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Allergic Rhinitis among Children, Jazan Region Saudi Arabia: Role of Environmental Factors

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***Abstract*: Allergic diseases such as allergic rhinitis represent a global health problem, affecting 10%–25% of the world population. There is clear evidence to support the concept that allergic diseases are influenced by genetic predisposition and environmental exposure. The main objective of this study to identify the role of environmental factors in development of allergic rhinitis among children in Jazan Region, Saudi Arabia. Methods: This is a cross-sectional study used a modified used the International Study of Asthma and Allergies in Children (ISAAC) questionnaire. Results: The total study population was 1400, most of them were Saudi 1273 (90.9%) . Male students were 840 (60.0%), and female were 560 (40.0%). According to the residency 811 (57.9%) students were lived in rural, 64.7% of them were male, and 589 (42.1%) of participants lived in urban area. Most of the students lived in plain area 840 (60.0%), and only 16.4% of them lived in mountain area, which 63.5% of them were male. Elementary school students account 54.1% of total students; about 63% of them were male. The prevalence of life-long sneezing and nasal block without cold (AR-related symptoms) was 27.1%. This study listed about 13 environmental risk factors Conclusion: A wide range of environmental factors have been observed in JR: as indoor and outdoor aeroallergens grass, weed, shrub and tree pollen, moulds, house dust and storage mites, insects and dander from domestic animals, rodents and farm animals.**

***Keywords:* Allergic Rhinitis, Environmental Factor, Jazan Region, Saudi Arabia.**

1. INTRODUCTION

Allergic diseases result from an interaction between individual genetic susceptibility and exposure to environmental factors. According to twin studies, the genetic contribution to allergic disease has been estimated as more than 50%, with heritability estimates ranging from 36-79% [1-3]. Due to probable changes in the environment, an increase in the prevalence of allergies in the past decades has been observed. Environmental factors, in combination with genetic predisposition of a patient may contribute to the development of so-called extrinsic forms of asthma, allergic rhinitis (AR) or atopic dermatitis, which are accompanied by sensitization to environmental factors and the presence of antigen-specific serum IgE [1-4].

AR is one of allergic diseases affecting approximately 10%–25% of the world population [5]. The symptoms of AR include rhinorrhea, nasal blockage, nasal itching, and sneezing. The symptoms are reversible and are occurred due to exposure to allergens and triggering factors or whilst under treatment. AR is a disease affecting respiratory system, with increased morbidity and significantly impairs a patient's quality of life. It is also associated with other allergic conditions such as asthma and dermatitis and other local conditions as paranasal sinusitis, anosmia, nasal poly, otitis media, lower airway infection, and even dental malocclusion [6-8]. In study conducted in Madinah, Saudi Arabia (SA) revealed symptoms suggestive of ever-having had AR were common, affecting 24.2% of children overall, with an estimated 18.2% experiencing symptoms of sneezing in the last 12 months [9].

AR is caused frequently by exposure to indoor and outdoor allergens. The most common allergens, pollens (grass, trees, and weeds) are the predominant causes of seasonal allergic rhinitis. House dust mites, pets, and molds are the major causes of perennial allergic rhinitis. Other environmental factors such as increased air pollution, changed lifestyle, and decrease in bacterial/viral infection are frequently reported as risk factors for allergic sensitization and possible causes of the increased prevalence of AR and other allergic diseases. Climatic conditions are of the most important environmental factors in Jazan Region (JR) seem to have a significant impact on allergic patients. These are varies according to geographical regions from hot humid to cold rainy weather. Climate may directly influence each organism, but on the other hand, determines the model of flora and fauna within particular geographical regions and thus determines the sources of airborne and food allergens. It is well-known that increased temperature increases sweating, causes high water loss, and therefore nasal mucosal dryness. [10].

Under normal conditions, the nasal mucosa quite efficiently humidifies and cleans inspired air. This is the result of orchestrated interactions of local and humoral mediators of host defense [11]. In AR, these mechanisms go awry and contribute to the signs and symptoms of the disorder [12].

The current study was conducted to explore the relation between environmental factors and the AR-related symptoms in children in JR Saudi Arabia (SA).

2. METHODS

Study Area:

This study conducted in Jazan (also called Gizan) region is one of the thirteen regions of the SA. It is located on the tropical Red Sea coast in southwestern SA. Jazan covers an area of 11,671 square kilometers, including some 5,000 villages and towns with a total population of 1.5 million. Geographically Jazan Region divides into three zones (costal, plain and mountain), which intersected with perennial streams, these geographical factors may be as risk factors for AR.

Study Design:

This was a cross-sectional study using the ISAAC questionnaire conducted among school children within Jazan region, SA over a period of 3 months started on November 2015 to fulfill the proposed objectives.

Sample Design and Size:

The ultimate objective of the study was to correlate the environmental factors with presence of AR-related symptoms among school children in Jazan region, SA. For this purpose, multistage cluster random sampling utilized. Jazan Region geographically is classified into three geographical distinct zones, the mountain, hills and the coastal zones. Following Cochrain (1977), the suitable sample size determined on the bases of the standard formula given by:

$$n = \frac{Z^2 \pi (1 - \pi)}{d^2}$$

Where:

n: the sample size.

π: is an anticipated proportion here, the prevalence of AR.

Z: the standardized variable that corresponds to 95% level of confidence.

d: the desired marginal error.

Since there is no prior knowledge about the prevalence of AR in Jazan region we will set the values $\pi = 0.5$ to provide the maximum sample size, d the desired marginal error = 0.05 and z=1.96, the study sample size, denoted (n), is given by:

$$n = \frac{(1.96)^2 x(0.5)x(0.5)}{(0.05)^2} = 384$$

Since the sample proportion to the total population is less than 0.05 of the total number of school students in Jazan region, we don't need to use the finite population correction factor to adjust the sample size. However, in order to increase precision, which might be lost as a result of adopting multi-stage cluster sampling method, we multiply the sample size (n) by the design effect factor, which is the ratio of the variance of estimates for a particular sample design to the variance of estimates for a simple random sample of the same size. The design effect is equal to the number of geographical zones

in Jazan region, so that the minimum sample size required is 1152. The sample size distributed between areas, school level (elementary or intermediate schools) and both sexes according to the sex ratio in the schools. The schools as well students in the different clusters selected using simple random technique. For that the calculated sample were distributed according to the three geographical areas costal, plain and mountain as 250, 750 and 200 respectively. When distributing questionnaires we added 30 % for each for non-responders.

Data collection and analysis:

Data collected using modified structured questionnaire that developed by ISAAC. The questionnaire written in Arabic and were mainly address to target group and filled by their parents. These data had been entered and analyzed using Statistical Package for Social Sciences (SPSS) software version 20.0. A p-value < 0.05 was considered to be statistically significant.

3. RESULT

A total of 1560 questionnaires were distributed to the students in both level elementary and intermediate schools all-over Jazan Region, 1400 questionnaires were collected with response rate of 90.6%, most of them were Saudi 1273 (90.9%) . Male students were 840 (60.0%), and female were 560 (40.0%). The age of participants range from 10 to 15 years with a mean of 12.8 ± 1.5 years and a median of 13 years. According to the residency 811 (57.9%) students were lived in rural, 64.7% of them were male, and 589 (42.1%) of participants lived in urban area. Most of the students lived in plain area 840 (60.0%), and only 16.4% of them lived in mountain area, which 63.5% of them were male. Elementary school students account 54.1% of total students; about 63% of them were male as shown in table I.

Table I: The background characteristics of the study population

Demographic characteristics		**Gender – Frequency (%)**		**Total (%)**
		Boys	**Girls**	
		840 (60.0)	**560 (40.0)**	**1400 (100)**
Age	10 years old	33 (2.3)	26 (1.9)	59 (4.2)
	11 years old	134 (9.6)	84 (6.0)	218 (15.6)
	12 years old	251 (17.9)	125 (8.9)	376 (26.9)
	13 years old	177 (12.6)	117 (8.4)	294 (21.0)
	14 years old	95 (6.8)	96 (6.8)	191 (13.6)
	15 years old	150 (10.7)	112 (8.0)	262 (18.7)
Nationality	Saudi	751 (53.6)	522 (37.3)	1273 (90.9)
	Non-Saudi	89 (6.4)	38 (2.7)	127 (9.1)
Residency	Urban	315 (22.5)	274 (19.6)	589 (42.1)
	Rural	525 (37.5)	286 (20.4)	811 (57.9)
Geographical Distribution	Coastal	229 (16.4)	101 (7.2)	330 (23.6)
	Plain	465 (33.2)	375 (26.8)	840 (60.0)
	Mountain	146 (10.4)	84 (6.0)	230 (16.4)
Level of education	Elementary	477 (34.1)	280 (20.0)	757 (54.1)
	Intermediate	363 (25.9)	280 (20.0)	643 (45.9)

Prevalence of life-long sneezing and nasal block without cold (AR-related symptoms) was 27.1% as shown in figure I.

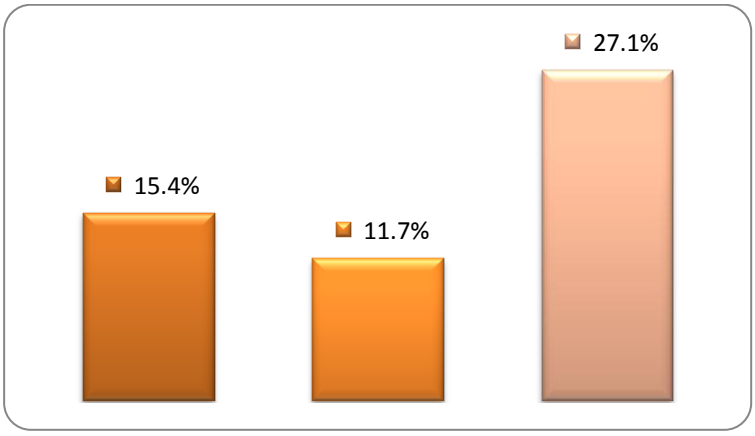

Figure I: Prevalence of life-long sneezing and nasal block without cold

Table II revealed list of environmental factors incriminated as risk factors for allergic diseases. There were many mode of housing include apartment, villa and traditional house with frequency rate of 431 (30.8%), 360 (25.7%), and 594 (42.4%) respectively. Most of them used air conditioning window /spilt unit 1318 (94.1%), with only 12 (0.9%) had no electricity supply. Those who were used gas for cooking account 1242 (88.7%), with only 23 (1.6%) used wood for cooking. Few had earthy floor 113 (8.1%), 137 (9.8%) had a carpet and 943 (67.3%) had curtain in their houses. About 482 (34.4%) had animals in their houses, which cat and sheep were most dominant 181 (12.9%) and 170 (12.1%) respectively. The number of khat chewers 128 (9.1%) exceeding the smokers 42 (3.0%) and one third of participants were passive smokers. Most of study population (93.5%) ate nuts, eggs and dairy products at least 3 times per week and only 346 (24.7) ate sea food once a week. There are significant statistical difference in these factors between male and female for the following factors: Strenuous exercise (*p* value = 0.000), flooring (*p* value = 0.000), curtain (*p* value = 0.000), animal in the house (*p* value = 0.001), khat chewing (*p* value = 0.000), egg intake (*p* value = 0.010), and dairy products (*p* value = 0.002).

Table II: List of Environmental factors incriminated as risk factors for allergic diseases

#	Environmental factors		Frequency			*p* value
			Male	Female	Total	
1	Strenuous exercise		339 (24.2)	159 (11.4)	498 (35.6)	**0.000**
2	Type of house	Apartment	264 (18.9)	167 (11.9)	431 (30.8)	**0.012**
		Villa	177 (12.6)	183 (13.1)	360 (25.7)	
		Traditional house	388 (27.7)	206 (14.7)	594 (42.4)	
3	Air cooling system	Air conditioning window /spilt unit	786 (56.1)	532 (38.0)	1318 (94.1)	0.481
		Evaporative cooler	38 (2.7)	32 (2.3)	70 (5.0)	
		No AC at home	10 (0.7)	2 (0.2)	12 (0.9)	
4	Cooking fuel	Electrical	79 (5.6)	31 (2.2)	110 (7.8)	**0.031**
		Gaseous	734 (52.4)	508 (36.3)	1242 (88.7)	
		Wood	13 (0.9)	10 (0.7)	23 (1.6)	
5	Flooring	Earthy	87 (6.2)	26 (1.9)	113 (8.1)	**0.000**
		Carpeting	58 (4.1)	79 (5.6)	137 (9.8)	
		Hard flooring (Ceramic)	653 (46.6)	424 (30.3)	1077 (76.9)	
		Resilient flooring (linoleum)	26 (1.9)	15 (1.0)	41 (2.9)	
6	Curtain		534 (38.1)	409 (29.2)	943 (67.3)	**0.000**
7	Animal at home		318 (22.7)	164 (11.7)	482 (34.4)	**0.001**
8	Types of Animal contacts	Cat	111 (7.9)	70 (5.0)	181 (12.9)	**0.015**
		Dog	12 (0.9)	8 (.5)	20 (1.4)	
		Bird	50 (3.6)	36 (2.5)	86 (6.1)	
		Sheep	131 (9.3)	39 (2.8)	170 (12.1)	
		Cow	6 (0.4)	2 (0.1)	8 (0.5)	
		Camel	6 (0.4)	3 (0.2)	9 (.06)	
9	Smoking		33 (2.4)	9 (0.6)	42 (3.0)	**0.019**
10	Second hand smoking		277 (19.8)	185 (13.2)	462 (33.0)	0.479
11	Types of smoking	Cigarettes	11 (0.9)	0 (0.0)	11 (0.9)	0.107
		Water-pipe	23 (1.6)	9 (0.6)	31 2.2)	0.168
12	Khat chewing		103 (7.3)	25 (1.8)	128 (9.1)	**0.000**
13	Types of Food	Sea food	192 (13.7)	154 (11.0)	346 (24.7)	0.078
		Nuts	786 (56.1)	523 (37.4)	1309 (93.5)	0.120
		Egg	786 (56.1)	521 (37.2)	1307 (93.3)	**0.010**
		Dairy products	786 (56.1)	525 (37.5)	1311 (93.6)	**0.002**

The frequency of life-long AR-related symptoms (sneezing and nasal blockage without cold) in relation to the environmental factors and gender were well described in table III. The environmental factors that had statistical significance in development of life-long AR-related symptoms in relation to gender were type of house floor, smoking, khat chewing and dairy products intake (*p* value = 0.027, 0.031, 0.020 and 0.046 respectively).

Table III: Prevalence of life-long AR symptoms in relation to environmental factors according to the gender

#	Environmental factors		Frequency			*p* value
			Male	Female	Total	
1	Strenuous exercise		210 (15.0)	160 (11.4)	370 (26.4)	0.088
2	Type of house	Apartment	59 (4.2)	39 (2.8)	98 (7.0)	0.527
		Villa	64 (4.6)	56 (4.0)	120 (8.6)	
		Traditional house	92 (6.6)	67 (4.8)	159 (11.4)	
3	Air cooling system	Air conditioning window /spilt unit	207 (14.8)	157 (11.2)	364 (26.0)	1.000
		evaporative cooler	6 (0.4)	4 (0.3)	10 (0.7)	
4	Cooking fuel	Electrical	2 (0.1)	3 (0.2)	5 (0.3)	0.237
		Gaseous	210 (15.0)	150 (10.7)	360 (25.7)	
		Wood	3 (0.2)	6 (0.4)	9 (0.6)	
5	Flooring	Earthy	50 (3.6)	22 (1.5)	72 (5.1)	**0.027**
		Carpeting	18 (1.3)	24 (1.7)	42 (3.0)	
		Hard flooring (Ceramic)	140 (10.0)	108 (7.7)	248 (17.7)	
		Resilient flooring (linoleum)	4 (0.3)	6 (0.4)	10 (0.7)	
6	Curtain		148 (10.6)	116 (8.3)	264 (18.9)	0.480
7	Animal at home		79 (5.6)	46 (3.3)	125 (8.9)	0.078
8	Types of Animal contacts	Cat	40 (2.9)	23 (1.6)	63 4.5)	0.990
		Dog	1 (0.0)	1 (0.0)	2 (0.1)	
		Bird	15 (1.1)	9 (0.6)	24 (1.7)	
		Sheep	24 (1.7)	14 (1.0)	38 (2.7)	
		Cow	1 (0.0)	1 (0.0)	2 (0.1)	
9	Smoking		22 (1.6)	7 (0.5)	29 (2.1)	**0.031**
10	Second hand smoking		67 (4.8)	64 (4.6)	131 (9.4)	0.458
11	Types of smoking	Cigarettes	17 (1.2)	6 (0.4)	23 (1.6)	1.000
		Water-pipe	5 (0.4)	1 (0.0)	6 (0.4)	
12	Khat chewing		34 (2.4)	14 (1.0)	48 (3.4)	**0.020**
13	Types of Food	Sea food	199 (14.2)	148 (10.6)	347 (24.8)	0.254
		Nuts	199 (14.2)	146 (10.4)	345 (24.6)	0.373
		Egg	198 (14.1)	147 (10.5)	345 (24.6)	0.332
		Dairy products	199 (14.2)	146 (10.4)	345 (24.6)	**0.046**

The prevalence of life-long AR-related symptoms (sneezing and nasal blockage without cold) in relation to the environmental factors and residence were illustrated in table IV. Nine out of 13 environmental factors were had statistical significance in relation to AR-related symptoms and residence. About one quarter of participants were had strong relation between AR-related symptoms, residence and strenuous exercise (*p* value = 0.001). Types of house had statistical significance in relation to AR-related symptoms and residence (*p* value = 0.000), traditional house account 42.7%. Types of the house floor, use of curtain, types of cooking fuel an animal at house also had statistical significance relation with AR-related symptoms and residence (*p* value = 0.000, 0.000, 0.000. 0.001 respectively). Smoking also had statistical significance relation with AR-related symptoms and residence (*p* value 0.003).

Table IV: Prevalence of life-long AR symptoms in relation to environmental factors according to the Residency

#	Environmental factors		Frequency			*p* value
			Urban	Rural	Total	
1	Strenuous exercise		140 (10.0)	230 (16.4)	370 (26.4)	**0.001**
2	Type of house	Apartment	60 (4.3)	38 (2.7)	98 (7.0)	**0.000**
		Villa	33 (2.4)	87 (6.2)	120 (8.6)	
		Traditional house	50 (3.6)	109 (7.8)	159 (11.4)	
3	Air cooling system	Air conditioning window /spilt unit	138 (9.9)	226 (16.1)	364 (26.0)	0.567
		evaporative cooler	4 (0.3)	6 (0.4)	10 (0.7)	
4	Cooking fuel	Electrical	2 (0.1)	3 (0.2)	5 (0.3)	**0.000**
		Gaseous	130 (9.3)	230 (16.4)	360 (25.7)	
		Wood	9 (0.6)	0 (0.0)	9 (0.6)	
5	Flooring	Earthy	2 (0.1)	70 (5.0)	72 (5.1)	**0.000**
		Carpeting	21 (1.5)	21 (1.5)	42 (3.0)	
		Hard flooring (Ceramic)	110 (7.8)	138 (9.9)	248 (17.7)	

		Resilient flooring (linoleum)	9 (0.6)	1 (0.07)	10 (0.7)	
6	Curtain		112 (8.0)	152 (10.9)	264 (18.9)	**0.000**
7	Animal at home		33 (2.3)	92 (6.6)	125 (8.9)	**0.001**
8	Types of Animal contacts	Cat	22 (1.6)	41 (2.9)	63 (4.5)	**0.036**
		Dog	1 (0.0)	1 (0.0)	2 (0.1)	
		Bird	7 (0.5)	17 (1.2)	24 (1.7)	
		Sheep	3 (0.2)	35 (2.5)	38 (2.7)	
		Cow	1 (0.0)	1 (0.0)	2 (0.1)	
9	Smoking		3 (0.2)	25 (1.8)	28 (2.0)	**0.003**
10	Second hand smoking		66 (4.7)	65 (4.6)	131 (9.3)	**0.000**
11	Types of smoking	Cigarettes	1 (0.0)	2 (0.1)	3 (0.2)	0.408
		Water-pipe	3 (0.2)	20 (1.4)	23 (1.6)	
12	Khat chewing		14 (1.0)	34 (2.4)	48 (3.4)	0.136
13	Types of Food	Sea food	121 (8.6)	226 (16.1)	347 (24.7)	0.113
		Nuts	120 (8.6)	225 (16.0)	345 (24.6)	**0.013**
		Egg	119 (8.5)	226 (16.1)	345 (24.6)	**0.001**
		Dairy products	119 (8.5)	226 (16.1)	345 (24.6)	**0.000**

Geographical areas play a great role in prevalence of life-long AR symptoms in relation to environmental factors as shown in table V. Most of these factors had statistical significance results (*p* value 0.000).

Table V: Frequency of life-long AR symptoms in relation to Environmental factors according to the Geographical distribution

#	Environmental factors		Frequency				*p* value
			Costal	Plain	Mountain	Total	
1	Strenuous exercise		79 (5.6)	211 (15.1)	80 (5.7)	370 (26.4)	**0.000**
2	Type of house	Apartment	25 (1.8)	71 (5.1)	2 (0.1)	98 (7.0)	**0.000**
		Villa	3 (0.2)	60 (4.3)	57 (4.1)	120 (8.6)	
		Traditional house	55 (3.9)	83 (5.9)	21 (1.5)	159 (11.3)	
3	Air cooling system	Air conditioning window /spilt unit	78 (5.6)	207 (14.8)	79 (5.6)	364 (26.0)	0.054
		evaporative cooler	5 (0.4)	5 (0.3)	0 (0.0)	10 (0.7)	
4	Cooking fuel	Electrical	0 (0.0)	5 (0.4)	0 (0.0)	5 (0.4)	0.094
		Gaseous	79 (5.6)	201 (14.4)	80 (5.7)	360 (25.7)	
		Wood	4 (0.3)	5 (0.4)	0 (0.0)	9 (0.7)	
5	Flooring	Earthy	0 (0.0)	7 (0.5)	65 (4.6)	72 (5.1)	**0.000**
		Carpeting	7 (0.5)	27 (1.9)	6 (0.4)	40 (2.8)	
		Hard flooring (Ceramic)	68 (4.9)	173 (12.3)	7 (0.5)	248 (17.7)	
		Resilient flooring (linoleum)	4 (0.3)	6 (0.4)	0 (0.0)	10 (0.7)	
6	Curtain		58 (4.1)	154 (11.0)	52 (3.7)	264 (18.8)	0.247
7	Animal at home		30 (2.1)	68 (4.9)	27 (1.9)	125 (8.9)	0.782
8	Types of Animal contacts	Cat	23 (1.7)	34 (2.4)	6 (0.4)	63 (4.5)	**0.000**
		Dog	0 (0.0)	2 (.01)	0 (0.0)	2 (0.1)	
		Bird	6 (0.4)	18 (1.3)	0 (0.0)	24 (1.7)	
		Sheep	1 (0.0)	18 (1.3)	19 (1.4)	38 (2.7)	
		Cow	0 (0.0)	0 (0.0)	2 (0.1)	2 (0.1)	
9	Smoking		4 (0.3)	8 (0.6)	17 (1.2)	29 (2.1)	**0.000**
10	Second hand smoking		31 (2.2)	79 (5.6)	21 (1.5)	131 (9.3)	**0.000**
11	Types of smoking	Cigarettes	2 (0.1)	4 (0.3)	0 (0.0)	6 (0.4)	1.000
		Water-pipe	2 (0.1)	4 (0.3)	17 (1.2)	23 (1.6)	
12	Khat chewing		6 (0.4)	19 (1.4)	23 (1.6)	48 (2.4)	**0.000**
13	Types of Food	Sea food	74 (5.3)	193 (13.8)	80 (5.7)	347 (24.8)	**0.000**
		Nuts	74 (5.3)	191 (13.6)	80 (5.7)	345 (24.6)	**0.000**
		Egg	74 (5.3)	191 (13.6)	80 (5.7)	345 (24.6)	**0.000**
		Dairy products	74 (5.3)	191 (13.6)	80 (5.7)	345 (24.6)	**0.000**

4. DISCUSSION

An increasing worldwide prevalence of allergic diseases such as allergic rhinitis and asthma has been observed over the last decades. The reasons for the increase of prevalence of these diseases are still incompletely understood. Many epidemiological studies have shown that environmental exposure may have a crucial role in the development of tolerance to ubiquitous allergens found in natural environments [13]. The present study revealed that the prevalence of AR-related symptoms ((sneezing and nasal blockage without cold) was 15.4% in male and 11.7% in female with overall prevalence of 27.1%, which is close to the prevalence of AR in SA (26.5%) [14]. It also listed about 13 environmental risk factors, as in the national study reported an increase of allergic diseases in Saudi Arabia have from 20% to 25% during the period 1987 to 1995, and it was attributed to environmental factors [15].These can be as summarized in table II or other noticed very wide range of indoor and outdoor aeroallergens have been observed across the region: (i) pollen from different grasses, weeds, shrubs and trees, (ii) spores from species of moulds, (iii) insect allergens, such as cockroach and mosquito, (iv) dander from domestic animals, rodents and farm animals, and (v) many types of house dust mite and storage mites. The JR weather is differ according to geographical distribution ranged from hot humid costal area to rainy cold mountain throughout the year and dry, arid, desert-like, with hot windy summers, mild dry winters in plain areas. All these play great role in prevalence of AR-related symptoms as shown in result part. Few studies had been conducted to study the relation between environmental factors and allergic diseases in SA. The type of house floor play major environmental role in prevalence of AR-related symptoms in relation to gender, residence and geographical distribution (*p* value 0.027. 0.000, 0.000 respectively). This can be as source of indoor pollution , which most of the children were in close contact to the floor for most of the time and even they slept on it (Arab tradition known as majlis arabi). Active and passive smoking were associated with a modest increase in risk for AR, with prevalence of symptoms according to gender, residence and geographical distribution was 2.1% (*p* value 0.031), 2.0% (*p* value 0.003) and 2.1% (*p* value 0.000) respectively. This can be evident in study conducted in Sweden where exposure to parental smoking during infancy was associated with an overall elevated risk of prevalent AR (OR = 1.18; 95% CI, 1.01–1.39) [16]. The life-style habits of the Saudi population had been changed over the past decades with the increase of the fast food shops, the eating habits have also changed, both in consumption and diversity of foods rich in proteins. Diet is a major source of exposure to allergens in infancy and childhood [17]. That had been evident in this study, where foods account one of the risk factors for AR-related symptoms relation to the gender, residence and geographical distribution.

Indoor pets were found to markedly increase the risk of allergic diseases [18]. The prevalence of asthma, rhinitis, and skin allergy was significantly more common in families with animals than in those without [19]. In this study animal at house were incriminated as risk factor for AR in 125 (8.9%) of study population, with equal prevalence in relation to gender, residence and geographical distribution. Cats were the commonest pets, which account 12.9%, only 4.5% are incriminated as risk factor for AR. Sheep and birds also listed as risk factors with prevalence rate of 38 (2.7%) and 24 (1.7%) respectively. The secretary proteins from a large number of animals carry or contain powerful allergens capable of causing severe hypersensitivity reactions. AR and asthma are common clinical manifestations of allergies to animals. Therefore, removal of the pet (cat or dog) from the home is still recommended for sensitized patients with ongoing allergic diseases. The major cat allergen is a glycoprotein that is transported in the air by particles smaller than 2.5 μm, and these particles can remain airborne for long periods [13]. They are also adherent, contaminating an entire environment for weeks or months after cessation of allergen exposure [13]. A typical example is that allergens adherent to the clothing of people who have cats at home can trigger allergic reactions in sensitized individuals. It makes avoidance and prevention by sensitized individuals much more difficult, requiring public cooperation and awareness. It has been suggested in almost all clinical guidelines for sensitized patients with AR and/or asthma that pets (ie, cats and dogs) should be removed and to also carefully vacuum clean all carpets, mattresses, and upholstered furniture.

Geographical areas play a great role in prevalence of life-long AR symptoms in relation to environmental factors as shown in table V. Most of these factors had statistical significance results (p value 0.000). This mainly due to Climatic conditions across JR. Jazan has a hot desert climate with an average annual temperature above 30 °C (86 °F). The weather is very hot all year round and its average annual temperature is one of the hottest in the world, even in its short winters. It is very humid in summer months, making the weather very oppressive this is in coastal area. In plain area with dry hot windy weather and many farms, the environmental factors were the dominant risk factors for AR-related symptoms as shown in table V. Prevalence of AR-related symptoms increased in rural area compare to urban, that mainly due to presence of farms, types of house (*p* value = 0.000) animals (outdoor or indoor) which account 6.6 vs 2.3% in urban (*p* value = 0.001), and hot windy weather known as Ghubra, the house floor were earthy or covered by carpets 6.5% vs 1.6 in urban area (*p* value = 0.000).

5. CONCLUSION

A wide range of environmental factors have been observed in JR: as indoor and outdoor aeroallergens grass, weed, shrub and tree pollen, moulds, house dust and storage mites, insects and dander from domestic animals, rodents and farm animals. These were not well studied in form of drawing allergens map across the region for further control plan. We recommend further immunological studies to identify list of allergens and other environmental factors responsible for development of AR and other allergic diseases.

6. LIMITATIONS OF THE STUDY

Although the present study is the first to consider role of environmental factors and AR-related symptoms among children in JR, SA, it has some significant limitations. First the study was based on sample size, so the frequency of these factor results should be interpreted carefully. Second, our participants were school age students and the questionnaire filled by their parents, whom may gave an over/under estimated answers. Third, this study depend of participant experience to report symptoms , which can be miss interpreted inform of over/under estimated these symptoms, which may affect the result of this study. Finally correlation of environmental factors with RA-related symptoms should be confirmed by laboratory tests.

7. COMPETING OF INTERESTS

The authors have no conflict of interest to declare.

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