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Prevalence of Asthma Symptoms in Children and Adolescents in Karaj, Iran: A Report from the Global Asthma Network Phase I Study

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ABSTRACT

This study is a part of the Global Asthma Network (GAN) phase I project to assess asthma symptoms in children, adolescents, and their parents in Karaj, Iran. The present cross-sectional study was conducted in 2019-2020 in Karaj, Iran, in alignment with the goals of the GAN study, including assessing asthma prevalence, severity, and risk factors.

In this study, 1500 students were selected using a multistage stratified cluster sampling method from 40 public and private schools in Karaj. The entire population of children aged 6-7 years or adolescents aged 13-14 years in a given school and their parents was considered the sample unit. The GAN core questionnaires were completed for students and parents.

The results showed that the response rate was 89.6%. A total of 1326 children and adolescents, 572 children aged 6-7 years, and 754 aged 13-14 years and their parents were enrolled in the study. The prevalence of ever- and current wheezing was 24% and 13.8% among 6-7-year-olds, and 18.8% and 12.3% among 13-14-year-olds, respectively. In children aged 6-7 years, parental wheezing significantly increased the chances of children wheezing (odds ratio: 3.27; 95% confidence interval: 1.70, 6.310).

The current study's findings showed that the prevalence of asthma symptoms among children and adolescents and their parents in Karaj, Iran, was mainly higher than the findings of studies conducted in other cities in Iran.

Keywords: Asthma; Adults; Children; Epidemiology; Wheezing

INTRODUCTION

As the most prevalent chronic inflammatory disease of the respiratory tract, asthma is associated with reversible bronchospasm and airway hyper-responsiveness and is generally diagnosed based on

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clinical features. The most common manifestations include recurrent wheeze, breathlessness, nocturnal and dry cough, and exercise intolerance.[1] Approximately 300 million people have asthma worldwide.[2] Despite considerable advances in the diagnosis and treatment of allergic diseases, including asthma, in recent decades, according to numerous studies, the prevalence of asthma has been increasing.[3] Moreover, asthma is associated with high morbidity and mortality rates, and the majority of asthma-related deaths occur in less developed or developing countries. In addition, studies on the quality of life of children with asthma demonstrated that they have a lower quality of life than healthy children of the same age.[4,5]

Genetic and environmental factors play an important role in the development of asthma. Diet, being exposed to environmental allergens and irritants such as pollutants, tobacco, and occupational elements increase the probability of asthma.[6]

The documented prevalence of asthma among Iranian children and adolescents has been 6% and 8%, respectively.[7] According to a recent survey conducted in Karaj, 10.52% of 13-14-year-old adolescents, had experienced wheezing in the past 12 months.[8]

The International Study of Asthma and Allergy in Childhood (ISAAC), started in 1991, aimed to assess the prevalence of asthma and allergic diseases in various countries. This survey was carried out in three phases and the third phase was held in 2001. The objective of the study was to estimate the prevalence, severity, and risk factors of asthma, eczema, and rhinitis, using validated and standardized questionnaires prepared for two age groups, including 6-7-year-old children and 13-14-year-old adolescents.[9]

The Global Asthma Network (GAN) initiated its work in 2012 and is a joint of the ISAAC and the International Union against Tuberculosis and Lung Disease (The Union). The ultimate goal of this network is universal improvement in asthma care focusing on low- and middle-income countries through surveillance, cooperation in asthma surveys and providing quality-controlled vital medicines.[10] The inclusion of data from adult patients in the surveys distinguishes GAN projects from ISAAC.[11]

The current study was carried out as part of the GAN Phase I project to assess the prevalence of asthma symptoms in children, adolescents, and their parents in Karaj, Iran.

MATERIALS AND METHODS

The present cross-sectional study was conducted in 2019-2020 in Karaj, Iran, in alignment with the goals of the GAN, including assessing asthma prevalence, severity, and risk factors. The study population consisted of students aged 6–7 years, adolescents aged 13-14 in private and public schools, and their parents in Karaj. They were selected using a multistage stratified cluster sampling method. Sampling was conducted proportional to the size of each age group (6-7 years or 13-14 years), sex group, and geographical region. Clusters were chosen at school levels, and the size of each cluster was 16 students in the 6-7 years age group and 21 students in the 13-14 years age group in addition to their parents. The number of clusters in each age group was 40. The total sample size was 1480 students (640 students aged 6-7 years and 840 students aged 13-14). This was the maximum sample size that helped estimate the prevalence of asthma symptoms in these age groups using the cluster sampling method. According to the GAN phase I manual, a sample size of 1000 to 3000 for each age group is required for detecting differences in the prevalence of asthma.[12] Proportional to the number of students in public and private schools, students were selected from public and private schools to match the socioeconomic level of the participants. The number of samples in each cluster was proportional to the total number of students in each age group in Karaj.

Two sets of questionnaires were considered for students and their parents, obtained from the GAN. GAN questionnaire is developed from ISAAC questionnaires, and it assesses the prevalence and severity of asthma.[13,14] After receiving permission from the GAN, the questionnaires were translated into Persian by a bilingual in cooperation with an expert doctor, and they were tested in populations that were representative of the study population. After completing the questionnaires, they were translated back into English by an independent translator. The validity of the questionnaires was assessed. Cronbach's alpha coefficient for all questionnaires was 0.97, and Pearson's correlation coefficient for the test-retest phase was 0.94, which confirmed the reliability of the questionnaires.

The study was reviewed and approved by the ethical committee of Alborz University of Medical Sciences (Code No: IR.ABZUMS.REC.1398.169). After explaining the objectives and procedure of the study, verbal and written consent was obtained from students

and parents, respectively. Parents completed the questionnaires for the younger group, and the older group completed the questionnaire themselves. Additionally, parents completed a separate questionnaire for their own health.

In addition to demographic information from the participants, the GAN standardized Core Questionnaire was used to assess asthma symptoms over the past year, including wheezing in the chest, wheezing severe enough to limit the child's speech, and type of medication, seasonal allergies, wheezing attacks, and sleep disturbance. A team of trained healthcare experts measured the height and weight of participants according to standard protocols using calibrated instruments in the schools. The weight was measured on a scale placed on flat ground to the nearest 0.1 kg with the participants wearing a light cloth without shoes, and the height was measured without shoes to the nearest 0.1 cm. Body Mass Index (BMI) was calculated by dividing weight (kg) by height squared (m^2).

Data were analyzed using SPSS version 20.0 (SPSS Inc., IBM Company), and $p<0.05$ was considered statistically significant. Data are expressed as a percentage for categorical variables. The t-test was used to compare the mean differences between quantitative variables. The association between categorical variables was assessed using Pearson's chi-square test. The association between parental and children wheezing was evaluated using a crude and adjusted logistic regression model for each age group. In the adjusted model, sex and BMI were adjusted. The results of the logistic regression model were reported as odds ratio (OR) and 95% confidence interval (CI).

RESULTS

A total of 1326 children and adolescents out of 1480 invited students participated in this study (response rate: 89.6%). The participants included 572 children aged 6-7 years and 754 children aged 13-14 years and one of their parents. Among 1326 parents who completed the surveys, 68.2% of parents of the 6-7-year-old age group and 51.5% of the 13-14-year-old age group were female. The mean (standard deviation) BMI of students in the 6-7-year-old age group and 13-14-year-old age group were 16.40 (2.89) and 22.59 (3.88), respectively.

Table 1 presents the prevalence of asthma symptoms by gender in children aged 6-7 years and their parents. In 6-7-year-old children, the prevalence of overall ever wheezing (WHEZEV) was 24.0%. The prevalence of current wheezing (WHEZE12) was 13.8%, which in girls was statistically higher than in boys ($p=0.022$). The prevalence of ever and current wheezing in parents was 12.4% and 8.0%, respectively, with no significant difference between genders. The rate of ever having asthma (ASTHMAEV) in this age group of students was 9.8%. The joint prevalence of ever and current wheezing in children and their parents was 6.6% and 3.5%, respectively (Figure 1). Additionally, the prevalence of student-parent ever and current wheezing discordancy was 22.7 (95% CI, 19.3-26.4) and 14.9 (95% CI, 12-18.0), respectively (Figure 2).

The rate of students and parents who received medication instruction (ASTHPLAN) was lower than ASTHMAEV. The prevalence of medication use, including inhaler (MEDPUFF) and pill/syrup (MEDPILL), was 8% and 7.2% in 6-7-year-old students, respectively. The prevalence of seasonal allergy (HFEVEREV) in the 6-7-year-old age group was 32.2%. The HFEVEREV in parents of this age group was 25%, which was significantly higher in females than males.

Regarding the severe asthma symptoms, the prevalence of speech-limiting wheezing in children and their parents in the last 12 months (SPEECH12) was low (0.9% and 1.4%, respectively). For the wheezing attacks occurring in the past 12 months (NWHEZ12), 8.2%, 1.7%, and 2.4% of children had 1-3, 4-12, and more than 12 attacks, respectively. The sleep disturbance due to wheezing (AWAKE12) in children was estimated 2.8% for <1 night a week and 4.2% for ≥1 night a week in the past 12 months.

Table 2 presents the prevalence of asthma symptoms by gender in children aged 13-14 and their parents. The prevalence of WHEZEV in the 13-14-year-old age group and their parents were 18.8% and 9.8%, respectively. The rate of WHEZ12 in children and parents was 12.3% and 6.9%, respectively. The ASTHMAEV rate was 7.3% in 13-14-year-old children. The joint prevalence of ever and current wheezing in 13-14-year-old children and their parents were 2.9% (95% CI, 1.8-4.3) and 2.0% (95% CI, 1.1-3.2), respectively (Figure 1). Moreover, the prevalence of student-parent ever and current wheezing was 20.7 (95% CI, 17.8-23.7) and 15.0 (95% CI, 12.5-17.7) (Figure 2).

Table 1. The prevalence of asthma symptoms by sex in children aged 6-7 years and their parents.

Variable			Children aged 6-7 years		Parent	
			Frequency	Prevalence (95% CI)	Frequency	Prevalence (95% CI)
WHEZEV		Male	81	22.0 (18.0, 26.0)	20	11.0 (6.8, 16.5)
		Female	54	26.0 (20.0, 32.0)	51	13.1 (9.9, 16.8)
		Both	135	24.0 (20.0, 27.0)	71	12.4 (9.8, 15.4)
	p			0.270		0.495
WHEZ12		Male	41	11.2 (08.1, 14.8)	18	9.9 (6.0, 15.2)
		Female	38	18.4 (13.3, 24.4)	28	7.2 (4.8, 10.2)
		Both	79	13.8 (11.0, 16.9)	46	8.0 (5.9, 10.5)
	p			0.022		0.259
SPEECH12		Male	3	0.8 (0.1, 2.0)	6	3.3 (1.2, 7.0)
		Female	2	1.0 (0.1, 3.0)	2	0.5 (0.06, 1.8)
		Both	5	0.9 (0.2, 2.0)	8	1.4 (0.6, 2.7)
	p			0.708		0.129
ASTHMAEV		Male	33	9.0 (06.0, 12.4)	6	3.3 (1.2, 7.0)
		Female	23	11.2 (07.2, 16.2)	18	4.6 (2.7, 7.1)
		Both	56	9.8 (07.4, 12.5)	24	4.2 (2.7, 6.1)
	p			0.406		0.471
ASTHDOC		Male	30	8.2 (5.6, 11.5)	6	3.3 (1.2, 7.0)
		Female	22	10.7 (6.8, 15.7)	17	4.4 (2.5, 6.8)
		Both	52	9.1 (6.8, 11.7)	23	4.0 (2.5, 5.2)
	p			0.498		0.555
ASTHPLAN		Male	22	6.0 (3.8, 8.9)	5	2.8 (0.9, 6.3)
		Female	17	8.3 (4.8, 12.8)	11	2.8 (1.4, 4.9)
		Both	39	6.8 (4.8, 9.2)	16	2.8 (1.6, 4.5)
	p			0.562		0.317
MEDPUFF		Male	25	6.8 (4.5, 9.9)	6	3.3 (1.2, 7.0)
		Female	21	10.2 (6.4, 15.2)	18	4.6 (2.7, 7.1)
		Both	46	8.0 (5.9, 10.6)	24	4.2 (2.7, 6.1)
	p			0.135		------
MEDPILL		Male	22	6.0 (3.8, 8.9)	6	3.3 (1.2, 7.0)
		Female	19	9.2 (5.6, 14.0)	18	4.6 (2.7, 7.1)
		Both	41	7.2 (5.1, 9.6)	24	4.2 (2.7, 6.1)
	p			0.185		-------
HFEVEREV		Male	116	31.7 (26.9, 36.7)	34	18.8 (13.3, 25.2)
		Female	68	33.0 (26.6, 39.8)	109	27.9 (23.5, 32.6)
		Both	184	32.2 (28.1, 36.1)	143	25.0 (21.5, 28.7)
	p			0.746		0.019
NWHEZ12	Male	Never	336	91.8 (88.5, 94.4)	166	91.2 (86.0, 94.9)
		1-3	21	5.7 (3.5, 8.6)	7	3.9 (1.5, 7.8)
		4-12	3	0.8 (0.1, 2.2)	5	2.8 (0.9, 6.3)
		>12	6	1.6 (0.6, 3.5)	4	2.2 (0.6, 5.5)
	Female	Never	171	83.0 (77.2, 87.9)	367	94.1 (91.3, 96.2)
		1-3	26	12.6 (8.4, 17.9)	13	3.3 (1.7, 5.6)
		4-12	7	3.4 (1.3, 6.8)	7	1.8 (0.7, 3.6)
		>12	2	1.0 (0.1, 3.4)	3	0.8 (0.1, 2.2)
	Both	Never	507	88.6 (85.7, 91.1)	533	93.2 (90.8, 95.1)
		1-3	47	8.2 (10.2, 15.9)	20	3.5 (2.1, 5.3)
		4-12	10	1.7 (0.8, 3.1)	12	2.1 (1.0, 3.6)
		>12	8	1.4 (0.6, 2.7)	7	1.2 (0.4, 2.5)
	p			0.003		0.817

		Never	350	95.6 (93.0, 97.4)	175	96.1 (92.2, 98.4)
	Male	< 1 night in week	6	1.6 (0.6, 3.5)	5	2.8 (0.9, 6.3)
		≥1 night in week	10	2.7 (1.3, 4.9)	2	1.1 (0.1, 3.9)
		Never	182	88.3 (83.1, 92.3)	379	97.2 (95.1, 98.6)
AWAKE12	Female	< 1 night in week	10	4.9 (2.3, 8.7)	9	2.3 (1.0, 4.3)
		> 1 night in week	14	6.8 (3.7, 11.1)	2	0.5 (0.0, 1.8)
		Never	532	93.0 90.6, 94.9)	554	96.8 (95.0, 98.1)
	Both	< 1 night in week	16	2.8 (1.6, 4.5)	9	2.3 (1.0, 4.3)
		≥ 1 night in week	24	4.2 (2.7, 6.1)	2	0.5 (0.0, 1.8)
	p			0.004		0.942

WHEZEV: wheezing in the chest at any time in the past; WHEZ12: wheezing in the chest in the past 12 months; SPEECH12: wheezing ever severe enough to limit child's speech to only one or two words at a time between breaths in the past 12 months; ASTHMAEV: child has ever had asthma; ASTHMADOC: doctor confirmed the child's asthma; ASTHPLAN: used written instructions on how to use the medication; MEDPUFF: ever used inhaled medications if had asthma; MEDPILL: ever used pills and syrups if had asthma; HFEVEREV: child ever had seasonal allergies; NWHEZ12: attacks of wheezing in child occurred in the past 12 months; AWAKE12: the child's sleep was disturbed in the past 12 months due to wheezing.

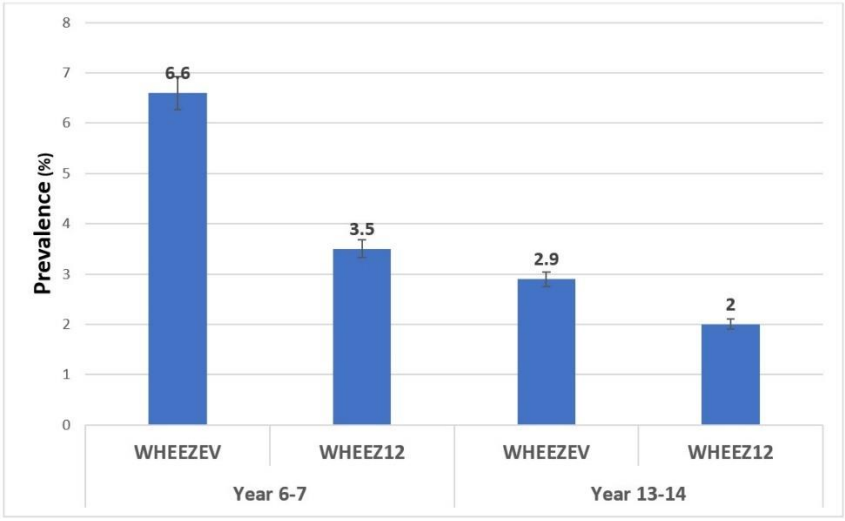

Figure 1. The joint prevalence of ever and current wheezing in students and their parents.

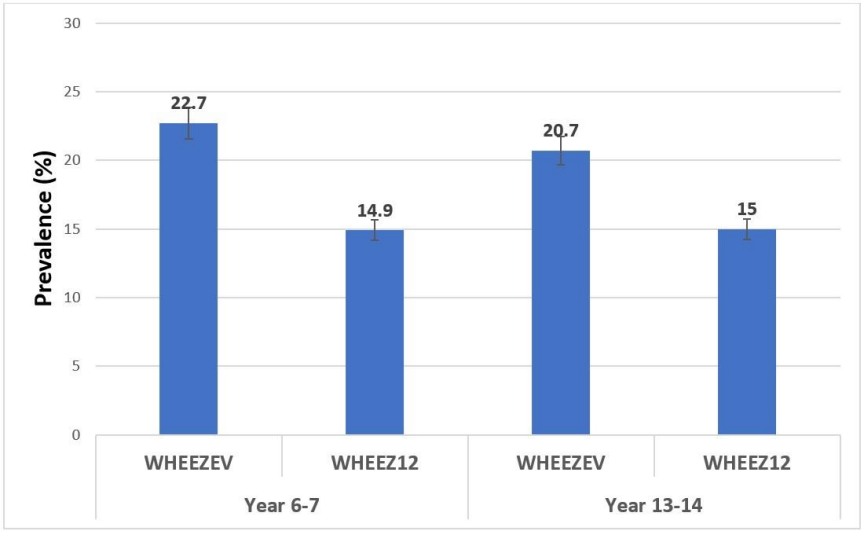

Figure 2. The prevalence of student-parent ever and current wheezing discordancy.

Table 2. The prevalence of asthma symptoms by sex in adolescents aged 13-14 years old and their parents.

Variable		Children aged 13-14 years		Parents	
		Frequency	Prevalence (95% CI)	Frequency	Prevalence (95% CI)
WHEZEV	Male	45	17.0 (12.6, 22.0)	24	11.1 (7.2, 16.0)
	Female	97	19.8 (16.4, 23.6)	35	9.0 (6.3, 12.3)
	Both	142	18.8 (16.1, 21.8)	59	9.8 (7.5, 12.4)
	p		0.338		0.407
WHEZ12	Male	29	10.9 (7.4, 15.3)	22	10.2 (6.4, 15.0)
	Female	64	13.1 (10.2, 16.4)	30	7.7 (5.2, 10.8)
	Both	93	12.3 (10.0, 14.9)	52	6.9 (5.1, 8.9)
	p		0.430		0.303
SPEECH12	Male	5	1.9 (0.6, 4.3)	3	1.4 (0.2, 4.0)
	Female	7	1.4 (0.5, 2.9)	7	1.8 (0.7, 3.0)
	Both	12	1.6 (0.8, 2.7)	10	1.3 (0.6, 2.4)
	p		0.521		0.381
ASTHMAEV	Male	21	7.9 (4.9, 11.8)	5	2.3 (0.7, 5.3)
	Female	34	7.0 (4.8, 9.6)	11	2.8 (1.4, 5.0)
	Both	55	7.3 (5.5, 9.3)	16	2.1 (1.2, 3.4)
	p		0.624		0.703
ASTHDOC	Male	20	7.5 (4.6, 11.4)	4	1.9 (0.5, 4.6)
	Female	29	5.9 (4.0, 8.4)	11	2.8 (1.4, 5.0)
	Both	49	6.5 (4.8, 8.5)	15	2.0 (1.1, 3.2)
	p		0.250		0.126
ASTHPLAN	Male	17	6.4 (3.7, 10.0)	3	1.4 (0.23, 4.0)
	Female	22	4.5 (2.8, 6.7)	7	1.8 (0.7, 3.6)
	Both	39	5.2 (3.7, 7.0)	10	1.3 (0.6, 2.4)
	p		0.197		0.889
MEDPUFF	Male	21	7.9 (4.9, 11.8)	5	2.3 (0.7, 5.3)
	Female	51	10.4 (7.8, 13.4)	11	2.8 (1.4, 5.0)
	Both	72	9.5 (7.5, 11.8)	16	2.1 (1.2, 3.4)
	p		0.264		---
MEDPILL	Male	29	10.9 (7.4, 15.3)	5	2.3 (0.7, 5.3)
	Female	49	10.0 (7.5, 13.0)	11	2.8 (1.4, 5.0)
	Both	78	10.3 (8.2, 12.7)	16	2.1 (1.2, 3.4)
	p		0.691		----
HFEVEREV	Male	97	36.6 (3.7, 42.7)*	41	19.0 (13.9, 24.8)*
	Female	144	29.4 (25.4, 33.7)*	106	27.3 (22.9, 32.0)*
	Both	241	32.0 (28.6, 35.4)	147	19.5 (16.7, 22.5)
	p		0.044		0.022

		Never	240	90.6 (86.4, 93.8)	200	92.6 (88.2, 95.7)
	Male	1-3	17	6.4 (3.7, 10.0)	14	6.5 (3.5, 10.6)
		4-12	7	2.6 (1.0, 5.3)	1	0.5 (0.0, 2.5)
		>12	1	0.4 (0.0, 2.0)	1	0.5 (0.0, 2.5)
		Never	439	89.9 (86.7, 92.3)	369	95.1 (92.5, 97.0)
	Female	1-3	43	8.8 (6.4, 11.6)	16	4.1 (2.3, 6.6)
NWHEZ12		4-12	5	1.0 (0.3, 2.3)	1	0.3 (0.0, 1.4)
		>12	2	0.4 (0.0, 1.4)	2	0.5 (0.0, 1.8)
		Never	679	90.0 (87.7, 92.1)	719	95.4 (93.6, 96.7)
	Both	1-3	60	8.0 (6.1, 10.1)	30	4.0 (2.7, 5.6)
		4-12	12	1.6 (0.8, 2.7)	2	0.3 (0.0, 0.9)
		>12	3	0.4 (0.0, 1.1)	3	0.4 (0.0, 1.1)
	p			0.254		0.077
		Never	257	96.9 (94.1, 98.7)	209	96.8 (93.4, 98.7)
	Male	< 1 night in week	5	1.9 (0.6, 4.3)	5	2.3 (0.7, 5.3)
		> 1 night in week	3	1.1 (0.2, 3.2)	2	0.9 (0.1, 3.3)
		Never	454	92.8 (90.2, 95.0)	379	97.7 (95.6, 98.9)
AWAKE12	Female	< 1 night in week	29	5.9 (4.0, 8.4)	4	1.0 (0.2, 2.6)
		≥ 1 night in week	6	1.2 (0.4, 2.6)	5	1.3 (0.4, 2.9)
		Never	711	94.3 (92.4, 95.8)	738	97.8 (96.6, 98.7)
	Both	< 1 night in week	34	4.5 (3.1, 6.2)	9	1.2 (0.5, 2.2)
		≥ 1 night in week	9	1.2 (0.5, 2.2)	7	0.9 (0.3, 1.9)
	p			0.038		0.186

WHEZEV: wheezing in the chest at any time in the past; WHEZ12: wheezing in the chest in the past 12 months; SPEECH12: wheezing ever severe enough to limit child's speech to only one or two words at a time between breaths in the past 12 months; ASTHMAEV: child ever had asthma; ASTHMADOC: doctor confirmed the child's asthma; ASTHPLAN: used written instructions on how to use the medication; MEDPUFF: ever used inhaled medications if had asthma; MEDPILL: ever used pills and syrups if had asthma; HFEVEREV: the child ever had seasonal allergies; NWHEZ12: attacks of wheezing in child occurred in the past 12 months; AWAKE12: child's sleep disturbed in the past 12 months due to wheezing.

Only 5.2% of 13-14-year-old students had ever received ASTHPLAN. The MEDPUFF and MEDPILL rates were 9.5% and 10.3%, respectively, in the 13-14-year-old children. The HFEVEREV rate was significantly higher in boys than in girls in the 13-14-year age group (36.6% vs. 29.4%; p=0.044). However, among their parents, seasonal allergies were statistically higher in women (27.3% in females vs. 19% in males; p=0.022).

The prevalence of SPEECH12 in the 13-14-year-old age group was 1.6%. Moreover, the assessment of the NWHEZ12 revealed that 8%, 1.6%, and 0.4% of 13-14-year-old children experienced 1-3, 4-12, and more than 12 wheezing attacks. The AWAKE12 rates among 13-14-year-old boys and girls were 1.9% and 5.9%, respectively, for<1 night per week, and 1.1% and 1.2%, respectively, for≥1 night(s) per week. There was a significant difference between genders in 13-14-year-old children (p = 0.038).

The association between wheezing by parents and children in the logistic regression model is presented in Table 3. In the multivariable model in children aged 6-7 years, parental ever wheezing significantly increased the odds of children ever wheezing (OR adjusted, 3.27 (95% CI, 1.70-6.310)). In the older age group, according to the crude and adjusted model, the association between parental and students wheezing was not statistically significant (OR crude, 2.52 (95% CI, 0.89-7.08); OR adjusted, 2.63 (95% CI, 0.93- 7.46)).

Table 3. The association between wheezing by parents and children in the logistic regression model.

		Children WHEZEV			
		6 and 7		13 and 14	
Parent WHEZEV		OR (95% CI)	*p*	OR (95% CI)	*p*
	Crude	3.43 (1.80, 6.55)	<0.001	2.52 (0.89, 7.08)	0.079
	Adjusted*	3.27 (1.70, 6.310)	<0.001	2.63 (0.93, 7.46)	0.068

*Adjusted for sex and body mass index.

DISCUSSION

Asthma is a prevalent chronic respiratory disease in children, imposing a high disability burden. The global age-standardized incidence rate of childhood asthma decreased by 5.3% from 1990 to 2019.[15] Phase III of the ISAAC, conducted between 2000 and 2003, reported that WHEZ12 varied from 2.4% in Jodhpur, India, to 37.6% in Costa Rica in 6-7 years old group, and 0.8% in Tibet, China, to 32.6% in Wellington, New Zealand in the 13-14 years old groups. The significant variation in asthma symptom prevalence in different geographical regions pointed toward a higher prevalence in higher-income countries.[16] Moreover, the observed geographical variation in asthma symptom prevalence highlights the importance of epidemiologic studies in determining the present prevalence in a specific geographical region needed for public health planning and generating hypotheses for asthma risk factors.

According to a meta-analysis conducted in 2020, the prevalence of asthma in Iran is estimated to be 6% in children and 8% in adolescents, which is lower than the global rates.[7,17] In the present cross-sectional study, in accord with GAN phase I, the prevalence of asthma symptoms in 6-7-year-olds, 13-14-year-olds, and their parents was investigated in Karaj, Iran, in 2019-2020. We demonstrated that the prevalence of ASTHMAEV and WHEZ12 was 9.8% and 13.8%, respectively, in children aged 6-7 years, and 7.3% and 12.3%, in 13-14-year-olds respectively. WHEZ12 was significantly higher in girls than in boys in children aged 6-7 years. An Iranian national survey conducted in 2015-2016 showed that ASTHMAEV and WHEZ12 were 3.6% and 7.8%, respectively, in 6-7-year-olds, and 5.1% and 9.5%, respectively, in 13-14-year-olds. Also, both parameters were significantly higher in boys than in girls.[18] In other cities of Iran, the rate of ASTHMAEV ranged from 3.7% (in Ahvaz province) to 10.8% (in Golestan province) in 6-7-year-olds and from 5.7% (Yazd) to 21.6% (Golestan) in 13-14-year-olds. Moreover, the prevalence of WHEZ12 ranged from 7.5% (Golestan) to 19.8% (Ahvaz) in 6-7-year-olds and from 7.6% (Ahvaz) to 11.2% (Golestan) in 13-14-year-olds.[19-22] As opposed to our findings, ASTHMAEV and WHEZ12 rates were either higher in boys, or there was no significant association with genders and these parameters rates.[19-22] The higher rate of asthma symptoms in our study could be attributed to girls' more attention and dedication to filling out the questionnaires. Since there was no objective assessment and the asthma was not physician-proved in our study, there is a need for further investigation concerning the gender distribution of asthma symptoms in Karaj. The high prevalence of asthma symptoms in Karaj could be caused by air pollution and pollen. Karaj city is located close to Tehran, the capital of Iran. Karaj is a populated city with multiple factories and industrial centers nearby. The previously mentioned factors and the lack of public transport facilities lead to the high level of air pollution. Moreover, there are many diverse pollens in Karaj caused by numerous parks, arboretums, and botanical gardens.

In the 6-7-year-old age group, asthma was confirmed by a doctor in 9.1% of the studied population. On the contrary, the rate of receiving written instruction on the use of medication was 6.8%. 8% of the studied population received MEDPUFF, and 7.2% received MEDPILL. In our study's 13-14-year-old age group, confirmed asthma by a doctor was observed in 6.5%, and 5.2% had ASHTPLAN. The prevalence of using MEDPUFF was 9.5%, and MEDPILL was 10.3%. The lower rate of ASTHPLAN and medication use in the 6-7-year-old age group could be explained by the nature of symptoms in the 6-7-year-old group, which are mainly thought of as cold. The 13-14-year-olds understand their symptoms better and seek treatment themselves.

Furthermore, fear of families about the effect of corticosteroid treatments on their child's growth could influence adherence in the 6-7-year-old group, whereas this fear decreases in the older group.

Severe asthma symptoms include SPEECH12 or NWHEZ12≥4 or AWAKE12 ≥1. The prevalence rates of SPEECH12, NWHEZ12≥4, and AWAKE12≥1 were 0.9%, 3.1%, and 4.2%, respectively, in the 6-7 year-olds. The rates of NWHEZ12≥4 and AWAKE12≥1 were significantly higher in girls than boys. In comparison, these rates in 6-7 year-olds were 1.8%%, 1.5%, and 1.1%, respectively, and the rate of NWHEZ≥4 was higher in boys in an Iranian national survey in 2015-2016.[18] Our study's higher prevalence of severe asthma could be attributed to a lack of public awareness and poor asthma management. In our study's 13-14-year-old age group, these parameters were 1.6%, 2.0%, and 1.2%, respectively, while in the national survey, they were 3.4%, 2.2%, and 1.1%.[18]

In our study, asthma symptoms among parents vary from 0.4% to 25%. A survey by Sharifi et al, in 2019, conducted in five provinces of Iran, demonstrated that the prevalence of asthma symptoms among adults varied from 20.6% to 30.7%.[23] In a global cross-sectional study, the rate of wheezing was reported at 8.65%, ranging from 1.73% in China to 27.4% in Australia [24]. In Pakistan, Turkey, and the United Arab Emirates, the prevalence of wheezing was 5.02%, 11.34%, and 7.21%, respectively.[24] The prevalence of wheezing among Iranian adults was 20.7%.[23] In our study, the prevalence of WHEZEV was 7.2% and 2.1% among parents of the 6-7 years and 13-14 years old age group, respectively. These figures for WHEZ12 were 8.0% and 6.9%, respectively. The results showed a lower wheezing prevalence than in some European countries and a higher rate than in Asian countries. According to Sharifi et al, 2.2% of adults aged 20-44 used asthma medications.[23] This figure in other studies conducted in Iran was 4.7%,[25] and 3%.[26] In our study, the rate of inhaled medication use was 4.2% and 2.1%, and the rate of pills/syrups use was 4.2% and 2.1% among parents of children and adolescents, respectively, similar to the results of previous studies.

In the present study, we showed that WHEZEV in parents significantly increased the odds of WHEZEV in 6-7 years-old children. However, there was no significant association between the WHEZEV rate of 13-14 years-old adolescents and their parents. A study on asthma risk factors among preschool children demonstrated that having a parent with a history of asthma increased the risk of asthma in children.[27] A large amount of data has indicated a strong asthma susceptibility in children with maternal asthma.[28-35] Therefore, genetic factors likely play a role in asthma symptoms among children. Moreover, shared environmental factors and common risk factors between parent and child might also be the basis of the abovementioned concordance between parents and children in WHEZEV.

The key strength of our study was that the prevalence of asthma and symptoms were assessed in both children and their parents by standard protocol and questionnaire of GAN with an acceptable sample size. Regarding the limitations, recall and residual biases are inevitable due to the questionnaire-based method of our study. Since no objective assessment was done in our study, a proportion of symptoms could be attributed to other conditions. Moreover, the lack of risk factor assessment is another limitation of our study.

The current study's findings demonstrated that the prevalence of asthma symptoms among children and adolescents in Karaj, Iran, differed from previous studies conducted in different cities of Iran and the national Iranian survey. Our study's higher rate of severe asthma symptoms could result from a lack of public awareness and poor asthma management. In contrast to previous studies, a higher rate of asthma symptoms and severity was observed in girls than boys. Future studies are needed to assess the asthma symptoms and their risk factors on a larger scale.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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