three zones (coastal, plain, and mountain), which intersected with perennial streams, these geographical factors may affect the prevalence of BA.

### Study design

This was a cross-sectional study using the ISAAC questionnaire conducted among schoolchildren within JR, SA, over a period of 3 months started on November 2015 to fulfill the proposed objectives.

### Sample design and size

The ultimate objective of the study was to estimate the prevalence of BA among schoolchildren in JR, SA. For this purpose, multistage cluster random sampling utilized. JR geographically is classified into three geographical distinct zones, the mountain, hills, and coastal zones. Following Cochran, (1977) the suitable sample size determined on the bases of the standard formula given by:

[INLINE:1]

where

$n$ : the sample size  $\pi$ : it is an anticipated proportion here, the prevalence of asthma  $Z$ : the standardized variable that corresponds to 95% level of confidence  $d$ : the desired marginal error.

Since there is no prior knowledge about the prevalence of BA in JR, we will set the values  $\pi = 0.5$  to provide the maximum sample size,  $d$  the desired marginal error = 0.05, and  $Z = 1.96$ , the study sample size, denoted ( $n$ ), is given by:

[INLINE:2]

Since the sample proportion to the total population is  $<0.05$  of the total number of school students in JR, we do not need to use the finite population correction factor to adjust the sample size. However, to increase precision, which might be lost as a result of adopting multistage cluster sampling method, we multiply the sample size ( $n$ ) by the design effect factor, which is the ratio of the variance of estimates for a particular sample design to the variance of estimates for a simple random sample of the same size. The design effect is equal to the number of geographical zones in JR, so that the minimum sample size required is 1152. The sample size distributed between areas, school level (elementary or intermediate schools), and both sexes according to the sex ratio in the schools. The schools as well students in the different clusters selected using simple random technique. For that, the calculated sample was distributed according to the three geographical areas: coastal, plain, and mountain as 250, 750, and 200, respectively. When distributing questionnaires, we added 30% for each for nonresponders.

#### Data collection and analysis

Data collected using structured questionnaire that developed by ISAAC. The questionnaires were written in Arabic and were mainly address to target group and filled by their parents. These data had been entered and analyzed using Statistical Package for Social Sciences software version 20.0 (SPSS, Chicago, IL, USA). A  $P < 0.05$  was considered statistically significant.

#### Ethical considerations

Ethical clearance first was approved by the Medical Research Ethical Committee - Faculty of Medicine - Jazan University. The questionnaire used after taking permission from corresponding author by e-mail.[23] A written permission from the Joint Program of Family Medicine, JR, was obtained before conducting the research. Field work was approved by Directorate General for Health, JR. The individual consent from each patient to participate in the study was a prerequisite for data collection. It was written on front page of questionnaire that answering questionnaire means agreement of participation in the study. All information was kept confidential and was not be accessed except for the purpose of the scientific research.

## Results

A total of 1560 questionnaires were distributed to the students in both level of elementary and intermediate schools all over JR; 1400 questionnaires were collected with response rate of 90.6%, most of them were Saudi (1273, 90.9%). A total of 840 (60.0%) students were male, and 560 (40.0%) were female. The age of participants ranges from 10 to 15 years with a mean of  $12.8 \pm 1.5$  years and a median of 13 years. According to the residency, 811 (57.9%) students were lived in rural, 64.7% of them were male, and 589 (42.1%) of participants lived in urban area. Most of the students (840, 60.0%) lived in plain area, and only 16.4% of them lived in mountain area in which 63.5% of them were male. Elementary school students account 54.1% of total students; about 63% of them were male as shown in [Table 1].{Table 1}

The prevalence of BA-related symptoms is shown in [Table 2], which revealed that the symptoms suggestive of life-long wheeze were affecting 248 (17.7%) of all students. Male accounts 54.8% of those with life-long wheeze, with no clear statistical significance difference in prevalence according to the gender ( $P = 0.067$ ). The prevalence of exercise-induced wheeze and wheeze during the last 12 months was 206 (14.7%) and 159 (11.4%), respectively. Students with the past medical history of BA were 212 (15.1%), with no clear statistical significant difference in frequency between male and female ( $P = 0.161$ ). Asthma was confirmed by doctor in 10% of participants.{Table 2}

The prevalence of life-long wheeze differs according to geographical distribution of participants ( $P = 0.014$ ), the prevalence was 146 (10.4%) in plain area, 73 (5.2%) in coastal area, and only 2.1% in mountain area. The prevalence was higher in rural area (151, 10.8%) versus urban area (97, 6.9%) without statistical significance difference. There was no statistical significant difference in prevalence according to nationality and level of education ( $P = 0.113$  and  $0.119$ , respectively) [Table 3]. Wheeze occurred in the last 12 months reported in 103 (7.4) in those lived in plain area and 148 (10.6) of Saudi participants as showed in [Table 4].{Table 3}{Table 4}

Excise-induced wheeze according to the geographical distribution reported in 146 (10.4%) of those who lived in plain area, 34 (2.4%) in coastal area, and 26 (1.8%) in mountain area, with clear statistical significance difference ( $P = 0.002$ ). According to the residents, those who lived in urban areas were more affected (127, 9.0%) than cities habitants (79, 5.6%) ( $P = 0.252$ ). In

regard to nationality, Saudi people (203, 14.5%) were more developed exercise-induced wheeze than non-Saudi people (3, 0.2%) ( $P = 0.000$ ) [Table 5].{Table 5}

Most of those who had a history of asthma were Saudi (209, 98.6%) and 143 (67.5%) of them lived in plain areas. Elementary school students reported a positive history of asthma (118, 8.4%) than intermediate school students (94, 6.7%) ( $P = 0.013$ ) as illustrated in [Table 6].{Table 6}

Asthma was confirmed by doctor showed clear statistical significance in relation to geographical distribution of participants ( $P = 0.002$ ) and level of education of the students ( $P = 0.018$ ) [Table 7].{Table 7}

[Table 8] showed that there was clear statistical significance between asthma confirmed by doctor and prevalence of BA-related symptoms ( $P = 0.000$ ). Diagnostic test evaluation (sensitivity and specificity of questionnaire to diagnose students with BA-related symptoms) was calculated using the data in [Table 8]. Life-long wheezing was calculated as follows.{Table 8}

Diagnostic test evaluation (sensitivity and specificity of questionnaire to diagnose students with BA-related symptoms) was calculated using the data in [Table 8] showed: Sensitivity = true positive/(true positive + false negative) = 65.9% (95% CI= 57.51% - 73.72%), that means 65.9% of those who had life-long wheeze where true asthmatics. Specificity = true negative/(false positive + true negative) = 87.7% (95% CI= 85.75% to 89.45%), that means 87.7% of those who had no symptoms were not asthmatics.

Specificity = true negative/(false positive + true negative) = 87.7% (95% CI = 85.75%–89.45%), that means 87.7% of those who had no symptoms were not asthmatics.

## Discussion

This study was conducted to assess the epidemiology of BA among children using ISAAC protocol. Phase I of ISAAC was a unique initiative involving genuinely worldwide involvement in research into the patterns and causes of asthma.[24] It represented by far the most extensive international survey of asthma symptom prevalence ever performed.[25] The ISAAC Phase I methodology was simple, the protocol was rigorously applied, and a number of validation studies had indicated that the ISAAC core questions on wheezing had acceptable sensitivity and specificity when compared with other indicators of asthma including physician diagnosis, other questionnaires, and physiological measures.[26]

A total of 1400 students were screened using ISAAC Phase I questionnaire written in Arabic with mean age of  $12.8 \pm 1.5$  years and median of 13-year-old. A total of 840 (60.0%) students were male, and 560 (40.0%) were female, which is similar to the study conducted in Taif, where 1082 (63.6%) of the participants were male.[27] The age of participants ranges from 10 to 15 years with a mean of  $12.8 \pm 1.5$  years and a median of 13 years, which differs from the study conducted in Al-Khobar city, where the mean age was  $10.7 \pm 3.1$  years.[28]

The prevalence of life-long wheeze was 248 (17.7%). Male accounts 54.8% of those with life-long wheeze, with no clear statistical significance difference in prevalence according to the gender ( $P = 0.067$ ). This rate is higher than that reported in local studies when compared with similar studies using self-administered questionnaires as in Jeddah (9.8%), Riyadh (9.3%), [29] Dammam (3.6%) among primary schoolchildren aged 7–12 years [28] and Taif (14.4%).[27] The prevalence is slightly higher than the prevalence of other neighboring Gulf countries: 10.5% in Sultanate of Oman, 10.8% in Bahrain, and 13.5% in United Arab Emirates.[30] It is within the global rate of asthma prevalence as reported in ISAAC report, which found that about 14% of the world's children were likely to have had asthmatic symptoms in the last year, and crucially, the prevalence of childhood asthma varies widely between countries and between centers within countries.[31] The highest prevalence (>20%) was generally observed in Latin America and in English speaking countries of Australasia, Europe, and North America as well as South Africa. The lowest prevalence (<5%) was observed in the Indian subcontinent, Asia-Pacific, Eastern Mediterranean, and Northern and Eastern Europe. In Africa, 10%–20% prevalence was mostly observed.[31] Life-long wheeze prevalence differs according to the geographical distribution of participants ( $P = 0.014$ ), the prevalence in plain, coastal, and mountain was 10.4% 5.2%, and 2.1%, respectively. The prevalence of BA at high altitude was 6.9%, which significantly lower than those who living at sea level (19.5%) ( $\chi^2 = 46.6$ ,  $P < 0.05$ ). The study showed that people living at sea level had almost three times the risk of suffering BA than those living at high altitude (crude odds ratio 3.27, 95% CI: 2.30–4.64)[9] This study reported that the prevalence was higher among students lived in rural area (10.8%) than urban (6.9%) without statistical significance difference. Other studies conducted in SA revealed that the prevalence of asthma in urban and rural children was 13.9% and 8%, respectively.[32]

In the current study, the prevalence of exercise-induced wheeze and wheeze during the last 12 months was 14.7% and 11.4%, respectively. This result is higher than reported result from local report, which revealed exercise-induced asthma and wheeze in the past year was 4% and 8%, respectively. Students with the past medical history of BA were 212 (15.1%), with no clear statistical significant difference in frequency between male and female ( $P = 0.161$ ). Asthma was confirmed by doctor in 10% of participants, which is differing from the local study conducted in Abha, which revealed the doctor-diagnosed asthma was 4%.

[33] Students lived in plain area account 7.1% of those who had confirmed asthma, which may indicate early doctor consultation and high prevalence of BA.

The questionnaire showed statistical significance between questionnaire-diagnosed asthma and physician-diagnosed asthma ( $P = 0.000$ ). Questionnaire sensitivity and specificity to diagnose students with BA-related symptoms was 65.9% (95% CI = 57.51%–73.72%) and 87.7% (95% CI = 85.75%–89.45%), respectively. That means, 65.9% of those who had life-long wheeze where true asthmatics and 87.7% of those who had no symptoms were not asthmatics.

## Conclusions

The screening methodology adopted in this study resulted in a fairly simple and noninvasive approach for identifying children with asthma in school setting using standard ISAAC questionnaire. In conclusion, the prevalence of asthma among children in JR is higher than those reported from local and regional reports. Students lived in plain area and rural area were more susceptible to asthma than in other areas. Further studies including large sample size and more than one hospital are required.

### Limitations of the study

Although the present study is the first to consider use of ISAAC protocol to measure the prevalence of BA symptoms among children in JR, SA, it has some significant limitations. First, the study was based on sample size, so the frequency of these factor results should be interpreted carefully. Second, our participants were school age students and the questionnaire filled by their parents, whom may gave an over/underestimated answers. Third, this study depends on participant experience to report symptoms, which can be misinterpreted as over/underestimated these symptoms, which may affect the result of this study. Finally, correlation of prevalence of BA-related symptoms should be confirmed by further investigation as laboratory tests, chest X-ray, and spirometry.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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