Original Article

Severity and prevalence of allergic rhinitis among school children, Jazan Region Saudi Arabia

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Abstract

Background: Allergic diseases such as allergic rhinitis (AR) 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. **Objectives:** To assess the severity and prevalence of AR among school children in Jazan Region, Saudi Arabia. **Methods:** This is a cross-sectional study using a modified International Study of Asthma and Allergies in Children (ISAAC) questionnaire. **Results:** The nasal blocking is considered to be one of the most common symptoms of AR. Regarding the frequency of AR-related symptoms which indicate severity in the last 12 months according to the gender, our statistical analysis results found that the severity regarding nasal symptoms varied from nasal block to disturbed sleep due to nasal block where 97 (6.9%) had nasal block, 109 (7.8%) had nasal block interfering with daily activities, 12.1% had nasal block resulting in breathing difficulties, and 67 (4.7%) had disturbed sleep due to nasal block/problem. About 258 (18.4%) of all population urgently visited the emergency department due to nasal problems. Sixty-four (4.5%) were admitted due to nasal problems and 92 (6.6%) missed school days due to nasal block. The prevalence in elementary and intermediate school was 209 (14.9) and 170 (12.2), respectively with *P* value of 0.013, according to gender of study population showed no statistical significance according to all parameters. The prevalence was higher among Saudi population, regarding education level the prevalence was higher among intermediate school children. **Conclusion:** In conclusion, it was clear that the prevalence of AR among Saudi school children is 27.1%. Living in urban areas, intermediate school education level, lowlander population are significant risk factors for the prevalence and severity of AR.

Keywords: Allergic rhinitis, Jazan Region, prevalence, Saudi Arabia

Introduction

Allergic rhinitis (AR) is an IgE-mediated disorder triggered by the exposure of nasal mucosa to allergens. This results in rhinorrhea, itching, sneezing, as well as sleep disturbance, which are easily observed and reported by parents or guardians. However, nasal congestion, the most common symptom of AR, may be more difficult to elicit from young children.[1,2]

The prevalence of AR and other allergic diseases has increased globally in the last three decades, and the geographical prevalence

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rates vary from 10% to 45%.[3,4] In addition to genetic factors, lifestyle factors influence the prevalence of AR and other allergic diseases. These include changing lifestyles, increasing vehicular pollution, increasing ownership of indoor plants and pets, choice of bedding and carpets, and an increasing use of air conditioning.[5,6] While major international epidemiological studies such as the International Study of Asthma and Allergy in Childhood (ISAAC)[7,8] and the European Community Respiratory Health Survey (ECRHS)[9] have greatly increased our understanding of allergic disease prevalence in many parts of the world, but there remains a limited number of epidemiological studies in population older than 16 years from Saudi Arabia and the Eastern Mediterranean region.[10] However, among children below the age of 15 years, Al Frayh and colleagues[11] reported an increasing prevalence of rhinitis from 20% in 1986 to 25% in 1995. Another study[12] that used the ISAAC Phase 1 questionnaire to evaluate rhinitis symptoms indicated a 26.5% prevalence among 6–15-year-old children in Saudi Arabia. More recently, a study that also used the ISAAC questionnaire reported a prevalence rate of 12.7% of AR in school children between the ages of 4 to 16 years.[13]

AR is presently classified as intermittent or persistent on the basis of the symptoms duration according to the ARIA guidelines. In addition, AR is classified as mild, moderate, or severe according to symptom severity.[1] The current study was conducted to assess the severity and prevalence of AR among school children in Jazan Region, Saudi Arabia using the ISAAC questionnaire.

Methods

Study area

This study conducted in Jazan (also called Gizan) region is one of the 13 regions of the SA. It is located on the tropical Red Sea coast in southwestern SA. Jazan covers an area of 11,671 km^2 including some 5000 villages and towns with a total population of 1.5 million. Geographically Jazan Region divides into three zones (coastal, plain, and mountain), which intersected with perennial streams, these geographical factors may be a risk factor 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 in November 2015 to fulfill the proposed objectives.

Sample design and size

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

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

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 the 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:

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

Since the sample proportion to the total population is <0.05 of the total number of school students in Jazan Region, we do not need to use the finite population correction factor to adjust the sample size. However, to increase precision, which might be lost as a result of adopting multistage 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 coastal, plain, and mountain as 250, 750, and 200, respectively. When distributing questionnaires we added 30% for each for non-responders.

Questionnaire

Questionnaire permission was obtained from the Oman University to use the Arabic version of the validated ISAAC questionnaire.[14] The questionnaire was in two parts. Part one was the Arabic-translated version of the core ISAAC questionnaire, which comprised 21 questions posed to parents relating to the prevalence of eczema, rhinitis, and asthma in their children; the information requested included: (1) parental reports of symptoms of allergic diseases; (2) parental reports of diagnosed allergic diseases; and (3) parental reports of current symptoms of allergic disorders. The second part of the questionnaire contained questions relevant to possible environmental risk factors for the development of these conditions. These environmental questions were modified slightly to ensure that all questions were relevant to the Saudi context, for example, relating to housing conditions,

exposure to animals and presence of animals at home, number of siblings and other people living in the house, and parental smoking. Data on these environmental risk factors will be reported separately in due course.

Data collection and analysis

These data had been entered and analyzed using the Statistical Package for Social Sciences (SPSS) software version 20.0. The qualitative data were presented as frequencies and percent. Independent t-test was used to compare quantitative variables between two study groups. Chi-square test was used for comparing qualitative variables between groups, Fisher exact test was used instead of the Chi-square with two by two tables when expected cell count <5. A probability value of ≤0.05 was considered statistically significant.

Results

A total of 1500 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 93.3%, most of them were Saudi 1273 (90.9%). Male students were 840 (60.0%) and female were 560 (40.0%). The age of participants ranged from 10 to 15 years with a mean of 12.8 ± 1.456 years and a median of 13 years. According to the residency, 811 (57.9%) students lived in rural, 64.7% of them were male, and 589 (42.1%) participants lived in urban area. Most of the students lived in lowlander area 840 (60.0%) and only 16.4% of them lived in mountain area, in 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 1 (this table was derived from the mother study which is concerned with identification of the role of environmental factors in development of AR among children in Jazan Region, Saudi Arabia, https://www.slideshare.net/rpj001/allergic-rhinitis-among-children-jazan-region-saudi-arabia-role-of-environmental-factors).

Table 1: 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)

The prevalence of AR related in the last 12 months was 27.1% as shown in Table 2. The prevalence according to background characteristics of study population showed clear statistical significance according to all parameters. The prevalence was high in lowlander and rural area in comparison to other areas. The prevalence in elementary and intermediate school was 209 (14.9) and 170 (12.2), respectively with *P* value of 0.013.

The nasal blocking is considered to be one of the most common symptoms of AR. Regarding the frequency of AR-related symptoms which indicate severity in the last 12 months according to the gender, our statistical analysis results found that the severity regarding nasal symptoms varied from nasal block to disturbed sleep due to nasal block where 97 (6.9%) had nasal block, 50 (3.6%) were males, 109 (7.8%) had nasal block interfering with daily activities, 57 (4.1%) were females, 12.1% had nasal block resulting in breathing difficulties, 113 (8.1%) were males, and 67 (4.7%) had disturbed sleep due to nasal block/problem, 37 (2.6%) were females. About 258 (18.4%) of all population urgently visited the emergency department due to nasal problems, 152 (10.8%) were males. Sixty-four (4.5%) were admitted due to nasal problems, 41 (2.9%) were males and 92 (6.6%) missed school days due to nasal block, 53 (3.8%) were males. The frequency of AR-related symptoms which indicate severity in the last 12 months according to gender of study population showed no statistical significance according to all parameters [Table 3].

Frequency of AR-related symptoms which indicate severity in the last 12 months according to the nationality, showed clear statistical significance according to frequency of attacks of nasal block, frequency of nasal block interfering with daily activities, frequency of disturbed sleep due to nasal block/problem, frequency of admission due to nasal problem ($P = 0.000$, 0.003, 0.000, and 0.022, respectively), where the prevalence was higher among Saudi population [Table 4].

Frequency of AR-related symptoms which indicate severity in the last 12 months according to the level of education showed clear statistical significance according to all parameters except regarding the frequency of missing school days due to nasal block where the prevalence of AR-related symptoms indicate severity was higher among intermediate school children [Table 5].

Frequency of AR-related symptoms which indicate severity in the last 12 months according to the residence showed clear statistical significance according to frequency of disturbed sleep due to nasal

Table 2: Prevalence of AR-related in the last 12 months according to the background characteristics of the study population

Prevalence of AR-related in the last 12 months		Frequency (%)			χ^2	*P*
Gender		**Male 215 (15.4)**	**Female 164 (11.7)**	**Total 379 (27.1)**		
Residence	Urban	63 (4.5)	81 (5.8)	144 (10.3)	19.935	0.000
	Rural	152 (10.9)	83 (5.9)	235 (16.8)		
Geographical distribution	Costal	58 (4.1)	25 (1.8)	83 (5.9)	10.917	0.000
	Lowlander	107 (7.7)	108 (7.7)	215 (15.4)		
	Mountain	50 (3.6)	31 (2.2)	81 (5.8)		
Level of education	Elementary school	124 (8.9)	85 (6.0)	209 (14.9)	6.230	0.013
	Intermediate school	91 (6.5)	79 (5.7)	170 (12.2)		
Nationality	Saudi	203 (14.5)	155 (11.1)	358 (25.6)	5.912	0.015
	Non-Saudi	12 (0.9)	9 (0.6)	21 (1.5)		

Table 3: Frequency of AR-related symptoms which indicate severity in the last 12 months according to the gender

Frequency of AR-related symptoms which indicate severity in the last 12 months	Frequency (%)			χ^2	*P*
	Male	**Female**	**Total**		
Frequency of attacks of nasal block	50 (3.6)	47 (3.3)	97 (6.9)	2.318	0.128
Frequency of nasal block interfering with daily activities	52 (3.7)	57 (4.1)	109 (7.8)	1.811	0.178
Frequency of nasal block resulting in breathing difficulties	113 (8.1)	56 (4.0)	169 (12.1)	2.318	0.128
Frequency of disturbed sleep due to nasal block/problem	30 (2.1)	37 (2.6)	67 (4.7)	0.017	0.896
Frequency of using nasal medication	30 (2.1)	36 (2.6)	66 (4.7)	1.992	0.158
Frequency of urgent visits to emergency department due to nasal problems	152 (10.8)	106 (7.6)	258 (18.4)	2.330	0.127
Frequency of admission due to nasal problem	23 (1.6)	41 (2.9)	64 (4.5)	1.853	0.173
Frequency of missing school days due to nasal block	39 (2.8)	53 (3.8)	92 (6.6)	1.901	0.168

Table 4: Frequency of AR-related symptoms which indicate severity in the last 12 months according to the nationality

Frequency of AR-related symptoms which indicate severity in the last 12 months	Frequency (%)			χ^2	*P*
	Saudi 358 (25.6)	**Non-Saudi 21 (1.5)**	**Total**		
Frequency of attacks of nasal block	86 (6.1)	11 (0.8)	97 (6.9)	18.771	0.000
Frequency of nasal block interfering with daily activities	109 (7.8)	0 (0.0)	109 (7.8)	18.329	0.003
Frequency of nasal block resulting in breathing difficulties	199 (14.2)	13 (0.9)	212 (15.1)	1.627	0.202
Frequency of disturbed sleep due to nasal block/problem	56 (4.0)	10 (0.7)	66 (4.7)	20.165	0.000
Frequency of using nasal medication	65 (4.6)	1 (0.1)	66 (4.7)	2.556	0.110
Frequency of urgent visits to emergency department due to nasal problems	111 (7.9)	11 (0.8)	122 (8.7)	4.328	0.288
Frequency of admission due to nasal problem	64 (4.5)	0 (0.0)	64 (4.5)	9.675	0.022
Frequency of missing school days due to nasal block	92 (6.6)	0 (0.0)	92 (6.6)	3.994	0.407

Table 5: Frequency of AR-related symptoms which indicate severity in the last 12 months according to the level of education

Frequency of AR-related symptoms which indicate severity in the last 12 months	Frequency (%)			χ^2	*P*
	Elementary school 209 (14.9)	**Intermediate school 170 (12.2)**	**Total**		
Frequency of attacks of nasal block	40 (2.8)	57 (4.1)	97 (6.9)	21.750	0.000
Frequency of nasal block interfering with daily activities	46 (3.3)	63 (4.5)	109 (7.8)	18.737	0.002
Frequency of nasal block resulting in breathing difficulties	99 (7.1)	113 (8.0)	212 (15.1)	30.050	0.000
Frequency of disturbed sleep due to nasal block/problem	16 (1.1)	50 (3.6)	66 (4.7)	27.470	0.000
Frequency of using nasal medication	10 (0.7)	56 (4.0)	66 (4.7)	32.987	0.000
Frequency of urgent visits to emergency department due to nasal problems	43 (3.1)	79 (5.6)	122 (8.7)	11.191	0.011
Frequency of admission due to nasal problem	17 (1.2)	47 (3.3)	64 (4.5)	20.675	0.000
Frequency of missing school days due to nasal block	33 (2.4)	59 (4.2)	92 (6.6)	6.894	0.142

block/problem, frequency of using nasal medication, frequency of urgent visits to emergency department due to nasal problems, and frequency of missing school days due to nasal block (*P* value = 0.000, 0.013, 0.000, 0.000, and 0.003, respectively), where the prevalence of AR-related symptoms indicate severity was higher among urban population regarding to this parameters [Table 6].

Frequency of AR-related symptoms which indicate severity in the last 12 months according to the geographical distribution showed clear statistical significance according to all parameters where the prevalence of AR-related symptoms indicate severity was higher among lowlander population [Table 7].

Discussion

The severity and prevalence of AR among school children in Jazan Region, Saudi Arabia. Based on this study, the prevalence of AR is estimated at 27.1%. This compares with other studies carried out in Madinah using the ISSAC protocol, which have previously shown a prevalence of 40% of children – within the first 8 years of life[15] and 38.6% in Riyadh.[16] The ISSAC method considers seasonal AR predominantly, while other types of rhinitis, such as perennial disease, are not studied.[17]

Large international, multicenter studies have shown significant variations in the prevalence of rhinitis and other allergic diseases between various parts of the world, between various age groups, and between different socio-economic classes. The multicenter studies have also indicated significant variations in the severity of each of the conditions. The multifactorial nature of rhinitis, especially with regards to the environment, affluence lifestyles, pollution, and climate, makes it difficult to match data with an identical population group, and the Phase III ISAAC publications have demonstrated this problem.[3] The World Allergy Organization recently published the White Book on Allergy (2011) that reported AR to affect between 10% and 30% of all adults and as many as 40% of children. The World Health Organization has estimated that 400 million people in the world suffer from AR.[18]

In our study the frequency of AR-related symptoms which indicate severity in the last 12 months according to gender of study population showed no statistical significance according to all parameters, these results disagreed with Al-Ghobain *et al.*,[16] who reported that the present study shows that girls report more rhinitis symptoms during the preceding 12 months compared with boys.

The prevalence of AR-related symptoms which indicate severity was higher among intermediate school children. These results disagreed with Pawankar *et al.*[19] who indicated that the educational level of elementary school increased the risk of AR also support our inference. Since health education, awareness, and media promotion of asthma and AR have been increased over the past few years in Mainland China, it is possible that the prevalence of AR may have been overestimated in individuals with poor educational background, considering that 45.5% of the rural participants only received elementary school education in the present study.

Table 6: Frequency of AR-related symptoms which indicate severity in the last 12 months according to the residence

Frequency of AR-related symptoms which indicate severity in the last 12 months	Frequency (%)			χ^2	*P*
	Urban 144 (10.3)	Rural 235 (16.8)	Total		
Frequency of attacks of nasal block	42 (3.0)	55 (3.9)	97 (6.9)	5.727	0.126
Frequency of nasal block interfering with daily activities	55 (3.9)	54 (3.9)	109 (7.8)	6.144	0.292
Frequency of nasal block resulting in breathing difficulties	84 (6.0)	128 (9.1)	212 (15.1)	0.610	0.435
Frequency of disturbed sleep due to nasal block/problem	40 (2.9)	26 (1.8)	66 (4.7)	25.659	0.000
Frequency of using nasal medication	41 (2.9)	25 (1.8)	66 (4.7)	5.545	0.013
Frequency of urgent visits to emergency department due to nasal problems	69 (4.9)	53 (3.8)	122 (8.7)	27.978	0.000
Frequency of admission due to nasal problem	48 (3.4)	16 (1.1)	64 (4.5)	41.417	0.000
Frequency of missing school days due to nasal block	54 (3.9)	35 (2.5)	92 (6.6)	15.827	0.003

Table 7: Frequency of AR-related symptoms which indicate severity in the last 12 months according to the geographical distribution

Frequency of AR-related symptoms which indicate severity in the last 12 months	Frequency (%)				χ^2	*P*
	Costal 83 (5.9)	Lowlander 215 (15.4)	Mountain 81 (5.8)	Total		
Frequency of attacks of nasal block	21 (1.5)	52 (3.7)	24 (1.7)	97 (6.9)	33.379	0.000
Frequency of nasal block interfering with daily activities	31 (2.2)	70 (5.0)	8 (0.6)	109 (7.8)	36.110	0.000
Frequency of nasal block resulting in breathing difficulties	24 (1.7)	122 (8.7)	66 (4.7)	212 (15.1)	13.920	0.000
Frequency of disturbed sleep due to nasal block/problem	21 (1.5)	38 (2.7)	7 (0.5)	66 (4.7)	12.456	0.053
Frequency of using nasal medication	18 (1.3)	47 (3.3)	1 (0.1)	66 (4.7)	19.763	0.000
Frequency of urgent visits to emergency department due to nasal problems	41 (2.9)	79 (5.7)	2 (0.1)	122 (8.7)	34.908	0.000
Frequency of admission due to nasal problem	19 (1.3)	43 (3.1)	2 (0.1)	64 (4.5)	26.342	0.000
Frequency of missing school days due to nasal block	20 (1.4)	62 (4.4)	10 (0.8)	92 (6.6)	48.282	0.000

In our study the prevalence of AR-related symptoms which indicate severity was higher among urban population regarding to nasal blocking symptoms, these results may be due to some environmental factors which can affect the prevalence of severe asthma symptoms in different areas. Several epidemiology studies have shown that exposure to environmental tobacco smoking (ETS) and other air pollutant factors which are more common in urban environment than rural is associated with poor respiratory health in children, adversely affect lung function, and may increase the risk of development of bronchial asthma. This also matched other previous studies.[20,21]

Conclusion

In conclusion, it was clear that the prevalence of AR among Saudi school children is 27.1%. Living in urban areas, intermediate school education level, and lowlander population are significant risk factors for the prevalence and severity of AR.

Limitations of the study

Although the present study is the first to estimate prevalence and severity of AR in Jazan, Saudi Arabia, 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, who gave an over/under-estimated answers. Third, this study depends on participant experience to report symptoms, which can be misinterpreted in form of over/under-estimated symptoms, which may affect the result of this study. Finally correlation of environmental factors with RA-related symptoms should be confirmed by laboratory tests.

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Conflicts of interest

There are no conflicts of interest.

References

1. Bousquet J, Schünemann HJ, Zuberbier T, Bachert C, Baena-Cagnani CE, Bousquet PA, *et al.* Development and implementation of guidelines in allergic rhinitis–an ARIA-GA2LEN paper. Allergy 2010;65:1212-21.
2. International Rhinitis Management Working Group. International consensus report on the diagnosis and management of allergic rhinitis. Allergy 1994;49:5-34.
3. Sibbald B, Rink E. Epidemiology of seasonal and perennial rhinitis: Clinical presentation and medical history. Thora×1991;46:895-901.
4. Asher MI, Barry T, Clayton J, Crane J, D'Souza, Ellwood P, *et al.* The burden of symptoms of asthma, allergic rhinitis and atopic aczema in children and adults in six New Zealand centers: ISAAc phase one. NZ Med J 2001;114:114-20.
5. ISAAC-2; World wide variation in the prevelance of asthma symptoms: The International Study of Asthma and Allergies in Childhood. Eur Respir J 1998;12:315-35.
6. Bellanti JA, Wallerstedt DB. Allergic rhinitis update: Epidemiology and natural history. Allergy Asthma Proc 2000;12:367-70.
7. Beasley R, of Asthma TI. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. Lancet 1998;351:1225-32.
8. Asher MI, Keil U, Anderson HR, Beasley R, Crane J, Martinez F, *et al.* International Study of Asthma and Allergies in Childhood (ISAAC): Rationale and methods. Eur Respir J 1995;8:483-91.
9. Burney UK, Chinn S, Luczynska C, Jarvis D, Neukirch F, Pin I, *et al.* Variations in the prevalence of respiratory symptoms, selfreported asthma attacks, and use of asthma medication in the European Community Respiratory Health Survey (ECRHS). Eur Respir J 1996;9:687-95.
10. Aït-Khaled N, Enarson DA, Ottmani S, El Sony A, Eltigani M, Sepulveda R. Chronic airflow limitation in developing countries: Burden and priorities. Int J Chron Obstruct Pulmon Dis 2007;2:141-50.
11. Al Frayh AR, Shakoor Z, Gad El Rab MO, Hasnain SM. Increased prevalence of asthma in Saudi Arabia. Ann Allergy Asthma Immunol 2001;86:292-6.
12. Sobki SH, Zakzouk SM. Point prevalence of allergic rhinitis among Saudi children. Rhinology 2004;42:137-40.
13. Harfi H, Al Abbad K, Alsaeed AH. Decreased prevalence of allergic rhinitis, asthma and eczema in Riyadh city, Saudi Arabia. Trends Med Res 2010;5:57-62.
14. ISAAC Tools – Arabic Version. Available from: http://isaac.auckland.ac.nz/resources/tools.php?menu=tools1. [Last accessed on 2011 Apr 14].
15. Nahhas M, Bhopal R, Anandan C, Elton R, Sheikh A. Prevalence of allergic disorders among primary school-aged children in Madinah, Saudi Arabia: Two-stage cross-sectional survey. PloS One 2012;7:e36848.
16. Al-Ghobain MO, Al-Moamary MS, Al-Hajjaj MS, Al-Fayez AI, Basha SI. Prevalence of rhinitis symptoms among 16 to 18 years old adolescents in Saudi Arabia. Indian J Chest Dis Allied Sci 2013;55:11-4.
17. Jones NS, Smith PA, Carney AS, Davis A. The prevalence of allergic rhinitis and nasal symptoms in Nottingham. Clin Otolaryngol Allied Sci 1998;23:547-54.
18. Zheng M, Wang X, Bo M, Wang K, Zhao Y, He F, *et al.* Prevalence of allergic rhinitis among adults in urban and rural areas of china: A population-based cross-sectional survey. Allergy Asthma Immunol Res 2015;7:148-57.
19. Pawankar R, Canonica GW, Holgate ST, Lockey RF. World Allergy Organization (WAO) White Book on Allergy. Wisconsin: World Allergy Organisation; 2011.
20. Thomson NC. The role of environmental tobacco smoke in the origins and progression of asthma. Curr Allergy Asthma Rep 2007;7:303-9.
21. Gold DR. Environmental tobacco smoke, indoor allergens, and childhood asthma. Environ Health Perspect 2000;108(Suppl 4):643-51.