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Prevalence of Allergic Rhinitis and Eczema in Adolescents Living in Yazd City: Part of Global Asthma Network Survey

Zahra Nafei¹, Nasrin Behniafard^{1,2}, Mohsen Mirzaei³, Mehran Karimi¹, and Elahe Akbarian¹

¹ Children Growth Disorder Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

² Department of Allergy and Clinical Immunology, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

³ Health Monitoring Research Center, School of Medicine, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

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ABSTRACT

Allergic rhinitis and eczema are two common global diseases that can lead to impaired quality of life. Determining the prevalence of these allergic disorders can be useful in planning prevention and treatment.

This study aimed to investigate the prevalence and severity of allergic rhinitis and eczema in adolescents living in Yazd city. Using an electronic questionnaire based on the Global Asthma Network (GAN) core questionnaire, 5141 adolescents aged 13–14 years were cross-sectionally surveyed.

The prevalence of current symptoms of rhinitis turned out to be 36.3%, proving significantly higher in boys ($p=0.009$). Moreover, the prevalence of allergic rhinitis and rhinoconjunctivitis in the past year leveled at 12.4% and 10.5%, respectively; however, the former was significantly higher in females ($p=0.014$). Additionally, severe rhinoconjunctivitis was observed in 0.2% of the participants with no gender preference ($p=0.09$). Confirmed hay fever by a doctor was reported in 13.2% of adolescents, significantly higher in males ($p<0.001$). The prevalence of current itchy rash and current eczema was found to be 5.5%, and 2.9%, respectively, with no difference in terms of gender. Severe atopic eczema and eczema confirmed by a doctor were seen in 0.4% and 5% of the participants, no gender preference was identified. Concurrent prevalence of current rhinoconjunctivitis and eczema was detected in 1% of the participants.

Despite the increasing trend of allergic diseases in most parts of the world, the prevalence of rhinoconjunctivitis and eczema in adolescents has not increased in Yazd in the last two decades, and this city is located in a low to moderate prevalence area.

Keywords: Adolescent; Allergic rhinitis; Eczema; Prevalence

Corresponding Author: Nasrin Behniafard, MD;
Department of Allergy and Clinical Immunology, Shahid Sadoughi
University of Medical Sciences, Yazd, Iran. Tel: (+98 917) 303 7234,
Fax: (+98 353) 1833 532, E-mail: N_Behniafard@yahoo.com

INTRODUCTION

Allergic rhinitis and eczema are two chronic and annoying diseases that can influence the impaired

quality of life in patients and their families from childhood, including sleep disturbance, impaired academic and professional performance, and problems affecting social and family relationships. These two allergic diseases also impose a great economic burden on the family and society.^{1,2}

Based on the worldwide International Study of Asthma and Allergies in Childhood (ISAAC) phase three, the average prevalence of current rhinoconjunctivitis symptoms for children 13 to 14 years old was 14.6% (range 1.0–45%). The prevalence of current rhinoconjunctivitis stood even greater in high-income countries, and its severity higher in less affluent nations.³ The range prevalence of current eczema among adolescents in ISAAC phase 3 was reported 0.2% to 24.6% in different regions of the world.⁴ According to ISAAC global studies, lower latitudes, and eastern longitudes appear to be associated with a higher prevalence of current symptoms of asthma, rhinoconjunctivitis, and eczema in children and adolescents.⁵

Based on the results of two phases of the ISAAC study (phases one and three) in Iran, the prevalence of current symptoms of eczema and rhinoconjunctivitis showed to be 2.6%, 4.4% (change in a year: 0.3%), and 7.5%, 9.8% (change in a year: 0.31) respectively, hence representing Iran as being in a low prevalence zone despite the growing level of prevalence.⁶ Based on the only study conducted in Yazd in 2003; using the ISAAC questionnaire, the prevalence of current eczema and rhinoconjunctivitis amounted to 9.3% and 12.3%, respectively;⁷ this shows a higher prevalence of these allergic disorders in Yazd compared to ISAAC concurrent studies performed in other parts of Iran.

To accurately estimate the prevalence of allergic diseases and proper planning in this area, the decision was made to conduct this study in Yazd, a city located in the desert region of central Iran, as part of the Global Asthma Network (GAN) study.

MATERIALS AND METHODS

This is part of the GAN 2020 survey conducted in early 2020 for five months in Yazd. GAN is cross-sectional, multi-center, multi-country, epidemiological research with a standard questionnaire including questions related to asthma, allergic rhinitis, eczema, and associated environmental factors. The GAN

questionnaire is derived from the ISAAC questionnaire to which the questions comprising asthma treatment, rhinitis, eczema, and asthma confirmed by a doctor, as well as some associated environmental factors have been added.⁷

Questionnaire and Sampling

Once the questionnaire was translated into Persian, and some experts determined its validity, the reliability of the translated version was confirmed by a randomized study conducted on 100 selected students aged 13-14 years using Cronbach's alpha. The alpha coefficient for rhinitis and eczema symptoms turned out to be 0.74, thus exhibiting appropriate internal consistency.

Finally, the questionnaire was translated back into English and sent to the GAN principal in New Zealand, then approved. At the beginning of the study, due to schools' closure during the outbreak of coronavirus disease 2019 (COVID-19), an electronic questionnaire was designed and placed in the virtual education groups of schools. According to the GAN recommendation, at least 3,000 samples are required to estimate a good prevalence. Students of 48 state and private schools randomly selected from two educational districts were included to make a cluster sampling design for the study. Moreover, non-Iranian students were excluded from the study. All the subjects aged 13-14 in these schools were invited to fill in the questionnaire. Out of 7214 students, 5141 completed the questionnaire (response rate: 71.3%), and then demographic data that seemed unacceptable were reviewed by telephone and corrected if necessary.

Definition of Items

Rhinitis: According to the study protocol, those who had shown nasal problems (sneezing or runny nose or nasal obstruction without a cold) in the past 12 months were considered as current rhinitis (Question 18) as well as those who had shown nasal problems accompanied by an itchy nose (Questions 18 and 19) and nasal problems accompanied by itchy watery eyes (Questions 18 and 20) in the past year were considered as having allergic rhinitis and rhinoconjunctivitis, respectively. Severe rhinoconjunctivitis refers to current rhinoconjunctivitis that significantly interferes with daily activities (Question 21).

Eczema: Adolescents who gave a positive response to a question on the presence of an itchy rash in the past

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year and the involvement of areas defined for eczema (Questions 25 and 26) were labeled as current eczema cases. Furthermore, those who woke up ≥ 1 night per week due to their itchy rash were considered to have severe eczema (Question 28). Self-reported eczema was defined as "eczema ever" (Question 29).

Rhinitis & Eczema Overlap: Rhinitis and eczema overlap was defined as subjects who simultaneously showed both rhinoconjunctivitis and current eczema in this study.

Statistical Analysis

The output data were received through an Excel spreadsheet. All analyses were performed via SPSS, version 23.0 (IBM, Armonk, NY). Pearson Chi-Square test was deployed to determine the relationship between the variables as percentages. The value of $p < 0.05$ was considered statistically significant.

Ethics

Before initiation of the study an ethics certificate was obtained from Shahid Sadoughi University of Medical Sciences in Yazd, Iran (IR.SSU.REC.1398.244). Permission was then obtained from the Department of Education to conduct the study in the schools. A form of informed consent was placed at the beginning of the electronic questionnaire so that the students can feel completely free to participate in the study.

RESULTS

Allergic rhinitis: A total of 5141 students answered the questionnaires, 2072 (40.3%) of whom were male and 3069 (59.7%) were female. In this study, 43.6% of adolescents reported nasal symptoms such as sneezing or runny or obstructed nose without a cold or flu in the past (rhinitis ever), and 36.3% symptoms of rhinitis in the previous 12 months; both were significantly higher in boys. ($p=0.004$ and 0.009 respectively). Moreover, 34.2% of the participants with current symptoms of rhinitis reported itchy nose, which was considered allergic rhinitis according to the study protocol; they constituted 12.4% of all the subjects. Allergic rhinitis, however, proved to be significantly higher in the female gender ($p=0.014$). The prevalence of rhinoconjunctivitis in total adolescents amounted to 10.5% with no sex

predominance ($p=0.18$). Furthermore, disturbance in daily activity due to nasal problems was observed in 7.8% of the subjects, projected as significantly higher in males ($p=0.008$). Only 0.2% of the participants showed signs of severe rhinoconjunctivitis but devoid of gender preference ($p=0.09$). Finally, self-reported hay fever was reported in 24.9% of all cases 52.8% of whom had confirmed hay fever by a doctor (13.2% of participants). Both of these proved significantly higher in males (Table 1).

Eczema: Prevalence of ever itchy rash was identified in 9.5% of the participants ($p=0.13$). In this study, 5.5% of all students reported itchy rash in the past 12 months with no difference between the sexes ($p=0.48$). In addition, current eczema was observed in 2.9% of the participants. These students constituted 52.7% of those who had an itchy rash during the past year. And again, there was no significant difference between the two genders ($p=0.25$).

Moreover, sleep awakening due to itchy rash was reported by 1.6% of total subjects, and severe atopic eczema was observed in only 0.4% of the participants. In response to the question "Have you ever had eczema?" 7.3% of the students gave a positive response. And in 70.2% of those who had self-reported eczema, the problem was confirmed by a physician. In other words, 5% of the participants had eczema confirmed by a doctor, and no gender difference was again revealed in any of the above cases (Table 2). Concurrent prevalence of current rhinoconjunctivitis and eczema: Given the definition presented for current rhinoconjunctivitis and eczema in this study, 1% of the participants were affected by both diseases simultaneously (Figure 1).

Table 1: Analysis of questions related to nasal problems that occur in the absence of colds or flu in the aged group of 13-14 years by gender

		Male	Female	Total	<i>p</i>
Ever sneezing or runny or blocked nose	Yes	951 (45.9%)	1293(42.1%)	2244 (43.6%)	0.004
	No	1121 (54.1%)	1776(57.9%)	2897 (56.4%)	
sneezing or runny or blocked nose in the past year	Yes	794 (38.3%)	1075(35%)	1869 (83.3%)	0.009
	No	1278 (61.7%)	1994(65%)	3272 (16.7%)	
sneezing or runny or blocked nose and itchy nose in the past year	Yes	232 (29.2%)	408 (38.0%)	640 (34.2%)	0.014
	No	562 (70.8%)	667 (62.0%)	1229 (65.8%)	
sneezing or runny or blocked nose and itchy watery eye in the past year	Yes	207 (26.1%)	332 (30.9%)	539 (28.8%)	0.2
	No	587 (73.9%)	743 (69.1%)	1330 (71.2%)	
Intensity interference in daily activities	Not at all	610 (76.8%)	860 (80.0%)	1470 (78.7%)	0.09
	A little	156(19.6%)	185 (17.2%)	341 (18.2%)	
	moderate	23 (2.9%)	23 (2.1%)	46 (2.5%)	
	A lot	5 (0.6%)	7 (0.7%)	12 (0.6%)	
Self- reported Hay fever	Yes	571 (27.6%)	710 (23.1%)	1281 (24.9%)	<0.001
	No	1501 (72.4%)	2359 (76.9%)	3860 (75.1%)	
Confirmed hay fever by a doctor	Yes	324 (56.7%)	353 (49.7%)	677 (52.8%)	<0.001
	No	247 (43.3%)	357 (50.3%)	604 (47.2%)	

Table 2. Analysis of questions related to itchy skin rash in the aged group of 13-14 years by gender

		Male	Female	Total	<i>p</i>
Ever recurrent itchy skin rash	Yes	208(10.0%)	278(9.1%)	486(9.5%)	0.13
	No	1864(90.0%)	2791(90.9%)	4655(90.5%)	
Recurrent itchy skin rash in the past year	Yes	114(5.5%)	167(5.4%)	281(5.5%)	0.47
	No	1958(94.5%)	2902(94.6%)	205(94.5%)	
Involvement of defined area for eczema	Yes	64(3.1%)	84(2.7%)	148(2.9%)	0.25
	No	2008(96.2%)	2985(97.3%)	4993(97.1%)	
Number of sleep awakening	Never	2035 (98.2%)	3020 (98.4%)	5055 (98.4%)	0.66
	<1 night /week	29(1.4%)	35(1.1%)	64(1.2%)	
	≥1 night /week	8(0.4%)	14(0.5%)	22(0.4%)	
Self -reported eczema	Yes	163(7.9%)	210(6.8%)	373(7.3%)	0.09
	No	1909(92.1%)	2859(93.2%)	4768(92.7%)	
Confirmed eczema by a doctor	Yes	114(5.5%)	148(4.8%)	262(5.1%)	0.15
	No	1958 (94.5%)	2921 (95.2%)	4879 (94.9%)	

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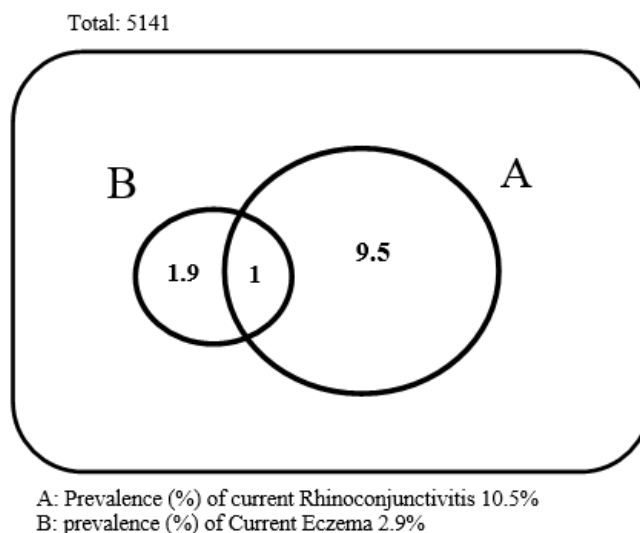


Figure 1. Concurrent prevalence of current rhinoconjunctivitis and eczema

DISCUSSION

This study was for the first time conducted in this area as part of the GAN study to evaluate the prevalence and severity of allergic diseases and related factors. (The results of the prevalence and severity of asthma pertinent to this study have been reported in advance.⁸

Allergic rhinitis: In this study, the prevalence of rhinitis ever, current rhinitis symptoms, allergic rhinitis, rhinoconjunctivitis, and severe rhinoconjunctivitis for the past 12 months were proved to be 43.6%, 36.3%, 12.4%, 10.5%, and 0.2% in all adolescents, respectively. Compared to the previous study based on the ISAAC questionnaire and conducted about two decades ago by Karimi et al in Yazd, rhinitis ever and current rhinitis have, to date, slightly increased although rhinoconjunctivitis in the past 12 months has tended to subside.⁹ A systematic review by Mohammadzadeh et al, analyzing studies based on the ISAAC questionnaire between 2003 and 2011 revealed the average prevalence of rhinitis ever in children aged 13-14 years in Iran is 21.2%. The lowest prevalence was related to Ahvaz, a city in the southwest of Iran with a subtropical hot desert climate and significant rainfall (15.4%) and the highest was related to Yazd with a hot desert climate and no humidity (42.7%).¹⁰ Yet, in a study conducted by Zamanfar et al in northern

Iran in 2012 based on the ISAAC questionnaire, the prevalence of rhinitis in the last year and rhinitis ever appeared to be lower than that of our study. However, the prevalence of current rhinoconjunctivitis predicated on the GAN guidelines indicates atopy being significantly higher than that of our study.¹¹ Similar results were obtained regarding the prevalence of rhinoconjunctivitis compared with the study of Nasiri et al in Kurdistan.¹² Although there exists a time difference between these investigations and ours, the higher prevalence of rhinoconjunctivitis in these areas can be justified due to the extensive and diverse forest cover attributed to suitable humidity and abundant rainfall. The higher prevalence of current symptoms of rhinitis and rhinitis ever in both studies in Yazd during two decades can be due to non-allergic causes hence giving rise to nasal symptoms including cold and dry climate in this area.

A study based on the ISAAC questionnaire in Turkey in 2016 showed that the prevalence of current rhinoconjunctivitis being 17.3% in adolescents aged 13-14 years. The higher prevalence of rhinoconjunctivitis in Turkey compared to our study can be justified by the similarity of climate and vegetation diversity of this country with the northern part of Iran.¹³

In the 2018 Bangkok study based on the GAN questionnaire, the prevalence of rhinoconjunctivitis,

severe rhinoconjunctivitis, and hay fever in the age group of 13-14 years were reported 17.5%, 1.9%, and 27.4%, respectively. Similar to our study, a decrease in the prevalence of current rhinoconjunctivitis was observed compared to the ISAAC phase three study.¹⁴ Although Thailand, like Iran, is a developing country, the prevalence and severity of rhinoconjunctivitis in Bangkok appear to be significantly higher than those in our study. Compared to the hot and dry desert climate of our city, Bangkok enjoys a tropical savanna climate as well as diverse vegetated forests with higher pollution, which is probably the reason for the higher prevalence and severity of this allergic disease.

Another study in Kosovo in 2020 based on the GAN questionnaire reported the prevalence of current symptoms of rhinitis, current rhinoconjunctivitis, and severe rhinoconjunctivitis being 25%, 11.3%, and 0.5% respectively.¹⁵ Compared to our study, the prevalence of current rhinoconjunctivitis was lower and severe rhinoconjunctivitis was higher. Various reasons can likely be involved in the low prevalence of severe rhinoconjunctivitis in our study, compared to Kosovo, including cultural, genetic, climatic differences, diet, and early diagnosis and treatment of rhinoconjunctivitis.

In our study, accorded with Kosovo, the prevalence of allergic rhinitis appeared to be significantly higher in females. This is consistent with the results of ISAAC Phase three, which showed the symptoms of all three atopic diseases (asthma, rhinoconjunctivitis, and eczema) in the 13-14 age group being higher in the girls than in the boys in most parts of the world.⁵ Increased estrogen level during puberty and its effect on the deviation of the immune response to the T-helper2 and the activation of mast cells could explain the reason for this high prevalence in female adolescents.¹⁵⁻¹⁷

Eczema: The prevalence of ever, current itchy rash which was coming and going and severe eczema leveled at 9.5%, 5.5%, and 0.4% in all the students, with no gender predominance. This can be compared to the results of the study conducted by Karimi et al in Yazd in 2003, which turned out to be 14.8%, 9.3%, and 1.2% respectively.⁹ The prevalence and severity of eczema subsiding in less than two decades in Yazd can be attributed to various factors including changes in economic status, indoor or outdoor environment, eating habits, disease awareness, and migration to this industrial city and the resulting genetic changes. The

prevalence of self-reported eczema (eczema ever) in this study was 7.3% without any significant gender differences. The pooled prevalence of eczema in Iranian adolescents was 6.52% as reported in a systematic study and meta-analysis by Ghaffari et al in 2014 thus illustrating a different state of eczema prevalence from 4.1% to 24.3% in varying parts of Iran.¹⁸ The prevalence of current eczema, based on this study protocol, was 2.9% with no gender predominance. According to the ISAAC phase three worldwide study, the range prevalence of current eczema symptoms among the age group 13 to 14 years varied from 0.2% (China) to 24.6% (Colombia), and the prevalence of severe eczema ranged from 0.0% (India) to 5.8% (Morocco). Our results compared to other findings in Iran predicated on ISAAC has three represents the prevalence of current symptoms of eczema, eczema ever and severe eczema subsiding thus proving Yazd to be still in a low prevalence area.^{4,6}

Findings of recent two studies based on the GAN questionnaire in Bangkok and southern Kosovo demonstrated the prevalence of eczema ever, current symptoms of eczema and severe eczema being higher compared to this study, especially in Bangkok. Consonant with the results obtained for rhinitis in Bangkok, the high prevalence of eczema could be due to discrepancies in the genetic factors and polymorphisms, climate, and vegetation of that area with the desert region of Yazd. Comparison of the results of this study with those of Kosovo study projected the prevalence of severe eczema in our study is lower and the ratio of confirmed eczema cases to self-reported eczema being higher. This indicates that further diagnosis and confirmation by a physician can assist in reducing the severity of eczema.^{14,15} Several researchers have reported the simultaneous occurrence of these three allergic diseases.^{19,20} A meta-analysis based on the ISAAC questionnaire reported the prevalence in people of all three atopic diseases (asthma, allergic rhinitis, and eczema) being 9.8 times higher than what could be expected by chance.²⁰ As the result of this study reveals a patient with one of the diseases such as rhinitis or eczema can bear a significantly higher chance than a healthy adolescent to develop another allergic disease ($p < 0.001$).

Our study showed 1% of all the participants had both diseases simultaneously. In an ISAAC study on a large population of adolescents in the UK, 16.4% and 18.2% revealed current eczema and rhinoconjunctivitis

respectively, and 6% showed both at the same time.²¹ The difference in the simultaneous prevalence of these two diseases in these two studies can be ascribed to genetic and environmental factors as well as more population in the UK study.

Moreover, of those affected with current eczema, 34.5% had concomitant rhinoconjunctivitis, but only 9.5% of that contracting rhinoconjunctivitis had current eczema as well. In agreement with the results of ours, several studies have recognized that eczema can increase the risk of allergic rhinitis more than the condition in which a person develops eczema following allergic rhinitis.^{19,21,22}

A limitation of this study is that some questions related to allergic rhinitis and eczema are from the past, and the recall bias may interfere with the results. The advantage of this study is that electronic questionnaire was used. In web design, all factors affecting incorrect data entry in the paper questionnaire were controlled to prevent junk data entry; on the other hand, more population was studied.

The findings of this study demonstrated that according to ISAAC classification, Yazd, in terms of the prevalence of current rhinoconjunctivitis and severe rhinoconjunctivitis in adolescents, is located in moderate and low prevalence area respectively.³ According to ISAAC global studies which show a higher prevalence and lower severity of current rhinoconjunctivitis in high-income countries, the prevalence, and severity of allergic rhinitis in Yazd appear to be more similar to those of the developed countries. Regarding that, the ISAAC phase three study in Iran also reports a low prevalence of severe rhinoconjunctivitis, and given that Iran is a non-affluent country and enjoys a far varying climate, the low prevalence of severe rhinoconjunctivitis in our country can probably be attributed to genetic and racial factors. The reduction in the prevalence and severity of current eczema and the prevalence of current rhinoconjunctivitis in less than two decades in Yazd can stem from lifestyle changes such as reducing indoor pollutants, disease awareness as well as racial change arising from immigration to this industrial city.

CONFLICT OF INTEREST

There is no conflict of interest in this study to declare.

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REFERENCES

1. Meltzer EO. Quality of life in adults and children with allergic rhinitis. *J Allergy Clin Immunol.* 2001;108(1):S45-S53.
2. Christiansen ES, Kjaer HF, Eller E, Bindslev-Jensen C, Høst A, Mortz CG, et al. The prevalence of atopic diseases and the patterns of sensitization in adolescence. *Pediatr Allergy Immunol.* 2016;27(8):847-53.
3. Ait-Khaled N, Pearce N, Anderson HR, Ellwood P, Montefort S, Shah J, et al. Global map of the prevalence of symptoms of rhinoconjunctivitis in children: The International Study of Asthma and Allergies in Childhood (ISAAC) Phase Three. *Allergy.* 2009;64(1):123-48.
4. Odhiambo JA, Williams HC, Clayton TO, Robertson CF, Asher MI, Group IPTS. Global variations in prevalence of eczema symptoms in children from ISAAC Phase Three. *J Allergy Clin Immunol.* 2009;124(6):1251-8. e23.
5. Mallol J, Crane J, von Mutius E, Odhiambo J, Keil U, Stewart A, et al. The International Study of Asthma and Allergies in Childhood (ISAAC) phase three: a global synthesis. *Allergol Immunopathol.* 2013;41(2):73-85.
6. Asher MI, Montefort S, Björkstén B, Lai CK, Strachan DP, Weiland SK, et al. Worldwide time trends in the prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and eczema in childhood: ISAAC Phases One and Three repeat multicountry cross-sectional surveys. *The Lancet.* 2006;368(9537):733-43.
7. Ellwood P, Ellwood E, Rutter C, Perez-Fernandez V, Morales E, García-Marcos L, et al. Global Asthma Network Phase I surveillance: geographical coverage and response rates. *J Clin Med.* 2020;9(11):3688.
8. Behniafard N, Nafei Z, Mirzaei M, Karimi M, Vakili M. Prevalence and Severity of Adolescent Asthma in Yazd, Iran: Based on the 2020 Global Asthma Network (GAN)

- Survey. *Iran J Allergy Asthma Immunol.* 2021;20(1):24-32.
9. Karimi M, Mirzaei M, Ahmadi MH. The Prevalence of Asthma, Allergic Rhinitis and Eczema symptoms among 13-14 year-old school children in Yazd in 2003. *Jundishapur Scientific Medical Journal.* 2007;6(3 (54)):270-5
 10. Mohammadzadeh I, Barari-Savadkoochi R, Alizadeh-Navaei R. The prevalence of allergic rhinitis in Iranian children: A systematic review and descriptive meta-analysis. *J Pediatr Rev.* 2013;1(2):19-24.
 11. Zamanfar D, Ghaffari J, Behzadnia S, Yazdani-charati J, Tavakoli S. The prevalence of allergic rhinitis, eczema and asthma in students of guidance schools in Mazandaran Province, Iran. *Open Access Maced J Med Sci.* 2016;4(4):619-23
 12. Nasiri R, Homagostar G, Tajik M, Shekari A, Roshani D, Ataei P, et al. Evaluation of Prevalence of Allergic Rhinitis Symptoms in Kurdistan, a Western Province in Iran. *Int J Pediatr.* 2015;3(6.1):1039-46.
 13. Hatice Simsek R, Bennur Koca R, Temel AB. The Prevalence of Asthma and Allergic Diseases in Middle School Students and Related Environmental Factors. *Int J Caring Sci.* 2016;9(3):1049.
 14. Chinratanapisit S, Suratannon N, Pacharn P, Sritipsukho P, Vichyanond P. Prevalence and severity of asthma, rhinoconjunctivitis and eczema in children from the Bangkok area: The Global Asthma Network (GAN) Phase I. *Asian Pac J Allergy Immunol.* 2019;37(4):226-31.
 15. Gashi V, Ahmetaj LN, Ahmeti B. Allergic Rhinitis and Eczema in a Population of School Children from the City of Gjilan in Kosovo. *Experimed.* 9(3):113-9.
 16. Chen W, Mempel M, Schober W, Behrendt H, Ring J. Gender difference, sex hormones, and immediate type hypersensitivity reactions. *Allergy.* 2008;63(11):1418-27.
 17. Roved J, Westerdahl H, Hasselquist D. Sex differences in immune responses: Hormonal effects, antagonistic selection, and evolutionary consequences. *Horm Behav.* 2017;88:95-105.
 18. Ghaffari J, Navaeifar MR, Alizadeh-Navaei R. The prevalence of Eczema in Iranian children: A systematic review and meta-analysis. *J Pediatr Rev.* 2014;2(1):2-9.
 19. Hong S, Son DK, Lim WR, Kim SH, Kim H, Yum HY, et al. The prevalence of atopic dermatitis, asthma, and allergic rhinitis and the comorbidity of allergic diseases in children. *Environ Health Toxicol.* 2012;27:e2012006.
 20. Pols DH, Wartna JB, van Alphen EI, Moed H, Rasenberg N, Bindels PJ, et al. Interrelationships between atopic disorders in children: a meta-analysis based on ISAAC questionnaires. *PLoS One.* 2015;10(7):e0131869.
 21. Austin JB, Kaur B, Anderson HR, Burr M, Harkins LS, Strachan DP, et al. Hay fever, eczema, and wheeze: a nationwide UK study (ISAAC, international study of asthma and allergies in childhood). *Arch Dis Child.* 1999;81(3):225-30.
 22. Rahimi Rad M, Hejazi M, Behroozian R. Asthma and other allergic diseases in 13-14-year-old schoolchildren in Urmia: an ISAAC study. *East Mediterr Health J.* 2007;13(5):1005-16.