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ORIGINAL ARTICLE

Prevalence of Asthma and Allergic Rhinitis Among School Children of Karachi, Pakistan, 2007

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In recent times, the incidence of allergic diseases, particularly bronchial asthma, has been increasing worldwide. However, there appears to be no published data on the prevalence of allergic diseases among school children (3 to 16 years of age) in Karachi, Pakistan, with only limited data available among few age groups under one ISAAC study. The objective of this project was to investigate the prevalence of allergic diseases among school children (3 to 16 years of age) in the city of Karachi. The questionnaire that was used for data collection had previously been used for a similar study in neighboring Saudi Arabia and the U.A.E. In 2007, a total of 3,000 surveys were distributed in various schools of Karachi, of which 2,325 completed surveys were obtained. SPSS was used to perform statistical analysis on the collected data. Survey results showed that the frequency of diagnosed (previously seen by physicians) cases of asthma stood at 15.8%, while the frequency of allergic rhinitis was found to be 28.50% among these children. Other parameters that were analyzed included dry cough (20.1%), wheezing (11.7%), breathlessness (15.40%), and eczema (21.8%). Furthermore, smoking by family members was found to be associated with asthma (p value less than 0.05), allergic rhinitis (p value less than 0.05), breathlessness (p value less than 0.05), dry cough (p value 0.002), and wheezing (p value less than 0.05). This study reveals that there is a significant number of school children in the metropolitan city of Karachi who have various allergic symptoms. It also sheds light on the fact that exposure to indoor environmental factors as well as family atopy can play a key role in increasing the chances of an individual to experience asthma and other allergy symptoms.

Keywords epidemiology, bronchial asthma, allergic diseases, Karachi, school children

INTRODUCTION

Allergy and asthma are characterized by an overreaction of the human immune system to allergens due to elevated levels of IgE antibodies (1, 2). Hypersensitive individuals have occasional episodes of asthma attacks, wheezing, breathlessness, and chest tightness (3). These attacks bring about airway hyper-responsiveness, which then leads to the narrowing of airway passages due to the hindrance or obstruction of airflow—a key feature of asthma (3, 4).

Worldwide variations in the incidence rates of allergies and asthma suggest that environmental factors play a critical role in the development of such disorders among immunocompromised individuals (5). Various factors are known to be associated with the bronchial asthma and allergic rhinitis, which include smoking habits, atopy, age, nutritional status, coexisting lung diseases, lifestyle, occupation, family size, and environmental stimuli (e.g., house dust, animal dander, mold spores and fragments, cockroach droppings, indoor/outdoor aeroallergens, pollution, climate) (4, 6, 7). Research conducted in China revealed that environmental factors and diet intake can also create a difference in the prevalence of asthma

among different regions within the same country (8). Pollen grains and fungal spores are the major constituents of outdoor atmosphere and stand as the major cause of allergic response and pathogenic infections in the human respiratory tract (9). Furthermore, genetic susceptibility to allergic diseases is linked to the interaction between genetic and environmental factors (10, 11). It is also suspected that if a child wheezes or shows symptoms of inhalant allergy at a younger age, then he/she is most likely to develop chronic pulmonary diseases and low level of lungs functions during the late adult years (12).

Despite the recent advances in the field of allergy medicine, the frequency of hay fever and asthma is increasing day by day throughout the world (6, 4, 13–15). The reason behind this could be the emergence of new risk factors or loss of protective traditional life style (16). In India the prevalence of allergic rhinitis is about 20% to 30% of the total population, of which 15% have developed asthma (17). In 1995, a study conducted in Saudi Arabia showed the incidence of allergic rhinitis cases to be 20% to 25% among school children, while the figure for eczema stood close to 12% to 13% (18). In Hong Kong, the prevalence of hay fever was reported to be 15.7% in 1992, while the prevalence of asthma was 11% and allergic rhinitis was 52% during the years 1994–95 (19). The emergence of new environmental risk factors and/or loss of protective factors of a traditional lifestyle may explain the increase or variations in the prevalence of allergic diseases (16).

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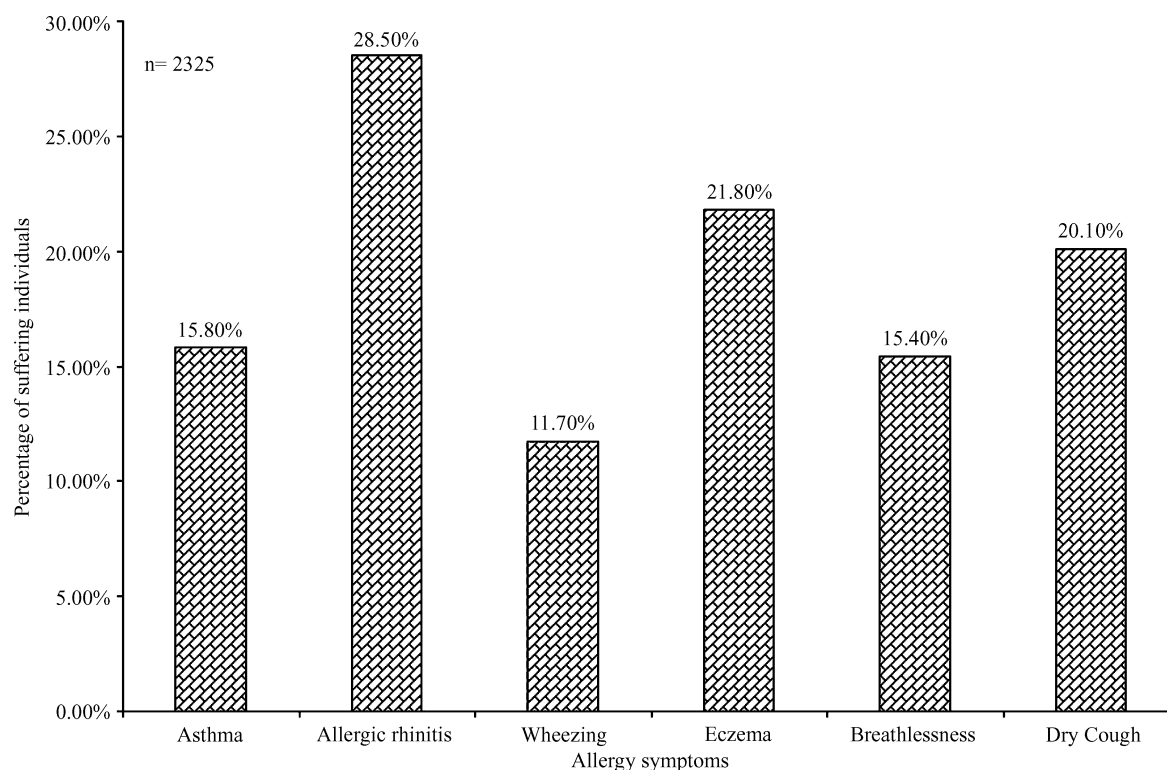


FIGURE 1.—Prevalence of allergy symptoms in school children of Karachi.

To standardize the set of questions to be asked in an asthma prevalence study, the International Study of Allergy and Asthma in Childhood (ISAAC) developed certain protocols (19, 21). Epidemiological study questionnaires were also prepared for a study in Saudi Arabia in 1986. At that time ISAAC did not exist. These questionnaires were designed by Professor Anne Woolcock from the University of Sydney, Australia and Professor J.D. Wilson, from the University of Auckland, New Zealand (18).

SUBJECTS AND METHODS

To estimate the prevalence of allergic diseases in a cross-sectional population of school-going children (3 to 16 years of age), a protocol consisting of 35 questions was distributed among the parents of school children with the help of various schools located throughout the densely populated city of Karachi—inhabiting almost 20 million people of different cast, color, and races. The questionnaire aimed at obtaining information about whether a physician had diagnosed the child with asthma and allergic rhinitis. Furthermore, questions inquiring the child's family history of these conditions and exposure to predisposing factors (e.g., cigarette smoke, pets) were also included in the survey. The questionnaire was developed in two languages; although English stood as the primary language of this protocol, Urdu (local language) per-

formae were also prepared, and were distributed among those students and parents that were found to be more comfortable with their local language.

Before distributing the questionnaire, a written consent of including their children in this study was obtained from the parents. The distributed questionnaires were received within 2 to 3 weeks. In 2007, a total of 3,000 surveys were distributed in various schools of Karachi, out of which 2,325 performae duly filled in by the parents were successfully obtained. The completed performae were checked for completeness and consistency, and those with mistakes or errors were omitted from the data analysis. The data was then entered into a computer database and reviewed by two individuals to ensure the accuracy of collected data. After this step, the entered data were categorized and analyzed using the Statistical Package for Social Sciences (SPSS) for Windows (22). Chi-square test was applied on the data for the comparison of prevalence. A *p* value less than 0.05 was considered to be significant, as the level of significance set for this study was 5%.

RESULTS

Figure 1 illustrates the overall data for the prevalence of allergic diseases, while Table 1 represents the prevalence of symptoms of these allergies among the students of different

TABLE 1.—Prevalence of allergy in school children of Karachi.

Age in years (Class boundaries)	Frequency of Students	Gender		Wheezing	Eczema	Allergic rhinitis	Asthma	Dry Cough	Breathlessness
		Male	Female						
3.5-7.5	142	69%	31%	15%	10%	29%	12%	12%	11%
8-12.5	812	66%	34%	16%	12%	23%	22%	28%	6%
13-17.5	1222	40%	60%	10%	32%	35%	14%	18%	24%

TABLE 2.—Parents smoking.

Smokers in house	Wheezing in child			Breathlessness in child			Dry cough in child			Asthma in child			Eczema in child			Allergic rhinitis in child		
	YES	Total	<i>p</i> value	YES	Total	<i>p</i> value	YES	Total	<i>p</i> value	YES	Total	<i>p</i> value	YES	Total	<i>p</i> value	YES	Total	<i>p</i> value
Father	99	566		153	567		152	566		105	566		224	567		283	567	
Mother	1	2		1	2		1	2		1	2		2	2		2	2	
Both Mother & Father	2	12	<0.05	1	12	<0.05	3	12	0.002	3	12	0.297	3	12	<0.05	2	12	<0.05
Any other person	50	223		97	221		73	221		31	221		85	219		108	219	
Total	152	803		252	802		229	801		140	801		314	800		395	800	

age groups that were surveyed in this study. These results indicate that 15.8% of the surveyed school children were diagnosed by their physicians with asthma and 28.5% were diagnosed with allergic rhinitis. In terms of the presence of allergic symptoms, 11.7% of the surveyed children showed signs of wheezing, 20.1% had dry cough, 16% exhibited breathlessness, and 21.8% had eczema.

According to the analyzed data, 367 out of the 2,325 students surveyed suffer from asthma (male: 49.3%, female: 50.7%) and 663 suffer from allergic rhinitis (male: 48.9%, female: 51.1%). Although females makeup a slightly higher percentage of children with allergic rhinitis, this value turns out to be statistically non-significant (*p* value 0.120). However, there is a significant difference in the ratio of dry cough, wheezing, breathlessness, and eczema in males and females among 2,121 of the surveyed children who have these conditions. Male children reported a higher incidence of dry cough (62.3% vs. 37.7% in females), wheezing (74.7% vs. 25.3% in females) and breathlessness (67% vs. 33.0% in females). Conversely, 520 children had eczema, out of which the percentage of female students was higher (58.4% vs. 41.6% in males). Based on these results, it can be hypothesized that the allergic symptoms are more frequent in boys. The hypothesis of gender having an impact on the occurrence of dry cough, wheezing, breathlessness, and eczema is validated by looking at the statistical analysis results since the *p* values of these four symptoms is less than 0.05. However, the prevalence of asthma is shown to be independent of gender (*p* value: 0.203).

The results of this study also show that more than one allergy symptom manifests among hypersensitive individuals since asthma and hay fever was reported in 5% of the surveyed children, while asthma and wheezing was reported in 8%, asthma and breathlessness in 8%, asthma and dry cough

in 9%, and finally, asthma and eczema in 4% of the school children surveyed in this study. The presence of allergic rhinitis or hay fever, along with other allergy conditions, was also investigated in this study, and the following percentages were observed among the surveyed children: allergic rhinitis and eczema: 15%, allergic rhinitis and wheezing: 4%, allergic rhinitis and breathlessness: 7%, allergic rhinitis and dry cough: 9%, eczema and breathlessness: 5%, eczema and wheezing: 2%, asthma and dry cough: 6%, dry cough and wheezing: 7%, dry cough and breathlessness: 10%, and finally, wheezing and breathlessness: 8%.

Furthermore, the chi-square test was applied to investigate any correlation between parents with allergic symptoms and their children that had been diagnosed by a physician to have allergic conditions. The results revealed that a significant association existed between parental atopy and the incidence of allergy in children. The analysis shows that asthma, allergic rhinitis, eczema, breathlessness, dry cough, and eczema are all linked with the parental history of atopy, as a *p* value less than 0.05 was obtained when all of these allergy conditions were analyzed.

Moreover, the association between certain household factors and atopic symptoms were analyzed in this study. These factors included the smoking habits of parents as well as the presence of air conditioning, carpeting, and pets in the household. According to the data represented in Table 2, the smoking habits of parents increases the chances of their children to have eczema (*p* value less than 0.05), allergic rhinitis (*p* value less than 0.05), breathlessness (*p* value less than 0.05), dry cough (*p* value 0.002), and wheezing (*p* value less than 0.05). However, parental smoking habits do not play a role in increasing the likelihood of their children to have asthma (*p* value 0.297). The results displayed in Table 3 reflect the presence of air conditioning, carpeting, and pets in

TABLE 3.—Allergies due to different indoor factors.

Allergies due to air conditions in houses																		
	Wheezing in child			Breathlessness in child			Dry cough in child			Asthma in child			Eczema in child			Allergic rhinitis in child		
	Yes	Total	<i>p</i> value	Yes	Total	<i>p</i> value	Yes	Total	<i>p</i> value	Yes	Total	<i>p</i> value	Yes	Total	<i>p</i> value	Yes	Total	<i>p</i> value
Yes	123	717		123	721		194	721		118	721		117	721		246	721	
No	149	1498	<0.05	235	1496	0.54	270	1495	<0.05	249	1495	0.732	390	1497	<0.05	417	1493	0.006
Total	272	2215		358	2217		464	2216		367	2216		507	2218		663	2214	
Allergies due to carpet in houses																		
Yes	179	966		196	969		267	969		210	969		150	969		331	969	
No	93	1248	<0.05	162	1247	<0.05	197	1246	<0.05	157	1246	<0.05	357	1248	<0.05	332	1244	<0.05
Total	272	2214		358	2216		464	2215		367	2215		507	2217		663	2213	
Allergies due to pets in houses																		
Yes	109	534		195	533		192	533		182	533		113	534		182	534	
No	163	1679	<0.05	163	1683	<0.05	270	1682	<0.05	185	1682	<0.05	392	1683	0.328	481	1679	0.025
Total	272	2213		358	2216		462	2215		367	2215		505	2217		663	2213	

TABLE 4.—Prevalence of allergy symptoms in different countries.

Country	Asthma	Allergic rhinitis	Eczema	Wheeze	Dry cough
Pakistan	15.80%	28.58%	21.80%	11.70%	20.10%
Poland (25)	16.42%	38.80%	No mention	No mention	No mention
Turkey (26,27)	16.40%, 4.6%	12.30%, 14.1%	No mention	18.9%, 27.2%	No mention
Oman (24)	20.70%	10.50%	10.5%	No mention	No mention
India (17)	15%	20–30%	No mention	No mention	No mention
Saudi Arabia (18)	23%	25%	12.3%	No mention	No mention
Australia (4)	46%	No mention	No mention	No mention	No mention
Hong Kong (20)	11.6%	15.70%	20%	11.6%	No mention
Tibet (28)	1.1%	5.2%	0.4%	1.4%	No mention
Italy (13)	9.1%	6.30%	No mention	7.8%	No mention
Damam (29)	No mention	12%	No mention	No mention	6%
Riyadh (29)	No mention	17%	No mention	No mention	7.90%
Tonga (23)	12.5%	16.10%	16.1%	26.60%	No mention
New Caledonia (23)	12.5%	9.9%	12.5%	12.5%	No mention
Samoa (23)	14.10%	9.70%	41.1%	11.2%	No mention
Cook Islands (23)	14.80%	12.80%	14.2%	19.6%	No mention
Tokelau (23)	34.3%	31.8%	10.6%	43.9%	No mention
French Polynesia (23)	16%	12.30%	12.3%	12.2%	No mention
Fiji Island (23)	13.60%	10.30%	7.2%	20.4%	No mention
Niue (23)	30.40%	25.3%	16.5%	36.7%	No mention

the household affecting the likelihood of children to have allergies. According to the data, the presence of air conditioning in homes is statistically insignificant in increasing the chances of children to get asthma (p value 0.732) and experience breathlessness (p value 0.540) but is statistically significant in increasing the likelihood of children to experience dry cough (p value less than 0.05), wheezing (p value less than 0.05), eczema (p value less than 0.05), and allergic rhinitis (p value 0.006). Furthermore, carpeting in the household increases the chances of children to have hay fever (p value less than 0.05), asthma (p value less than 0.05), wheezing (p value less than 0.05), chest tightness or breathlessness (p value less than 0.05), dry cough (p value less than 0.05), and eczema (p value less than 0.05). The presence of pets in the house also increases the likelihood of children to have asthma (p value less than 0.05), allergic rhinitis (p value 0.025), dry cough (p value less than 0.05), wheezing (p value less than 0.05), and breathlessness (p value less than 0.05) but is seen to be statistically insignificant in the case of eczema (p value 0.328).

DISCUSSION

This study aimed at determining the overall incidence rates of asthma, allergic rhinitis, wheezing, dry cough, breathlessness, and eczema among school children in the city of Karachi. These results were then compared to similar studies that have been performed by various researchers and scientists throughout the world. Table 4 highlights the prevalence rates of bronchial asthma and other respiratory allergies in Pakistan (i.e., the study under discussion), Australia (4), Italy (13), India (17), Hong Kong (20), Pacific (23), Oman (24), Poland (25), Turkey (26, 27), Tibet (28), and Saudi Arabia (18, 29).

According to the findings of this study, boys have a greater predisposition to wheezing, dry cough, and breathlessness. Similarly, the study conducted in Turkey (26) concluded that among the children surveyed, males were more susceptible to wheezing due to tobacco smoke exposure.

Furthermore, this study reveals that different allergy symptoms can appear in the same individual at the same time.

In this regard, Saudi researchers have also demonstrated the existence of statistically significant associations between bronchial asthma and breathlessness among school children, with a p value of <0.0087 in 1990 (31) and <0.001 in 1998 (30).

Another interesting result of this study is the identification of a strong correlation between records of atopy in family and seasonal rhinitis (19, 29). A similar study conducted in Saudi Arabia also sheds light on this association between parental atopy (p value <0.007 [31]) and the appearance of allergy symptoms ($p < 0.01$ [30]) among children. In light of these findings, it can be hypothesized that atopic diseases are inherited in children; however, the mode of inheritance is yet to be discovered (32).

Finally, this study highlights the impact of common household factors on the development of asthma and other allergy symptoms among children, as the results clearly indicate that the smoking habits of parents, carpeting, and pet ownership can significantly increase the likelihood of children to develop some of the allergic diseases and associated symptoms.

CONCLUSION

There is a lack of research surrounding the prevalence of bronchial asthma as well as other allergic diseases in the Pakistan. To this end, the findings of this study reveal that the incidence and frequency of aero-allergies among school children in the city of Karachi stand at elevated levels. It has also revealed that exposure to indoor environmental factors as well as family atopy can increase the chances of children to suffer from allergic diseases. However, additional studies need to be conducted in other major cities of Pakistan to further investigate the etiological factors that can potentially contribute to the rising prevalence of allergy and asthma in Pakistan.

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