Increased prevalence of asthma in Saudi Arabia

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Background: Bronchial asthma is among the most common chronic illnesses of childhood. A number of reports in the recent past suggest that the prevalence of asthma is increasing globally.

Objective: To investigate the changing prevalence of asthma in the Kingdom of Saudi Arabia.

Subjects and Methods: Two populations of schoolchildren between the ages of 8 and 16 years were studied using an internationally designed protocol in 1986 and 1995. The questionnaire used in these studies was very similar to the one used in the International Study of Allergy and Asthma in Childhood. A total of 2,123 schoolchildren in 1986 (Jeddah and Riyadh) and 1,008 schoolchildren in 1995 (Hail and Gizan) were enrolled in the surveys. These cross-sectional studies of randomly selected schoolchildren were statistically analyzed using ANOVA and a *Z* test.

Results: The comparison of data between Riyadh versus Hail (inland desert dry environment) and Jeddah versus Gizan (coastal humid environment) revealed that the prevalence of asthma in the similar populations increased significantly from 8% in 1986 to 23% in 1995 ($P < .0001$). Likewise, the prevalence of allergic rhinitis also increased from 20% to 25% ($P < .003$) since 1986. However, no significant change in the prevalence of eczema (from 12% to 13%) was noted between 1986 and 1995.

Conclusions: The study indicates that there was a significant increase in the prevalence of bronchial asthma and, to a lesser extent, in the prevalence of allergic rhinitis in the Kingdom of Saudi Arabia during this 9-year period. The study also revealed increased exposure to environmental factors such as tobacco smoke and indoor animals in Saudi houses. It seems that the continuing changes in contemporary life may well have contributed to the increased prevalence of asthma in the country.

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INTRODUCTION

Allergic diseases are among the most common health disorders of childhood.[1,2] The overall prevalence of allergic disorders in children has been reported to be as high as 41% in Western countries,[3–8] with bronchial asthma having been shown to be a leading cause of morbidity and mortality among these allergic disorders.[9] Despite the recent advances in our understanding of the pathogenesis of asthma and improved treatment for this important disease, the prevalence of asthma is increasing.[10]

A number of epidemiologic studies show that the cumulative prevalence of wheeze and asthma has increased in children in the recent past.[11–13] This makes it important to ascertain whether this is because of a true increase in the incidence of asthma, an increase in the frequency and severity of asthma symptoms, or an increased awareness in the medical profession with regard to the diagnosis of asthma. Addressing this issue, two surveys conducted 13 years apart[14] have shown that the increase in the prevalence of asthma in schoolchildren is real, but the changes in diagnostic criteria may partly be responsible for some of the observed increase in schoolchildren.

Accurate measurement of the prevalence of asthma is difficult because of the lack of a clear definition of asthma.[15] Most of the old and some of the newer definitions of asthma[16,17] are based on variable airflow obstruction, and this definition is still followed in clinical practice. The most recent definitions, however, emphasize asthma as an inflammatory disease.[16] These definitions are descriptions of characteristics of asthma and fail to provide clear guidelines to distinguish asthmatic patients from nonasthmatic patients. Therefore, the diagnosis of asthma remains clinical as before. For epidemiologic purposes, information obtained in response to questions on the symptoms of asthma seems to be more reliable than objective measurement such as bronchial hyperresponsiveness.[18] A combination of information regarding the symptoms of asthma and the clinical diagnosis by a physician, therefore, seems to be a useful tool for evaluation of the prevalence of asthma in a community.

The majority of the estimates of the prevalence of asthma is based on the data from questionnaires asking about asthmatic symptoms or else from the diagnosis performed by a physician. A study of Scottish children estimated that the prevalence of wheeze increased from 10% to 19.8% over a period of 25 years.[19] As the context of the questionnaire was not standardized between the two studies, this estimate of increase may be unreliable. The standardized questionnaire used in the International Study of Allergy and Asthma in Childhood (ISAAC) study did not exist at the time when our first study in 1986 was conducted. For our two investigations, a standardized questionnaire comprised 35 questions very similar to the ISAAC study and was used to determine the prevalence of asthma among schoolchildren in the Kingdom of Saudi Arabia (KSA) in 1986 (Riyadh and Jeddah) and 1995 (Hail and Gizan).[20,21] Because many epidemiologic studies have confirmed

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the relationship between asthma, allergic rhinitis, and eczema, which was first established more than 100 years ago,[22] data regarding the prevalence of allergic rhinitis and eczema were also collected.

The cities of Riyadh and Hail share common geographical and environmental conditions in that they both have an inland desert dry environment, whereas the cities of Jeddah and Gizan both have a coastal humid environment. Therefore, the geographical and environmental factors would have little, if any, effect on the comparison and interpretation of results in these studies. This paper compares the prevalence of asthma in Saudi schoolchildren in 1986 to that in 1995, a period of 9 years.

Subjects and Methods

A total of 2,123 and 1,008 schoolchildren between 8 and 16 years were included in the studies of 1986 and 1995, respectively. The schoolchildren were selected randomly as subjects of a cross-sectional population study conducted in the coastal city of Jeddah and the inland city of Riyadh in 1986, and the coastal city of Gizan and the inland city of Hail in 1995.

Questionnaires[20] were distributed for parents to complete under the supervision of medical personnel. Professor Anne Woolcock of University of Sydney, Australia and Professor J.D. Wilson, University of Auckland, New Zealand originally designed the questionnaire comprising 35 questions. Apart from the demographic details, this survey included questions on the symptoms of asthma, physician-diagnosed asthma, rhinitis, eczema, family history of these conditions, and exposure to predisposing factors such as cigarette smoke and pets. The same questionnaire was used in both the studies for the purpose of standardization. The data were analyzed on an IBM computer at the College of Medicine of the King Saud University. ANOVA and a *Z* test were used to compare the data drawn from the different populations.

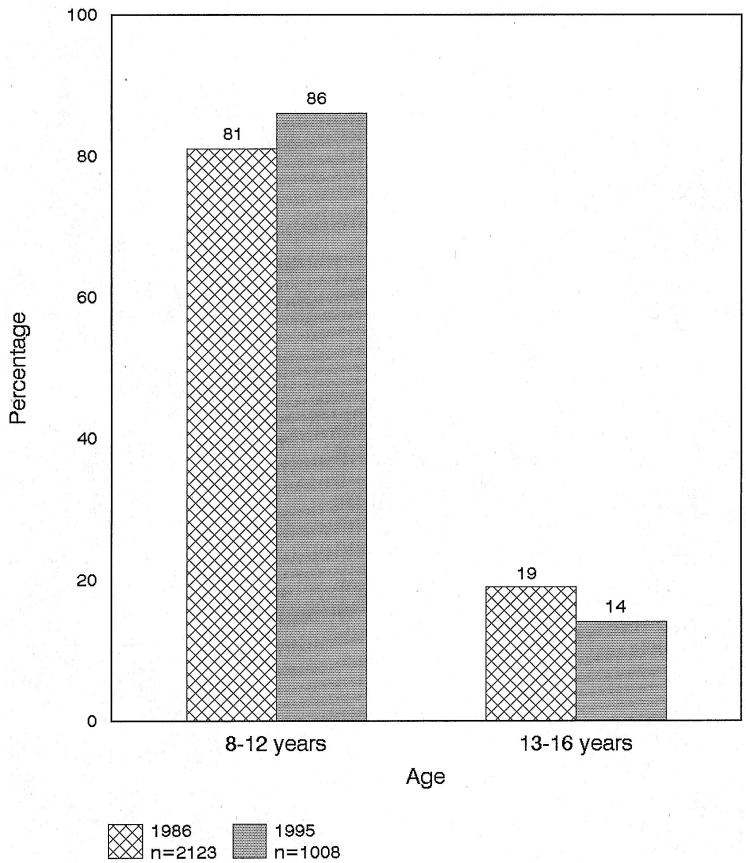

Figure 1. Age distribution of patients with asthma studies of 1986 and 1995.

RESULTS

The questionnaires were distributed to a total of 2,385 schoolchildren in 1986 and 1,169 in 1995. Of these, 2,123 and 1,008 completed questionnaires were used in the studies of 1986 and 1995, respectively, giving respective response rates of 89% and 93%. There were 55% male and 45% female children in the study of 1986, whereas 56% male and 44% female children were included in 1995 study. Figure 1 shows the age distribution of the Saudi schoolchildren in both the studies. The majority of the children with asthma in the studies of 1986 and 1995 (81% and 86%, respectively) were between 8 and 12 years of age. Only 19% of the schoolchildren with asthma in 1986 and 14% in 1995 were found to be between the ages of 13 and 16 years.

Figure 2 shows the comparison of prevalence of asthma, rhinitis and eczema in the schoolchildren. The prevalence of asthma was 8% in 1986 whereas a significantly higher 23% of schoolchildren were found to be suffering from asthma in 1995 ($P < .0001$). Similarly, the prevalence of allergic rhinitis also increased from 20% to 25% ($P < .003$) during this period. There was, however, no significant change in the prevalence of eczema from 1986 (12%) to 1995 (13%).

Table 1 compares the exposure of children to cigarette smoke and pets in the house. Seventeen percent of asthmatic children in 1986 had one or more family members who smoked cigarettes in the house, whereas 35% of children with asthma had one or more family members smoking cigarettes in the house in 1995. The number of children suffering from asthma with one or more smokers at home doubled over a period of 9 years ($P < .0001$). A significant increase in the exposure to

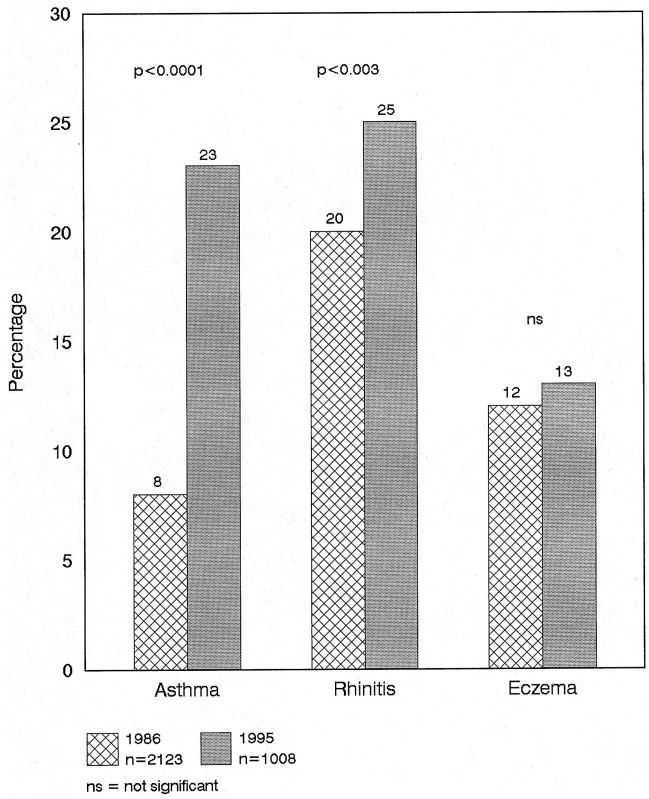

Figure 2. Changing prevalence of asthma, rhinitis, and eczema in Saudi schoolchildren

pets was also observed from 1986 to 1995, 14% and 34%, respectively.

DISCUSSION

Although many studies have documented an increased prevalence of asthma in recent years, this is the first to report an increase in the prevalence of asthma in Saudi schoolchildren. In the United States, the prevalence of asthma in 6- to 11-year-old children increased from 4.8% in 1974 to 1976 to 7.5% in 1980 to 1984.[23] An increased prevalence of symptoms of asthma from 20% to 25% has also been reported in separate studies in Australia and the United Kingdom.[24–26] An overall increase from 8% to 23% was observed over a period of 9 years in the present study. A 3-fold increase in the prevalence of asthma in Saudi children seems to be much higher than that seen in many other countries.

Increasing age seems to provide some protection against asthma.[27] Prevalence of diagnosed asthma has been found to be 1.6 times higher in children compared with adults living in the same home environment.[28] This study also shows that the prevalence of asthma decreases with advancing age. It is therefore possible that airways can develop protective mechanisms with increasing age.

There is a small chance that genetic factors could contribute to the increasing prevalence of asthma over a relatively short period of 9 years. The change in the environment directly or indirectly could be responsible for the observed increase in the prevalence of asthma. Similarly, because the prevalence of eczema remained unchanged, it is unlikely that a change in the prevalence of genetic susceptibility has taken place. This further suggests that possibly genetic predisposition may not have played a role in the increased prevalence of asthma in Saudi schoolchildren.

In contrast, environmental pollution by aeroallergens may be responsible for the rising asthma prevalence in the KSA. This is supported by the fact that there was a 5% rise in the number of allergic rhinitis sufferers as well. Increased prevalence of asthma and allergic rhinitis attributable to environmental pollution has also been reported in other studies.[29,30] Exposure to higher allergen levels both outdoors and indoors may have increased airway abnormalities in the Saudi children.

The soil and climate of the KSA was once considered unfavorable for plant growth. A large number of plants have been introduced to the Kingdom in recent years. Fungal spores and airborne pollens of grasses, weeds, and trees have been detected using a Burkard trap (Burkard Manufacturing Co., Rickmansworth, Hertfordshire, England) in the KSA.[31] A high proportion of Saudi children suffering from asthma have been shown to react to the extracts of these aeroallergens on skin prick testing. Among outdoor allergens, grass pollens and weed extracts have been shown to be the most common allergens to cause a reaction to the skin prick testing.[32] It is, therefore, not inconceivable that introduction of some new outdoor aeroallergens by imported plants and trees may have contributed to the increased prevalence of asthma in the KSA.

Indoor allergens have also been shown to be associated with asthma among schoolchildren. A high prevalence of IgE antibody to cat, house dust mite, and cockroach allergens has been shown to be correlated with the presence of insects and animals in the houses of children with asthma.[33] In

Table 1. Increased Exposure of Asthmatic Children to Predisposing Factors

	1986 (n = 2123)		1995 (n = 1008)		
	Percentage	Sample Size	Percentage	Sample Size	*P* Value
Smokers in the house	17	359	35	346	< .00001
Pets in the house	14	289	34	345	< .00001

Riyadh and other cities in the KSA, we have previously shown that 63.7% of individuals react to one or more allergens of indoor origin.[34] It is likely that increased exposure to pets in the household from 1986 to 1995 may also be associated with the increased prevalence of asthma. Detection of specific antibodies to domestic allergens in asthma patients is therefore important to evaluate the role of these allergens in the development of asthma.

Cigarette smoke inside the house is an important indoor predisposing factor. A study conducted in the KSA has clearly shown that passive smoking is positively correlated with childhood asthma.[35] Smokers in the family and number of cigarettes smoked in the house have also been shown to be associated with childhood asthma.[36] A significant increase in the smoking habit of the family members of the children with asthma was observed in this study. This may reflect a general increase in the prevalence of smoking in the Saudi population. It is therefore also possible that cigarette smoke may have contributed to an increase in the prevalence of asthma by irritating asthmatic children's airways, already inflamed by exposure to various allergens.

A new clinical entity of Desert Storm pneumonitis has recently been identified in the KSA.[37] Fine sand particles < 1 μm in diameter, in combination with pigeon droppings, have been shown to cause hyperergic lung condition. The pathogenesis of this disease and the proportion of Saudi population affected are not yet known. However, for patients with atopy, this may trigger an acute attack of asthma, thus contributing to the overall prevalence of asthma. Until further investigations are performed, it is difficult to implicate this condition as a contributing factor to the rising asthma prevalence in the KSA.

Saudi society has experienced a change in lifestyle from rural to urban in the recent past. The urbanization (Western way of living) may have an association with asthma attributable to general changes in the domestic environment. A study in Ethiopia has shown that children residing in urban areas are more likely to develop asthma compared with children in rural areas.[38] Increasing affluence in the Saudi society has also resulted in a higher proportion of centrally air-conditioned, double-glazed, and carpeted homes, providing ideal conditions for the growth of house dust mites.[39] The changing lifestyle may have increased the exposure of indoor-origin allergens. A study in Japan suggests climate, eating habits, and air pollution as factors for increased risk of contracting an allergic disease.[40] The increased prevalence of asthma in Saudi children could therefore be attributable to continuing extensive development in various sectors of the society.

CONCLUSION

Environmental factors are known to play an important role in the elicitation of asthma in genetically predisposed individuals. Although there has also been an increase in the awareness among doctors to diagnose asthma, a combination of various other factors may also be involved in the increased prevalence of asthma. Further investigations are recommended to identify the etiologic factors contributing to the rising prevalence of this disorder in the Kingdom.

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