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RESEARCH ARTICLE

Prevalence of asthma symptoms in Golestan schoolchildren aged 6–7 and 13–14 years in Northeast Iran

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Abstract **Asthma is the most common chronic disease among children, and its incidences are often imminent among elementary schoolchildren. This study aimed to examine the prevalence of asthma symptoms in Golestan schoolchildren aged 6–7 and 13–14 years in Northeast Iran. The prevalence rate was compared according to age group (aged 6–7 years vs. aged 13–14 years) and gender (male vs. female). In this cross-sectional study, 1706 Iranian schoolchildren aged 6–7 and 13–14 years in Golestan Province were enrolled. Participants completed questionnaires between February and July 2014. Asthma symptoms were assessed using the questionnaire of the International Study of Asthma and Allergies in Childhood protocol in Persian. The logistic regression model was used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) of the asthma symptoms for each of the gender and age groups. The prevalence rates of "current asthma" symptoms and "asthma ever" in all the children were estimated as 9.5% and 7.5%, respectively. The prevalence of asthma ("asthma ever" and "wheezing in the past 12 months") in junior high schoolchildren (aged 13–14 years) is higher than that in elementary schoolchildren (aged 6–7 years) ($P < 0.05$). The prevalence of the severity of wheezing in girls is lower than that in boys (OR = 1.7, 95%CI = 1.06–2.96, $P = 0.02$). Asthma is still a major public health problem. This study shows that the prevalence of the asthma symptoms in boys is lower than that in girls in both age groups, and the severity of asthma in girls is higher than that in boys aged 13–14 years.**

Keywords asthma; asthma symptoms; epidemiology; childhood; chronic disease

Introduction

Asthma is the most common chronic disease among children [1] and causes significant social and economic burden, thus resulting in missed school/work days, activity limitations, and increased health care utilization [2]. This health problem often occurs in elementary schoolchildren [1,3]. Symptoms may include wheezing, coughing, shortness of breath, and chest tightness [4]. According to the Global Asthma Report (2014), the number of people with asthma in the world may be as high as 334 million. A total of 14% of children in the world experience asthma symptoms, and the burden of asthma is highest for children aged 10–14 years and the elderly aged 75–79 years. Asthma is the 14th most important disorder in the world in terms of the extent and duration of disability [5].

Surveys as part of the International Study of Asthma and Allergies in Childhood (ISAAC) protocol are conducted based on a standardized international inventory to determine asthma prevalence [6]. A different distribution of its prevalence around the world was described by a previous study [7]. Asthma prevalence is higher in males than in females [8]. A relationship exists between parental smoking and the development of asthma (before 12 years of age) in children [9]. The causes of asthma are incompletely perceived. However, risk factors for increasing asthma consisted of inhaling asthma "triggers," such as allergens, tobacco smoke, and chemical irritants [10].

According to the results of a meta-analysis study, the prevalence rate of "asthma ever" among Iranian children varied from 0.5% to 11.0% in 27 articles that used the

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ISAAC written questionnaire (self-reported tool for ascertainment of disease) [11]. Several studies have shown that early diagnosis and timely treatment decrease the morbidity and mortality associated with asthma among elementary schoolchildren [12–14].

Gorgan is in the center of Golestan Province in northern Iran, only southeast of the Caspian Sea [15]. In general, Golestan has a moderate and humid climate known as "the moderate Caspian climate." Three different climates, namely, plain moderate, mountainous, and semiarid climates, exist in the region. Gorgan valley has a semiarid climate. According to Synoptic Stations Statistics, the average annual temperature is 18.2 °C (64.8 °F) and the annual rainfall is 600 mm (24 in.). The average relative humidity is 70.2% (http://www.irimo.ir/eng/index.php). The hypersensitivity to house dust mites is common in northern Iran, which may be attributed to the warm and humid weather of this area [16].

Therefore, understanding the prevalence of asthma may help in the control and management of this disease. The current study aimed to examine the prevalence of asthma symptoms in Golestan schoolchildren aged 6–7 and 13–14 years in Northeast Iran and the association of asthma symptoms with gender and age.

Materials and methods

This cross-sectional study was conducted on elementary schoolchildren in Northeast Iran (Golestan) from February 2014 to July 2014 to determine the prevalence of asthma symptoms.

A questionnaire was provided according to the ISAAC protocol. The written questionnaire includes 10 questions on past and current wheezing episodes, wheezing frequency, sleep disturbance, speech limitations during attacks, exercise-induced wheezing, and persistent cough unrelated to respiratory infections [17]. For each of the symptoms, a 12-month-period prevalence was calculated by dividing the number of positive responses to each question by the number of completed questionnaires. Demographic data were obtained from each individual. The participants were interviewed regarding their name, age, date of birth, school, gender, and date of completing the questionnaire. The core questionnaires for asthma must be entered into the computer exactly as they are presented in the questionnaire and must not be changed under any circumstances. The questionnaires were translated from English to Persian using a standard method. Then, the instrument was translated back to English by an independent person. These procedures were performed according to Section 14 of the "Guidelines for the Translations of Questionnaires" [18]. The validity and repeatability of the ISAAC questionnaire in Persian have been assessed by the Iranian Health Ministry.

This study was funded by the Ministry of Health and Medical Education to assess the prevalence of asthma symptoms. Considering the population of the entire province and according to urban and rural populations, the sample size assigned to the province was determined by the Ministry of Health. We prepared the sampling frame list from the boys and girls state schools. Then, 1800 pupils from 212 primary schools in rural and urban areas in 14 cities of the Golestan Province were selected from the frame list through the systematic random sampling of students. From 1800, 1706 questionnaires were collected. The response rate was 94%. A training course was held for the interviewers before completing the questionnaire. Notably, the questionnaires for the schoolchildren in the age group of 13–14 years were completed during their personal interviews in schools. Meanwhile, the questionnaires for the schoolchildren in the age group of 6–7 years were completed by their parents (mother or father).

The data were collected and statistical analyses were conducted using Stata software version 12 (Stata Corp., College Station, TX, USA). The quantitative and qualitative data were described as the mean (SD) and frequency (percentage), respectively. The chi-square test was used to evaluate the association between categorical variables. Logistic regression was used to estimate the risk factors for the current wheeze and severe asthma attacks. Estimates of odds ratio (OR) standard errors and 95% confidence intervals (95%CI) were based on asymptomatic likelihood theory. A P value < 0.05 was considered to be significant.

Results

A total of 1706 children, 778 children (414 boys [53.2%] and 364 girls [46.8%]) in the age group of 6–7 years and 928 children (442 boys [47.6%] and 486 girls [52.4%]) in the age group of 13–14 years, were screened in this study. Of the students, 53.3% (n = 910) lived in the city and the rest lived in rural areas. The prevalence rates of "current asthma" symptoms (wheezing or whistling in the chest in the past 12 months) and "asthma ever" in all the children were estimated as 9.5% and 7.5%, respectively.

Table 1 shows the parent-reported prevalence and severity of asthma in the age group of 6–7 years based on gender. In this age group, the prevalence rates of "wheezing or whistling ever" and "wheezing or whistling in the past 12 months" were 8.7% and 7.5%, respectively, and the prevalence rates of asthma wheezing were significantly higher in girls than in boys (OR = 1.94, 95%CI = 1.14–3.29, P = 0.01). Moreover, the prevalence rates of "attacks of wheezing," "sleep had been disturbed due to wheezing" in the past 12 months, and "the severity of wheezing" were 6.4%, 5.4%, and 1.6%, respectively. The prevalence rates of "chest sounded wheezy during or

Table 1 Association of gender and asthma symptoms in Golestan schoolchildren aged 6–7 years (2014)

Asthma symptoms		OR (95%CI)	*P* value	Boys (*n* = 414)	Girls (*n* = 364)	All (*n* = 778)
Ever wheezed	Yes	1.94 (1.14–3.29)	0.01	46 (11.1)	116 (13.6)	68 (8.7)
	No			368 (88.9)	734 (86.7)	710 (91.3)
Wheeze in the past year	Yes	2.05 (1.15–3.65)	0.01	40 (9.7)	18 (4.9)	58 (7.5)
	No			374 (90.3)	346 (95.1)	720 (92.5)
Wheezing with exercise in the past year	Yes	1.61 (0.68–2.92)	0.14	32 (7.7)	18 (4.9)	50 (6.4)
	No			382 (92.3)	346 (95.1)	728 (93.6)
Persistent cough in the past year	Yes	2.03 (1.04–3.97)	0.03	29 (7)	13 (3.6)	42 (5.4)
	No			385 (93)	351 (96.4)	736 (94.6)
Ever had asthma	Yes	1.07 (0.68–1.69)	0.07	46 (11.1)	38 (10.4)	84 (10.8)
	No			368 (88.9)	326 (89.2)	694 (89.2)

CI, confidence interval; OR, odds ratio; *P* indicates the significance between boys and girls.

Table 2 Association of gender and asthma symptoms in Golestan schoolchildren aged 13–14 years (2014)

Asthma symptoms		OR (95% CI)	*P* value	Boys (*n* = 442)	Girls (*n* = 486)	All (*n* = 928)
Ever wheezed	Yes	0.68 (0.47–0.96)	0.03	62 (14)	94 (19.3)	156 (16.8)
	No			380 (86)	392 (80.7)	772 (83.2)
Wheeze in the past year	Yes	0.93 (0.62–1.40)	0.75	48 (10.9)	56 (11.5)	104 (11.2)
	No			394 (89.1)	430 (88.5)	824 (88.8)
Wheezing with exercise in the past year	Yes	0.86 (0.56–1.34)	0.57	40 (9)	50 (10.3)	90 (9.7)
	No			420 (91.0)	436 (89.7)	838 (90.3)
Persistent cough in the past year	Yes	1.23 (0.78–1.93)	0.36	44 (10)	40 (8.2)	84 (9.1)
	No			398 (90)	446 (91.8)	844 (90.9)
Ever had asthma	Yes	1.71 (0.51–0.97)	0.38	82 (18.6)	118 (24.3)	200 (21.6)
	No			360 (81.4)	368 (75.7)	728 (78.4)

CI, confidence interval; OR, odds ratio; *P* indicates the significance between boys and girls.

after exercise" and "asthma ever" were 5.4% and 10.8%, respectively. Of the children in this age group, 12.9% was exposed to somebody who smokes at home or in their lifetime.

Table 2 shows the self-reported prevalence and severity of asthma in the age group of 13–14 years in different groups of gender. In this age group, the prevalence rates of "current asthma" and "wheezing ever" were 11.2% and 16.8%, respectively, and the prevalence rates of asthma wheezing were significantly higher in girls than in boys (OR = 0.68, 95%CI = 0.47–0.96, $P = 0.03$). Furthermore, the prevalence rates of "attacks of wheezing" and "sleep had been disturbed due to wheezing" in the past 12 months were 9.7% and 6.9%, respectively. The prevalence rates of "asthma ever" and "severity of wheezing" were 21.6% and 2.6%, respectively. Of the children in this age group, 20% was exposed to somebody who smokes at home or in their lifetime.

Overall, the lifetime prevalence rates of symptoms in girls were wheezing, 13.6%; attacks of wheezing, 7.9%; and self-reported asthma ever, 6.2%. In boys, the prevalence rates of "wheezing or whistling ever" and "wheezing or whistling in the past 12 months" were 12.6% and 10.3%, respectively. The prevalence rates of "chest sounded wheezy during or after exercise," "asthma ever," and "the severity of wheezing" were 10.5%, 8.5%, and 4.9%, respectively, in boys, as shown in Table 3.

This study shows that the prevalence of asthma ("asthma ever" and "wheezing in the past 12 months") in junior high schoolchildren (aged 13–14 years) is higher than that in elementary schoolchildren (6–7 years) (OR = 0.57, 95%CI = 0.39–0.84, $P = 0.004$).

Table 4 shows the severity of asthma in boys and girls. The prevalence of wheezing severity in girls is lower than that in boys ($P < 0.05$).

Discussion

The present study confirms that the prevalence rates of "current asthma" symptoms and "asthma ever" in all the children were estimated as 9.5% and 7.5%, respectively. The secondary study on 1818 cases in Sari, Iran showed that the 12-month prevalence of wheezing in elementary schoolchildren was 13%, but the prevalence of asthma was

Table 3 Prevalence of reported symptoms (%) indicating severity of asthma in Golestan schoolchildren (2014)

Symptoms		Aged 6–7 years (n = 778)	Aged 13–14 years (n = 928)	All (n = 1706)	P value
Number of wheezing episodes in the past year	None	728 (93.6)	838 (90.3)	1566 (91.9)	0.004
	1 to 3	38 (4.9)	66 (7.1)	102 (6)	
	4 to 12	6 (0.8)	22 (2.4)	28 (1.6)	
	More than 12	6 (0.8)	2 (0.2)	8 (0.5)	
Woken by wheeze	Never woken with wheezing	746 (95.9)	864 (93.1)	1610 (94.4)	0.002
	Less than one night per week	30 (3.9)	44 (4.7)	74 (4.3)	
	One or more nights per week	2 (0.3)	20 (2.2)	22 (1.3)	
Speech limitations during wheezing	Yes	12 (1.5)	54 (5.8)	66 (3.9)	0.000
	No	766 (98.5)	874 (94.2)	1640 (96.1)	

P indicates the significance between age groups.

Table 4 Prevalence of reported symptoms (%) indicating severity of asthma in Golestan schoolchildren (2014)

Symptoms		Boys (n = 856)	Girls (n = 850)	All (n = 1706)	P value
Number of wheezing episodes in the past year	None	784 (91.6)	782 (92)	1566 (91.9)	0.03
	1 to 3	46 (5.4)	58 (6.8)	102 (6)	
	4 to 12	20 (2.3)	8 (0.9)	28 (1.6)	
	More than 12	6 (0.7)	2 (0.2)	8 (0.5)	
Woken by wheeze	Never woken with wheezing	796 (93)	814 (95.8)	1610 (94.4)	0.03
	Less than one night per week	48 (5.6)	26 (3.1)	74 (4.3)	
	One or more nights per week	12 (1.4)	10 (1.2)	22 (1.3)	
Speech limitations during wheezing	Yes	42 (4.9)	24 (2.8)	66 (3.9)	0.02
	No	814 (95.1)	826 (97.2)	1640 (96.1)	

P indicates the significance between boys and girls.

12% [19]. A meta-analysis in Iran showed the prevalence of current and "asma ever" in the two age groups of 6–7 and 13–14 years. The pooled weighted prevalence rate of "asthma ever" for the included studies was 3.04% (95%CI = 2.5–3.6), and the overall prevalence of "wheezing in the past 12 months" was 9.3% (95%CI = 7.9–10.8) [11]. The present analysis showed that the prevalence rates of "current asthma" and "wheezing ever" in the age group of 13–14 years were 11.2% and 16.8%, respectively.

In this study, the prevalence rates of "attacks of wheezing" and "woken by wheeze" in the past 12 months in the age group of 6–7 years were 6.5% and 4.1%, respectively. Goh *et al.* reported the prevalence of attacks that limit speech in children aged 6–7 years as 9.2% and in children aged 13–15 years as 23.6% [20].

In this study, the 12-month period prevalence of wheezing in these children was 9.5%. Approximately 100 (6%) children who wheezed reported to have one to three wheezing attacks. Approximately 96 in 1706 children who wheezed reported to have frequent sleep disturbances one or more nights per week. Approximately 4% of children who wheezed reported to have speech limitations during wheezing attacks.

Our findings consistently show that the prevalence of the severity of wheezing in girls is lower than that in boys. Similar to our results, Ghaffari's study showed that the lowest prevalence of the severity of asthma was observed among girls aged 6–7 years and the highest prevalence of the severity of asthma was observed among boys aged 13–14 years [19]. By contrast, Tesfaye's study showed that genomic associations with asthma differed by gender, thereby indicating distinct biological underpinnings for asthma in boys versus girls and gender as a covariate can interact with genes to modify the asthma risk [21]. Wieringa's study revealed that the prevalence rates of the diagnosis of asthma were higher in boys than that in girls aged 6–7 years, and girls aged 13–14 years had higher rates for most symptoms, except asthma [22]. Assar's study revealed that gender difference was insignificant, and pupils aged 13–14 years showed a significantly higher prevalence than pupils aged 6–7 years for asthma and allergies [23].

Our findings support the hypothesis that the prevalence of asthma in junior high schoolchildren is higher than that in elementary schoolchildren (aged 6–7 years). A growing body of evidence supports the possibility that the prevalence of childhood asthma increases with the increase in age [7,9,19,24]. Childhood asthma is more common

than adult asthma and is a public health challenge in the world. According to several studies, between 30% and 70% of children who develop asthma are markedly improved or asymptomatic by early adulthood [25]; this deduction is contrary to the results of our study. This contradiction is due to information bias. The questionnaires were completed by the parents of elementary schoolchildren (aged 6–7 years) and by the junior high schoolchildren (aged 13–14 years) themselves. The parents probably underestimated the asthma symptoms of their children.

In our study, 15.7% of boys and 17.9% of girls were exposed to passive smoking. The association between those exposed to passive smoking and asthma ever was insignificant. However, Andrew *et al.* indicated that a correlation exists between asthma severity and the number of years the child had been exposed to passive smoking and that boys were more sensitive to passive smoking than girls [26]. The present study shows that the prevalence of asthma symptoms in boys is lower than that in girls in both age groups and that the severity of asthma in girls is higher than that in boys aged 13–14 years. Asthma continues to be a major public health problem in Golestan Province. Therefore, the health care system should be prepared for planning and evaluation to control and prevent asthma among schoolchildren.

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Compliance with ethics guidelines

Fatemeh Mehravar, Sohei Rrafie, Behnaz Bazrafshan, and Mahmoud Khodadoust declare no conflict of interest. All procedures were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the *Helsinki Declaration* of 1975, as revised in 2008. This study obtained its ethics approval from the Ethical Committee of Golestan University of Medical Science. Informed consents were obtained from the parents of the schoolchildren who participated in the study.

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