A Systematic Review of the Prevalence of Atopic Diseases in Children on the Arabian Peninsula

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Significance of the Study

- Studying the prevalence of atopic diseases and food allergy is important. The reported overall rates of these diseases in countries of the Arabian Peninsula are comparable to those reported in other industrialized countries. Health authorities should provide resources to facilitate early diagnosis and consider preventive measures which may help reduce economic burden.

Keywords

Atopic disease · Arabian Peninsula · Asthma · Eczema · Food allergy

Abstract

Objectives: To study the available data on the prevalence of atopic diseases and food allergy in children living on the Arabian Peninsula. **Methods:** A PubMed search for relevant published articles was conducted using the following search terms singly or in combination: "atopy," "atopic disease," "atopic disorder," "International Study of Asthma and Allergies in Childhood," "ISAAC," "asthma," "allergic rhinitis," "eczema," and "food allergy" in combination with the names of countries of the Arabian Peninsula (Kuwait, United Arab Emirates, Bahrain, Qatar, Oman, Kingdom of Saudi Arabia, and Yemen). The search captured studies published up to December 2017. **Results:** A total of 8 publications reporting

prevalence rates of any type of atopic disease in children in 7 countries of the Arabian Peninsula were retrieved. The prevalence of all atopic disorders was comparable between countries of the Arabian Peninsula. The overall prevalence of asthma ranged from 8 to 23%, while the reported prevalence of eczema ranged from 7.5 to 22.5%. There was great variation in the prevalence rates of rhinoconjunctivitis, which ranged from 6.3 to 30.5%. The prevalence of food allergy (8.1%) was reported for 1 country only, the United Arab Emirates. **Conclusions:** The reported overall rates of atopic disease in countries of the Arabian Peninsula are comparable to those reported in other industrialized countries. This is probably related to the good economic status in the region, which is reflected in the living standards and lifestyle. Further, genetic factors, such as factors related to gene polymorphism, and the high rate of consanguinity in the region may contribute to the higher prevalence of atopic diseases.

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Introduction

There has been a dramatic rise in the prevalence of atopic diseases in both developed and developing countries, especially in children. The phase III International Study of Asthma and Allergies in Childhood (ISAAC) reported a worldwide increase in the prevalence of atopic disorders over results obtained in the phase I study [1]. This report showed an increase in symptoms of eczema which was greatest in children aged 6–7 years compared to asthma and allergic rhinoconjunctivitis and compared to incidences in other age groups.

Atopic diseases are closely related. The manifestations may present in a characteristic sequence in children that has been named the atopic or allergic march [2]. Although the atopic march is highly controversial and only a minority of patients follow this march [3], the first signs of atopic diseases are usually food allergy and atopic dermatitis. As these signs of atopic disease are often observed in the first 3 years of life and are thought to be related to the maturation of the immune system [2]. Symptoms may persist over years or decades and often abate spontaneously with age. Having one atopic disorder is considered a risk factor for the development of a second atopic disorder. However, sequential appearance of atopic disorders is not usually because one disorder causes another, but rather because certain individuals exhibit atopic disorders which are influenced by sequential exposure to environmental factors [4].

The causes of atopic disorders include genetic and nongenetic factors. Some debate exists as to whether or not lifestyle, including socioeconomic status, and environmental pollutants play a role in the development of atopic disorders in children [5, 6]. A subanalysis of data from the ISAAC phase I study showed a weak relationship between environmental variables and reported symptoms of asthma, rhinoconjunctivitis, and eczema [7]. In addition to an increase in the prevalence of food allergy, their severity and complexity are increasing worldwide [5, 8]. Approximately 8% of children younger than 3 years may be affected by food allergy, with prevalences in children with eczema estimated to be as high as 30% [4]. Symptoms of cow's milk allergy are often apparent before 1 month of age, although tolerance may be evident in approximately half of children by 3 years and in 66% by 5 years [9].

Individual and family quality of life may be negatively affected in families with a child with multiple food allergy and coexisting allergic conditions such as eczema, rhinoconjunctivitis, or asthma. On a broader level, these condi-

tions can have a relevant impact on healthcare economics. There are little available data on the prevalence of atopic disorders and food allergy in children living on the Arabian Peninsula. This paper aimed to study the available data on the prevalence of atopic diseases and food allergy in this region.

Methods

We conducted this systematic review according to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10]. A PubMed search for articles of relevance to the prevalence of atopic disease in children in countries of the Arabian Peninsula was conducted (Fig. 1). The following search terms were used either singly or in combination: "atopy," "atopic disease," "atopic disorder," "International Study of Asthma and Allergies in Childhood," "ISAAC," "asthma," "allergic rhinitis," "eczema," and "food allergy" in combination with the names of countries of the Arabian Peninsula (Kuwait, United Arab Emirates (UAE), Bahrain, Qatar, Oman, Kingdom of Saudi Arabia [KSA], and Yemen). The search captured studies published up to December 2017. Data from each of the publications are presented in a descriptive manner.

Results

A total of 8 publications reporting prevalence rates of any type of atopic disease in children in a country of the Arabian Peninsula were found: 1 from the KSA, 2 from the UAE, 2 from Kuwait, 2 from Oman, and 1 from Qatar. No publications reporting the prevalence of atopic diseases in Yemen and Bahrain were found. A brief description of the study design, results, and conclusions from the publications included in this study is presented in Table 1.

Prevalence of Atopic Disorders

The prevalence of all atopic disorders was comparable between countries of the Arabian Peninsula and highest in Qatar. The overall prevalence of asthma ranged from 8 to 23%. The reported prevalence of eczema ranged from 7.5 to 22.5%. There was great variation in the prevalence rates of rhinoconjunctivitis, which ranged from 6.3 to 30.5% (Table 2).

Prevalence of Food Allergy

The prevalence of food allergy was reported for 1 country, the UAE [11]. In a sample of children aged 6–9 years, the rate of physician-diagnosed food allergy in the UAE was 8.1%. The most common food allergens identified were eggs, fruits, and fish.

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram of information through the different phases of the systematic review.

Changes in Prevalence in Individual Countries

Two papers used the ISAAC questionnaire to estimate the prevalence of asthma and allergic diseases in school-children aged 13–14 years living in Kuwait [12, 13]. A comparison of results obtained from the 1995/1996 study with those obtained from the 2001/2002 study indicated a significant decrease in self-reported symptoms of allergic rhinitis, while the rate of physician-diagnosed allergic rhinitis significantly increased over time. While self-reported symptoms of asthma significantly decreased, there was no change over time in the rate of physician-diagnosed asthma. The rates of physician-diagnosed eczema remained unchanged from the 1995/1996 study to the 2001/2002 study.

Using a modified version of the ISAAC questionnaire, Al Frayh et al. [14] compared the prevalence of asthma, allergic rhinitis, and eczema in a coastal versus an inland city in the KSA in 1986 and 1995. In children aged 8–6 years, the rate of asthma increased significantly from 8% in 1986 to 23% in 1995, and the prevalence of allergic rhinitis increased from 20 to 25%. No significant change in the prevalence of eczema was found: 12% in

1986 and 13% in 1995. Using data from the ISAAC phase I and phase III studies, Al-Rawas et al. [15] found no change after 6 years in the rate of asthma symptoms and diagnosis in children aged 6–7 or 13–14 years living in Oman. Similarly, a comparison of data from the two study periods showed no relevant change in the prevalence of self-reported symptoms of severe asthma in either age group.

Factors Contributing to Atopic Disorders

In addition to collecting data on the prevalence of atopic disease, the relationship between independent variables, such as environment and genetics, on the presence of atopic disease was reported in some studies. Al Frayh et al. [14] attributed the significant increase in asthma between 1986 and 1995 in the KSA to environmental factors. In 1986, 17% of asthmatic children had one or more family members who smoked cigarettes compared to 35% in 1995. In 1986, 14% of children with asthma were living in homes with pets compared to 34% in 1995. In Qatar, Janahi et al. [16] found a high correlation between parental history of asthma and the occur-

Table 1. Summary of studies included in the analysis of the prevalence of atopic disease on the Arabian Peninsula

Country and reference(s)	Study aims and design	Results	Conclusion
Kingdom of Saudi Arabia Al Frayh et al. [14], 2001	investigate the change in asthma prevalence between 1986 and 1995 in children aged 8–16 years; random selection of participants living in a coastal and inland city; ISAAC-based questionnaire used	$n = 2,123$ (1986), $n = 1,008$ (1995); the majority of children with asthma at both time points were aged 8–12 years; significant increase in asthma and allergic rhinitis; no change in eczema; significant increase in asthma if ≥ 1 family member smoked cigarettes	significant increase over 9 years in prevalence of asthma and allergic rhinitis
United Arab Emirates Al-Hammadi et al. [11], 2010	determine the prevalence of physician-diagnosed food allergy and atopic disorders in children aged 6–9 years; multistage random sampling used; modified ISAAC questionnaire used	$n = 397$, mean age 7.2 years; significantly higher rate of atopic disorders in children with food allergy	eggs, fruits, and fish main allergens; risk factors included family history and small number of siblings; strong association between food allergy and atopic disorders
United Arab Emirates Al-Maskari et al. [27], 2000	determine the prevalence of asthma, wheeze, hay fever, and eczema in children aged 6–13 years; ISAAC questionnaire used	$n = 3,200$	prevalence of asthma and wheeze consistent with prevalence rates in neighboring countries
Kuwait Behbehani et al. [12], 2000; Owayed et al. [13], 2008	estimate the prevalence of asthma and allergic disease; children aged 13–14 years; ISAAC questionnaire used; phase I conducted 1995–1996; phase III conducted 2001–2002	$n = 3,110$ (phase I), $n = 2,882$ (phase III); prevalence of asthma and respiratory symptoms higher in boys than girls	physician-diagnosed asthma and eczema rates unchanged; physician-diagnosed allergic rhinitis increased significantly
Oman Al-Riyami et al. [28], 2003 (ISAAC phase I)	determine the prevalence and severity of asthma, allergic rhinitis, and eczema in schoolchildren; ISAAC questionnaire used; conducted in 1995–1996	$n = 3,893$ (6–7 years), $n = 3,174$ (13–14 years); prevalence of diagnoses of asthma, allergic rhinitis, and eczema higher in older children than in younger children; allergic rhinitis and eczema associated with sleep disturbance and limitation of activity	prevalence of symptoms and diagnoses of asthma, allergic rhinitis, and eczema high and associated with significant morbidity and underrecognition
Oman Al-Rawas et al. [15], 2008	data from ISAAC phase I and III analyzed to identify changes in wheeze prevalence and patient-reported asthma	$n = 7,067$ (phase I), $n = 7,879$ (phase III); no significant change in self-reported asthma or asthma symptoms; highest prevalence of asthma in eastern region of Sharqiya; increases in wheeze and asthma significant in children aged 6–7 years	regional differences in self-reported asthma symptoms, persistent increases in Sharqiya region; differences possibly due to genetic and/or environmental risk factors; findings suggest underdiagnosis and/or poor recognition of asthma
Qatar Janahi et al. [16], 2006	determine asthma and allergic disease prevalence; ISAAC used; conducted in 2003–2004	$n = 3,283$; mean age 9 years; asthma and allergic rhinitis highest in children aged 6–8 years, eczema highest in children aged 12–14 years; high correlation between parental history and disease; 72% with asthma had either allergic rhinitis or eczema	prevalence of asthma, eczema, and allergic rhinitis higher in Qatar than in developing and some developed countries, but similar to rates in neighboring countries

ISAAC, International Study of Asthma and Allergies in Childhood.

rence of asthma, allergic rhinitis, and eczema in their children.

A few reports have described the genetic predisposition to asthma on the Arabian Peninsula (Table 3). Polymorphisms in the high-affinity IgE receptor (FcεRIβ) in the Kuwaiti population and in IL-13, STAT-6, and the IL-4 receptor alpha subunit (IL-4Rα) in the Saudi popula-

tion were associated with an increased risk of developing asthma [17–22]. In an evaluation of genetic disposition to food allergy in the UAE, Al-Hammadi et al. [11] found that children with fewer siblings and with a family history of food allergy were more likely to have food allergy themselves.

Table 2. Prevalence of asthma, eczema, rhinoconjunctivitis, and food allergy on the Arabian Peninsula

Country and reference	Prevalence of atopic disorder			
	asthma	eczema	rhinoconjunctivitis	food allergy
Kingdom of Saudi Arabia Al Frayh et al. [14], 2001	8% (1986) 23% (1995)	12% (1986) 13% (1995)	20% (1986) 25% (1995)	–
United Arab Emirates Al-Hammadi et al. [11], 2010	13.6%	8.8%	6.3%	8.1%
United Arab Emirates Al-Maskari et al. [27], 2000	13%	11%	14.9%	–
Kuwait Behbehani et al. [12], 2000 (ISAAC phase I)	16.8% (13–14 years)	17.1% (13–14 years)	11.3% (13–14 years)	–
Kuwait Owayed et al. [13], 2008 (ISAAC phase III)	15.6% (13–14 years)	22.2% (13–14 years)	12.8% (13–14 years)	–
Oman Al-Riyami et al. [28], 2003 (ISAAC phase I)	10.5% (6–7 years) 20.7% (13–14 years)	7.5% (6–7 years) 14.4% (13–14 years)	7.4% (6–7 years) 10.5% (13–14 years)	–
Oman Al-Rawas et al. [15], 2008 (ISAAC phase III)	10.6% (6–7 years) 19.8% (13–14 years)	–	–	–
Qatar Janahi et al. [16], 2006	19.8%	22.5%	30.5%	–

ISAAC, International Study of Asthma and Allergies in Childhood.

Table 3. Gene polymorphism and predisposition to asthma on the Arabian Peninsula

Country	Gene	Variant	Disease association	Reference
Kuwait	FcεRIβ IL-4	Leu181/Leu183 C590T	yes no	17 18
Kingdom of Saudi Arabia	IL-13	rs20541	yes	19
		rs1295686	yes	
		rs1800925	no	
		rs762534	no	
	STAT-6 (C2892T)	rs324011	yes	20
		rs324015	no	
	IL-4Rα	rs1805010	yes	21
	GLCCI1	rs1801275	yes	22
		rs37972	no	
		rs37973	no	

Discussion

Research on the epidemiology of atopic diseases in children has helped provide a better understanding of the occurrence of these disorders. Previously, the lack of a standardized method to collect epidemiological data presented an obstacle to identifying the actual prevalence or changes in disease prevalence. Implementation of the ISAAC questionnaire, however, has greatly enhanced the quality of information collected and allowed a comparison of the prevalence of atopic disorders between different age groups as well as between populations in different countries.

While many of the publications included in this review used the ISAAC questionnaire or a modified version thereof as an instrument of data collection, differences in methodology make it difficult to draw definitive conclusions about the prevalence of atopic disorders on the Arabian Peninsula. It is also important to highlight the limitation of the ISAAC criteria for atopic dermatitis, which

may also include allergic contact dermatitis and possibly also other less frequent pruritic dermatoses [23].

There were variations in the prevalence of atopic diseases among populations from different ethnicities and geographic areas. This could be attributed to differences in both genetic and environmental factors. The reported overall rates of atopic disorders in countries of the Arabian Peninsula are closer to those reported in industrialized countries than the rates in developing countries. For example, the rates of asthma, allergic rhinitis, and eczema in children aged 6–7 years living in Canada were 20, 12.9, and 17%, respectively [1]. By comparison, the rates of asthma, allergic rhinitis, and eczema in children aged 6–7 years living in India were 6.8, 3.9, and 2.4%, respectively, much lower than the rates reported in children from the Arabian Peninsula [1].

It can be assumed that the good economic status in the Arabian Peninsula region is reflected in the living standards and lifestyle. While greater affluence may have a positive impact on overall health, increased industrialization with subsequent increased exposure to pollutants may adversely impact the prevalence of some atopic diseases. An ecological analysis of the ISAAC phase I data revealed an association between economic development and changes influencing asthma, rhinoconjunctivitis, and eczema [7]. The increase in plantation and agricultural activities using nonnative trees and seeds may possibly contribute to the prevalence of atopic diseases in this region. In addition, countries of the Arabian Peninsula experience extremely hot weather, and due to changes in lifestyle, children are spending less time outdoors, which results in decreased exposure to ultraviolet rays. This may play a role in the relatively high prevalence of eczema [24]. Other possible contributing factors might include changes in health services with less exposure to microbial agents, widespread use of antibiotics and vaccines, and an increased awareness among healthcare professionals about atopic diseases. Further, genetic factors, such as factors related to gene polymorphism, and the high rate of consanguinity in the region may also play a role in the higher prevalence of atopic diseases.

Unfortunately, there is only 1 report on the prevalence of food allergy on the Arabian Peninsula. The prevalence of food allergy in one city in the UAE is similar to that reported for children in the US [25]. Without comparable data from other countries on the Arabian Peninsula, it is difficult to draw clear conclusions.

While this evaluation of available studies provides a basis for the assessment of the prevalence of atopic diseases in children on the Arabian Peninsula, a more sys-

tematic approach to gathering relevant literature might yield data of benefit in identifying not only the scope of the problem, but also information on allergen exposure, diet, air pollution, and genetic factors which are known to be associated with the development of atopic disorders or could exacerbate the manifestations of these disorders [7]. More objective data, such as better characterization of type and severity of asthma and confirmation of sensitization by either skin or specific IgE testing, are also needed to obtain a true picture of the scope of the problem of atopic disease in the region. Performing epidemiological studies on atopic diseases in Bahrain and Yemen is also important. These two countries have a somewhat lower economic status compared to the other countries assessed in this study, although their populations share the same genetic pool. Accordingly, such studies will help determine the effect of lifestyle versus genetic factors on the development of atopic diseases [26]. Since the diagnosis of food allergy is usually associated with atopic diseases and because of the likely role that food allergy plays in the later development of atopic disorders leading most experts to conclude that food allergy is a first step in the allergic march, studying the prevalence and pattern of food allergy in the region is highly recommended.

Conclusions

Studies evaluating both atopic disorders and food allergy could yield critical information to support intervention for the prevention of atopic disorders and for strategies to guide the diagnosis and management of these disorders. Implementation of strategies to facilitate patients' access to allergy services, introduction of modern diagnostic and therapeutic options, and physician education about atopic diseases are among the major challenges to provide better care to patients suffering from these diseases.

Disclosure Statement

The author has no conflicts of interest to declare.

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