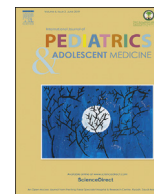


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International Journal of Pediatrics and Adolescent Medicine

journal homepage: <http://www.elsevier.com/locate/ijpam>

Invited review

The prevalence of childhood asthma in Saudi Arabia

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ARTICLE INFO

Article history:

Available online 14 June 2019

Keywords:

Asthma
Childhood
Epidemiology
Pediatric
Saudi Arabia

ABSTRACT

Asthma is considered one of the most important health issues worldwide. However, few epidemiological studies have been conducted in Saudi Arabia to assess the prevalence of asthma among children, and their results are highly variable. Thus, in this study, we investigated the prevalence of childhood asthma in Saudi Arabia. Previous studies of the prevalence of childhood asthma in Saudi Arabia were reviewed and 12 were included in this review. These studies were conducted at various locations in Saudi Arabia between 1986 and 2017. The prevalence of children asthma in Saudi Arabia varies among different regions throughout the country. The highest prevalence was reported in Alhofuf (33.7%) and the lowest in Abha (9%). However, various surveying methods were used and different age groups were assessed. This review highlights the need to conduct a national-level study using a single validated tool to assess the prevalence of childhood asthma in Saudi Arabia in order to calculate the burden of asthma and determine the targeted allocation of resources and manpower.

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1. Introduction

Asthma is one of the most important global health issues. People from different age groups are affected by this disease throughout the world, where it influences their physical well-being and quality of life. Clearly, asthma imposes a severe economic burden on healthcare systems. A study conducted in the United States found that the annual direct cost of asthma was 37.2 million USD [1], and an Emirati study performed in Dubai determined an annual direct cost of 88 million dirham [2]. In Oman, excluding medications, the cost of childhood asthma management was calculated as 27,014,735 Omani Riyals [3].

It has been reported that the prevalence of asthma is increasing worldwide, especially among children [4]. In 2014, the Global Asthma Network reported that the number of asthmatic people throughout the world had reached 334 million individuals [5]. A cross-sectional study conducted in Yemen during 2010 with children aged 13–14 years showed that the prevalence of asthma was 14.4% [6]. Another study performed in Egypt during 2016 with

children aged 6–12 years determined a prevalence rate of 6.3% [7].

Few epidemiological studies have been conducted in Saudi Arabia to assess the prevalence of asthma among children and their results are highly variable. Therefore, we conducted a systematic literature review to evaluate the prevalence of childhood asthma in Saudi Arabia because determining the incidence of common bronchial asthma among children can help physicians to understand the magnitude of this health issue, as well as supporting the planning and allocation of resources.

2. Studies selection

The studies considered in this systemic review were primarily identified using Google Scholar, PubMed, and the Saudi Digital Library. The search terms selected were “asthma,” “prevalence,” and “children.” Additional sources of potential studies comprised some of the references cited in the studies identified. The search was limited to studies written in English. Abstracts and titles were reviewed initially to assess their relevance to the topic. The selected articles were then read carefully to delete any duplications or misleading titles. Nineteen articles were retrieved and four were excluded because the main manuscripts were not available online and the authors were not able to reach the main authors [8–11]. One article was excluded because it contained false data [12]. A data collection form was designed that contained the components

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Peer review under responsibility of King Faisal Specialist Hospital & Research Centre (General Organization), Saudi Arabia.

required from each study (first author name, location, date, ages of participants, assessment tool employed, and main findings).

3. Results

The search yielded 12 studies that aimed to assess the prevalence of pediatric asthma in different cities and regions of Saudi Arabia, and all were included in this systemic review.

All of the studies were observational studies and they were conducted at various locations in Saudi Arabia between 1986 and 2017. No national level prevalence studies were found. Six studies used the International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire, which is a validated tool for assessing the prevalence of allergic diseases in children.

Table 1 [13–24] shows the author(s) names, study year, location, sample size, instrument employed, and the main findings for each study.

4. Discussion

Our findings showed that limited research has been conducted into the prevalence of asthma in Saudi Arabia. The average number of research studies in this area was 0.4 per year over the last 30 years.

Six of the 12 studies used the ISAAC questionnaire to evaluate the prevalence rate of childhood asthma. This questionnaire was developed as part of a program initiated in 1990 based on collaborative research between two teams from New Zealand and Germany. This program aimed to determine the worldwide trend in the prevalence of asthma and to develop a framework for future etiological assessments of the factors related to asthma development and control [25]. The most recent phase of ISAAC (2003) found that the global prevalence of asthma was somewhat lower compared with that in phase I (1993), but the prevalence was still increasing in highly populated countries, such as those in Africa, Latin America, and parts of Asia. Thus, asthma imposes a major healthcare burden that needs to be addressed [26].

The ISAAC study was an international multi-center study that provided the first population-based assessment of the prevalence and severity of asthma among children in many countries throughout the world [26], but it still had many limitations, such as those related to differences in language, educational level, socio-economic status, the availability and quality of health care, and the environment and climate [27]. The ISAAC study was also based only on information provided by patients and their families, and an objective measure was not employed to accurately confirm the diagnosis of asthma in the sample considered.

Our review showed that the prevalence of asthma in Saudi Arabia varied among different areas of the country. Saudi Arabia is the 13th largest nation in terms of land area. The climate is hot and arid with relatively cool nights. Some regions are situated inland and above sea level, whereas others are located on the coasts of the Red Sea and Persian Gulf [28]. Studies have shown that the prevalence of asthma symptoms is inversely related to variations in the altitude, temperature, and humidity [29]. Thus, these factors may have contributed to the variations in the prevalence of asthma among different regions of Saudi Arabia, as suggested by the prevalence in Abha [22] at 2270 m above sea level and in Madinah [18] at 620 m above sea level, where the prevalence rates were determined as 4% and 15.5%, respectively.

According to our review, studies that used the ISAAC determined prevalence rates of 4%–33.7% for asthma diagnosed by physicians among children in Saudi Arabia. The lowest prevalence rates were found in Abha [22] and Jazan [13], and the highest in Najran [15] and Al-Hofuf [20]. These studies attributed the higher

prevalence of asthma to male gender, dietary habits, having pets at home, and exposure to environmental factors.

According to the Saudi Initiative for Asthma, the prevalence of asthma is not known among adults and the prevalence in Saudi children ranges from 8% to 25% based on studies conducted over the past three decades [30]. These studies were reported by Al-Faryh et al. based on the longest epidemiological study to assess childhood asthma in Saudi Arabia. The studies were conducted in 1986, 1995, and 2003 over a period of 17 years in various regions of the country and the survey method employed was similar to the ISAAC questionnaire. The conclusions of these studies indicated that there was a sharp increase in the prevalence of asthma between 1986 and 1995 [24], followed by a downward trend between 1995 and 2003 [20]. However, it should be noted that this study did not track the prevalence of asthma in the same cities, but instead they investigated similar cities in terms of their geographical characteristics.

Three other studies used questionnaires to assess the prevalence of asthma. The first study was conducted in Al-Khobar during 2000 [21] and it determined a cumulative prevalence rate for questionnaire-diagnosed asthma of 9.5%. The second was conducted in Taif [16] during 2015 and it found an overall prevalence rate for asthma of 13.4%, where asthma was more common in younger children. The third study was conducted in Abha [14] and it determined a prevalence rate of 9.5%. However, direct comparisons of these studies are not possible because insufficient information was collected by the surveying methods employed, and the age groups and climate differed between the two cities.

Furthermore, two studies conducted in Jazan [13] and Taif [16] showed that asthma was more prevalent in rural areas than urban areas in Saudi Arabia. These findings were associated with variations in the living conditions, allergens, and socio-economic status between urban and rural areas. However, the differences in these findings were not statistically significant. The opposite results were obtained in another study conducted in Jeddah and surrounding villages (P value < 0.001), which is similar to the results of other international studies conducted in Ghana [31] and Zimbabwe [32].

5. Limitations of the review

This review considered all previous studies that determined the prevalence of asthma among children in Saudi Arabia, but several limitations must be highlighted. In particular, the studies that we reviewed employed different questionnaires for data collection, and there were also differences in the sample size, ages of the children, and sampling location.

6. Conclusion

The prevalence of asthma among children in Saudi Arabia varies among different regions of the country. The highest prevalence was reported in Alhofuf and the lowest in Abha. However, different surveying methods were employed and different age groups were assessed. This review highlights the need to conduct a national-level study using a single validated tool to assess the prevalence of childhood asthma in Saudi Arabia in order to calculate the burden of asthma and facilitate the targeted allocation of resources and manpower.

Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Table 1
Studies that investigated the prevalence of asthma among children in various cities in Saudi Arabia [13–24].

Reference	Study design	Year	City	N	Age (years)	Method of assessment	Conclusions
A Khawaji [13]	Cross-sectional study (random sampling from schools)	2017	Jazan	1400	10–15	ISAAC Questionnaire	<ul style="list-style-type: none"> - The prevalence of life-long wheeze was 17.7% - Prevalence rates of exercise-induced wheeze and wheeze during the last 12 months were 14.7% and 11.4%, respectively. - Students with past medical history of asthma = 5.1% - Asthma confirmed by a doctor in 10% of participants - Life-long wheeze prevalence in rural area = 10.8% - Life-long wheeze prevalence in urban area = 6.9%
S Imam [14]	Cross-sectional study (random sampling from schools)	2016	Ahad Rubaida City, District Abha	200	15–18	Constructed questionnaire	<ul style="list-style-type: none"> - The cumulative prevalence of questionnaire-diagnosed asthma (QDA) in the total sample was 9.5% - The highest prevalence of QDA (14%) was among school boys aged between 12 and 15 years but with no statistical significance - The overall prevalence of physician-diagnosed asthma was 8%
J Alqahtani [15]	Cross-sectional study (random sampling from schools)	2014–2016	Najran	1700	7–19	Modification of the ISAAC questionnaire.	<ul style="list-style-type: none"> - The overall prevalence of physician-diagnosed asthma was 27.5% - Asthma prevalence among males was 32.3% - Asthma prevalence among females was 22.7%
F Hamam [16]	Cross-sectional (convenience sample from schools and two major hospitals)	2014	Taif	1700	<3 to 18	Pretested questionnaire	<ul style="list-style-type: none"> - The overall asthma prevalence rate was 13.4% - Asthma prevalence among males was 12.4% - Asthma prevalence among females was 14.4% - Asthma prevalence in rural areas was 16.7% - Asthma prevalence in urban areas was 12.4% - The overall prevalence of physician-diagnosed asthma was 19.6% - Asthma prevalence among males was 21.5% - Asthma prevalence among females was 17.8%
M Al Ghobain [17]	Cross-sectional study (random sampling from schools)	2012	Riyadh	3073	16–18	ISAAC	<ul style="list-style-type: none"> - The overall prevalence of physician-diagnosed asthma was 19.6% - Asthma prevalence among males was 21.5% - Asthma prevalence among females was 17.8%
M Nahhas [18]	Cross-sectional (random sampling from schools)	2009	Madinah	5188	6–9	ISAAC questionnaire	<ul style="list-style-type: none"> - The overall prevalence of children with parental reports of ever having been diagnosed with asthma was 15.5% - Asthma prevalence among males was 16.9% - Asthma prevalence among females was 12.2% - The prevalence rate of asthma was 24% - The study concluded that the prevalence of asthma among Saudi children increased every year in Makkah
S Alharthi [19]	Retrospective study (random selection from one hospital)	2002–2006	Makkah	150	<5	Constructed questionnaire form using medical records	<ul style="list-style-type: none"> - The cumulative prevalence rate for childhood asthma was 21.7% - The prevalence of asthma in Hofuf was 33.7% - The prevalence of asthma in Riyadh was 17.7% - The prevalence of asthma in Jeddah was 14.1% - The study concluded that the prevalence of childhood asthma exhibited a downward trend
A. Alfaryh [20]	Cross-sectional study (random sampling from schools)	2002	Riyadh Jeddah Hofuf	Total = 1678 Riyadh = 555 Jeddah = 574 Hofuf = 549	7–15	Standardized questionnaire similar to ISAAC	<ul style="list-style-type: none"> - The prevalence of asthma in Hofuf was 33.7% - The prevalence of asthma in Riyadh was 17.7% - The prevalence of asthma in Jeddah was 14.1% - The study concluded that the prevalence of childhood asthma exhibited a downward trend
K Al-Dawood [21]	Cross-sectional (random sampling from schools)	2000	Alkhobar	1482	6–15	Constructed questionnaire	<ul style="list-style-type: none"> - The cumulative prevalence of questionnaire diagnosed asthma was 9.5% - This study only comprised males
M. Alshehri [22]	Cross-sectional study (random sampling from schools)	2000	Abha	4300	5–17	ISAAC questionnaire	<ul style="list-style-type: none"> - The prevalence of doctor-diagnosed asthma was 4%. - The prevalence of wheeze in the past year was 9% - The prevalence of exercise-induced wheezing was 4% - Based on asthma-related symptoms, the overall prevalence of asthma was estimated as 9%
N Hijazi [23]	Cross-sectional study (stratified sampling from schools)	1997	Jeddah and surrounding villages	1444	12	ISAAC questionnaire	<ul style="list-style-type: none"> - The overall prevalence of asthma was 12.1% - The prevalence rate of asthma among urban children was 14.9% - The prevalence rate of asthma among rural children was 5.4%
A Alfaryh [24]	Comparative study (random sampling from schools)	1986–1995	Riyadh vs Hail Jeddah vs Gizan	Riyadh = 1986 Hail = 1008 Jeddah = 2123 Gizan = 1995	8–16	Standardized questionnaire similar to ISAAC	<ul style="list-style-type: none"> - The prevalence of asthma in Jeddah and Riyadh during 1986 was 8% - The prevalence of asthma in Hail and Gizan during 1995 was 23% - It was concluded that the prevalence of asthma increased in the study period

Source of support

None.

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