

**Prevalence of asthma among male 16 to 18-year-old adolescents in the Northern Borders Region of Saudi Arabia**Mohammed Farhan Alruwaili¹, Amal Elwan²

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Abstract

Background: Asthma is a common chronic disease in adolescents, and has led to a significant morbidity and disability. Few studies have estimated the prevalence of asthma in the Northern Borders Region of Saudi Arabia. Only limited data has been available about prevalence of asthma in adolescents' age.

Objectives: The objectives of this study were to assess the prevalence of asthma and associated symptoms in 16 to 18-year-old adolescents, and to assess the level of asthma control among students with physician-diagnosed asthma, in the Northern Borders Region of Saudi Arabia.

Methods: A cross-sectional study was carried out on 511 male 16 to 18-year-old students in the Northern Borders Region of Saudi Arabia during the academic year 2017-2018. An International Study of Asthma and Allergies in Children (ISAAC) questionnaire and Asthma Control Test (ACT) were used as the measurement tool. The data were analyzed by SPSS version 20, using descriptive statistics and Chi-square test. A p-value of 0.05 or less was considered, statistically significant.

Results: Among the 511 students, the prevalence of physician-diagnosed asthma was 11.4%. The prevalence of lifetime wheeze, and exercise-induced wheeze were 30.3% and 19% respectively. The prevalence of night cough and wheezing attack in the past 12 months were 17% and 16.8% respectively. A total of 51.8% of asthmatic students have poor asthma control.

Conclusions: The prevalence of asthma and associated symptoms in 16 to 18-year-old students is high in the Northern Borders Region. Uncontrolled asthma was observed in half of asthmatic students.

Keywords: Asthma, Prevalence, Saudi Arabia, Control

1. Introduction**1.1. Background and study logic**

Asthma is a chronic airways disorder characterized by recurrent attacks of chest tightness, wheezing, cough and breathlessness (1). Symptoms of asthma vary in severity and frequency, and are related to one or more of airflow obstruction, bronchial hyper-responsiveness and underlying inflammation (1). Adolescents with asthma are at risk of significant morbidity and disability that affect their general health and well-being (2). The severity variation of asthma can lead to different degrees of disability on emotional aspects, school attendance, social and physical activities of adolescents (3). Furthermore, adolescents with the lowest physical activity caused by asthma may have a higher risk of asthma attacks (4). Asthma prevalence has been increasing worldwide over the past decades (5), and it was 14.1% in the adolescent age group, globally (6). Recent figures show that 235 million people suffer from asthma in all countries, independently to the level of income. Undiagnosed and untreated asthma have a major impact on quality of life of the affected person as well as the families (7). Compared to other chronic obstructive

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pulmonary disease like (COPD), asthma does not result in death, but left untreated and in compliance to treatment can be fatal, and the WHO estimate that 380,000 persons died due to asthma in 2015 (7). In the Middle East, the prevalence of asthma is higher among younger boys and it is present in 7.57% of children aged 13-14 years (8). Few studies have assessed the prevalence of asthma in the Kingdom of Saudi Arabia. Prevalence of asthma in adults is unknown according to the Saudi Initiative for Asthma (2016), but it has reached up to 25% in children (1). Prevalence of asthma has increased in Saudi Arabia from 8% in 1986 to 23% in 1995 among the ages between 6 and 18 years; and more than 2 million Saudis are affected (9). In Riyadh city (capital of Saudi Arabia), the prevalence of asthma was between 4.5% and 19.6% in students aged 16 to 18 (10, 11). In the south of Saudi Arabia, the prevalence of asthma was 27.5% at aged 7-19 years (12), while it was 6.45% in the Northern Borders Region of Saudi Arabia among adults ≥ 15 years according to the national household survey in 2013 (13). In other regions of Saudi Arabia such as Madinah city, Abha city and Taif area, asthma prevalence among school-age children was 23.6%, 9% and 13.1%, respectively (14-16). Among both the developed and developing world, asthma has a high cost burden (17). In developed countries, 1-2% of total healthcare costs is spent on asthma (18). Asthma represents 1.12% of total DALYs in Saudi Arabia (19), and is ranked at 26th position in causes of death (20). The goals of this study are to estimate the prevalence of asthma and associated symptoms in 16 to 18-year-old adolescents, and to assess the level of asthma control among asthmatic students in the Northern Borders Region of Saudi Arabia.

1.2. Objectives

The specific objectives of this study were: (1) To assess prevalence of asthma among adolescent male students at secondary schools in the Northern Borders Region of Saudi Arabia, (2) To assess control of asthma in the students with reported physician-diagnosed asthma.

2. Material and Methods

2.1. Study design and time period

A cross-sectional study was carried out on male 16 to 18-year-old students in the Northern Borders Region of Saudi Arabia during the academic year 2017-2018. Arar city is the capital of the Northern Borders Region of Saudi Arabia with an estimated population of 311,473, 88% of whom are Saudi citizens and Muslims. The Northern Borders Region represents 1.2% of the total population of the Kingdom of Saudi Arabia and has a desert climate (21).

2.2. Participants

2.2.1. Selection criteria

Inclusion criteria: male gender, adolescent age, resident in Arar city, Saudi, non-Saudi, and regular students. Exclusion criteria: Students who have hearing limitations or limited intellectual capabilities.

2.2.2. Study population

There are 21 secondary schools for boys in Arar city, Northern Borders Region of Saudi Arabia (22). The total number of regular secondary school male students in Arar city during the 2017-2018 academic years was 5,780 boys (22). Four of the 21 secondary schools were randomly selected with a total of approximately 540 male 16 to 18-year-old students.

2.3. Sampling

2.3.1. Sample size

We used this valid formula to determine the sample size for cross sectional study (23):

$$n = Z^2 p (1-p) / d^2$$

Where: n = sample size, p = percentage, picking a choice was 19.6% (11), $Z = 1.96$ for confidence level 95%, and $d = 0.05$ for confidence interval and acceptable margin error of 5% (23). Depending on this formula, the sample size was 243 and it was duplicated by cluster design effect to 486 students and increased 10% for non-response, so the total number was 535 students.

2.3.2. Sampling method

Multi-stage random sample. First stage was a simple random sample, we randomly selected 4 boys' schools out of 21 schools. In the second stage, all students in selected schools were taken as a cluster.

2.4. Measures and instruments

The students completed the self-administered questionnaires in the classroom under supervision of the researcher. The first section included the socio-demographic questions (age, residence, nationality, etc.). The other instruments are presented as follows:

2.4.1. The International Study of Asthma and Allergy in Childhood (ISAAC)

The ISAAC questionnaire was used to assess the prevalence of asthma. This is a self-administered questionnaire used to determine the prevalence of asthma among adolescents aged 13-14 years and its sensitivity and specificity were 85% and 81% respectively (24, 25). The ISAAC questionnaire was translated to Arabic language by three bilingual family medicine consultants and was translated back into English by an independent translator. The final translation was assessed and accepted by a panel of experts. The reliability of the translated questionnaire was 0.82 after a pilot study. This questionnaire covers the following variables: lifetime wheeze (if wheezing had ever occurred), current wheeze (in the past 12 months), number of wheezing attacks in the past 12 months, sleep disturbances due to wheeze, speech-limiting wheeze, physician-diagnosed asthma (if asthma had ever been diagnosed by a physician), exercise-induced wheeze, and night coughing in the past 12 months (24).

2.4.2. Asthma control test (ACT)

The ACT was used to assess the control of asthma. The ACT is a recommended and validated tool to assess asthma control by the guideline of the Saudi Initiative for Asthma (1). We used the Arabic version of ACT which is a valid tool for Arabic-speaking patients to assess asthma control with reliability of 0.92 (26). "The score of ACT is the sum of the five questions where each is scored from 1 (worst) to 5 (best) and the level of asthma control is categorized into: Controlled: An ACT score of ≥ 20 , Partially controlled: An ACT score of 16-19 and Uncontrolled: An ACT score of <16 " (1).

2.5. Data analysis

The data were analyzed by IBM© SPSS© Statistics version 20 (IBM© Corp., Armonk, NY, USA), using descriptive statistics and Chi-square test. A p-value of 0.05 or less was considered significant.

2.6. Ethical consideration

Official permission was received from the Ministry of Education. Approval for this study was obtained from the research and ethics committee at Health Affairs General Directorate, Northern Borders Region of Saudi Arabia (Reg. # H-09-A-51) with approval number: 3915. Verbal informed consent was taken from the students and the purpose of the study was explained to them. Students were assured that the surveys would be anonymous and that the data would be kept confidential during handling and storage.

3. Results

A total of 540 male students received the self-administered questionnaire. Of these, 29 questionnaires were excluded because of missing data. The concluded sample size was 511 with overall 94.6% response rate. The age of studied group was 17.08 years (± 1.1), 454 (88.9) were Saudi and 57 (11.1%) were non-Saudi people. The current study estimated that, the prevalence of asthma was 11.4%. The prevalence of lifetime wheeze, and exercise-induced wheeze was 30.3% and 19% respectively. The prevalence of night cough in the past 12 months and wheezing attack in the past 12 months was 17% and 16.8 respectively (Table 1).

Table 1. The prevalence of physician-diagnosed asthma and other symptoms in the study group

| Variables | n (total 511) | % |
|---|---------------|------|
| Physician-diagnosed asthma | 58 | 11.4 |
| Lifetime wheeze | 155 | 30.3 |
| Wheeze in the past 12 months | 86 | 16.8 |
| Number of wheezing attacks in the past 12 months (total=86) | 1-3 | 72.1 |
| | 4-12 | 16.3 |
| | > 12 | 11.6 |
| Sleep disturbances due to wheeze; nights/weel (total=43) | ≤ 1 | 51.2 |
| | >1 | 48.8 |
| Speech-limiting wheeze (total=86) | 30 | 34.9 |
| Exercise-induced wheeze | 97 | 19 |
| Night cough in the past 12 months | 87 | 17 |

Regarding severity of asthma, overall (72.1%) of the students reported less than 4 wheezing attacks in the past 12 months. The prevalence of speech-limiting wheeze was 34.9%. Additionally, in the past 12 months (48.8%) of the students have had sleep disturbance in more than one night per week due to wheezing (Table 1). The morbidity of asthma symptoms was statically significant, more so among the students who reported physician diagnosed asthma

(Table 2). Regarding asthma control, more than a half of the students diagnosed with asthma had poor control of asthma symptoms according to ACT score, including uncontrolled and partially controlled asthma each in 15 patients (25.9% each), and controlled asthma in only 28 patients (48.2%).

Table 2. Distribution of prevalence of physician-diagnosed asthma, according to morbidity in sample of 511 male adolescent, age 16-18 in Arar city, 2017-2018 academic years

| Item | Physician-diagnosed asthma, n (%) | | p-value |
|--|-----------------------------------|-----------|---------|
| | Yes | No | |
| Wheeze in the past 12 months | 27 (46.5) | 59 (13.1) | <0.001 |
| Number of wheezing attacks in the past 12 months | 1-3 | 15 (25.8) | <0.001 |
| | 4-12 | 9 (15.6) | |
| | >12 | 3 (5.1) | |
| Sleep disturbances due to wheeze | 18 (31.1) | 25 (5.5) | <0.001 |
| Speech-limiting wheeze | 13 (22.4) | 17 (3.8) | <0.001 |

4. Discussion

The present study estimated asthma prevalence in boys at adolescent age and assessed the level of their asthma control in Arar city (Capital of the Northern Borders Region in Saudi Arabia). The prevalence of physician-diagnosed asthma was 11.4%. The prevalence of asthma symptoms was 30.3% for lifetime wheeze, 16.8% for current (in past 12 months) wheezing and 19% for exercise induced wheezing throughout the past 12 months. Among students whom reported physician-diagnosed asthma, 51.8% of them have a poor control of asthma symptoms according to the asthma control test. According to the Saudi Initiative for Asthma, the available data are inadequate regarding asthma prevalence in adolescents aged 16-18 years old (1). In Saudi Arabia, asthma has an increasing pattern (9). Several studies were performed to evaluate asthma prevalence by utilizing the ISAAC survey in Saudi Arabia and other gulf countries (11, 12, 28-31). Asthma in the Northern Borders Region was within the same rate compared to other regions in KSA, and the prevalence was 6.45% according to the self-administered national household survey in 2013 (13). Now, it is alarming to know that the prevalence of asthma has markedly increased in the Northern Borders Region of Saudi Arabia from 6.45% to 11.4% over only a few years. The reason behind this rise is unknown but, it is probably because of a newly-built industrial city in the Northern Borders Region which operates on the process of Phosphate Extraction. A previous study in Saudi Arabia was conducted to compare prevalence of physician-diagnosed asthma in the industrial city of Yanbu to two nonindustrial villages (32). The study revealed high rates in industrial areas 13.9% compared to nonindustrial areas 8% (32). This study found that the prevalence of physician-diagnosed asthma was 11.4% and it is within the national range of 8% to 23% that was reported by Al Frayh et al. (9). The recent studies conducted in Saudi Arabia reported that the prevalence of physician-diagnosed asthma in Riyadh city was between 4.5% and 19.6% and in Najran city was 27.5% (10-12). Also, in other regions of Saudi Arabia such as, Madinah city, Abha city and Taif area, the prevalence of asthma was 23.6%, 9% and 13.1%, respectively (14-16). These finding indicate a clear variation in the prevalence rate between the different regions of Saudi Arabia, which might be related to lifestyle, hereditary, and different environmental factors. Furthermore, there is adequate evidence which suggests that the variability in the external allergens may demonstrate the diversity of asthma prevalence between the regions among the same kingdom (27). In addition, the prevalence of physician-diagnosed asthma in other gulf countries was reported as: 10.6% in Oman, 13% in the United Arab Emirates, 15.6% in Kuwait and 19.8% in Qatar (28-31). Our study estimated high rates of asthma symptoms. The rate of lifetime wheezing at 30.3% was higher than the reported rate from other regions in the Kingdom such as, Riyadh city which was 25.3%, Najran city (20.3%) and Jeddah city (21.2%) (11, 12, 33). Additionally, the prevalence of wheeze in the past 12 months in this study was 16.8%, which is higher than other reported rates such as, Madinah city (10.2%), Abha city (8%) and Taif area (3.4%) (14-16). These high rates of lifetime wheezing and current wheeze may be attributed to the high index of respiratory diseases that is associated with wheezing in the Northern Borders Region of Saudi Arabia. The present study revealed that the prevalence of current (past 12 months) wheeze was 16.8% in the study population, and 72.1% of them reported less than 4 wheezing attacks in the last 12 months. Additionally, the prevalence of exercise-induced wheezing and night coughing during the past 12 months was 19% and 17% respectively. According to the morbidity of asthma symptoms, the prevalence of speech-limiting wheeze was 34.9% out of the students whom reported wheezing attacks in the past 12 months. Also, among the students who experienced sleep disturbances, 48.8% have more than one sleepless night per week because of wheezing. Among students who reported no physician-diagnosed asthma, the prevalence of current (past 12 months) wheeze, speech-limiting wheeze and sleep disturbances were 13.1%,

3.8% and 5.5% respectively. These rates of morbidity have a major impact on the quality of life, and it may relate to under-diagnoses of asthma. To determine the level of asthma control, the asthmatic students completed the asthma control test (ACT). Among the physician-diagnosed asthma students (11.4%), the level of asthma control was 48.2% and the level of asthma uncontrolled was 25.9%. It is obvious that, more than half of the students who reported physician-diagnosed asthma need to step up their medication according to the guideline of the Saudi Initiative for Asthma 2016 (1). The factors of uncontrolled asthma were not assessed in this study but, many previous studies have looked for reasons behind uncontrolled asthma. Factors such as depression, poor knowledge about asthma, incorrect inhaler used, smoking and diet habits were all associated with poor asthma control (34-38). In the Northern Borders Region of Saudi Arabia, (92.5%) of the hospitals have no respiratory therapists (39). With respect to other uncontrolled asthma factors, the majority of patients with respiratory diseases in the Northern Borders Region of Saudi Arabia were receiving the services from a non respiratory therapist staff. The health care provided by eligible respiratory therapists, has a critical role in promoted patient outcome (40).

5. Strength and limitations

The present research was a descriptive cross-sectional study. This is the first study conducted in the Northern Borders Region of Saudi Arabia to estimate asthma prevalence among adolescent age. Results of this study may act as a baseline for further asthma studies in our region. The study has limitations as it is a self-administered questionnaire. Also, female students were not studied because of systems, cultures and social reasons.

6. Conclusions

The prevalence of asthma in the Northern Borders Region of Saudi Arabia was 11.4%, and 51.8% of whom were uncontrolled. The rate of asthma and asthma related symptoms is high among 16 to 18-year-old adolescents and half of the asthmatic students need to step up their medication. Awareness campaigns on asthma are recommended to be conducted by Ministry of Health for adolescents at the schools. Further studies are needed to explore the factors of uncontrolled asthma, and to assess the physicians' understanding and implementation of the SINA guidelines for the diagnosis and management of asthma.

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Conflict of Interest:

There is no conflict of interest to be declared.

Authors' contributions:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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