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# Relationship between obesity and asthma symptoms among children in Ahvaz, Iran: a cross sectional study

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## Abstract

**Background:** Obesity has been identified as a risk factor for higher prevalence of asthma and asthma-related symptoms in children. The objective of this study was to evaluate the relationship between the prevalence of asthma symptoms and obesity among school-age children in the city of Ahvaz, Iran.

**Methods:** A total of 903 children, 7 to 11 years of age, were enrolled in this study through cluster sampling. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used to identify the children who were currently suffering from asthma. Height and weight were measured and body mass index (BMI) was calculated in kg/m<sup>2</sup>. Overweight was defined as BMI greater than the age- and sex-specific 85th percentile, and obesity as BMI greater than the 95th percentile. We determined the relationship between obesity and asthma symptoms by chi-square tests.

**Results:** The prevalence of wheeze ever, current wheezing, obesity, and overweight was 21.56%, 8.7%, 6.87%, and 9.5%, respectively. The current prevalence of wheezing among obese and overweight children was 68.75% and 37%, respectively, and there was a statistical association between obesity and the prevalence of current wheezing ( $p < 0.001$ ), night cough ( $p < 0.001$ ), and exercise-induced wheezing ( $p = 0.009$ ), but obesity and overweight were not associated with eczema and allergic rhinoconjunctivitis, so it seems that the pathophysiology of asthma in obese and overweight children is not related to allergy.

**Conclusion:** There is a strong association between asthma symptoms and both overweight and obesity in both sexes among school-age children.

## Introduction

Asthma is characterized by episodic airflow obstruction, increased airway responsiveness, and airway inflammation. Asthma is a growing threat to the health of children [1]. The prevalence of asthma among school-age children has been rising in many regions of the developed world [2-6]. Also, in the past 2 decades there has been a significant increase in the prevalence of obesity among children worldwide [7].

It has been recognized that obesity is more common among children with asthma, and associations between asthma and obesity have been observed in cross-

sectional studies of adults and children [8,9]. Prospective studies with healthy non-asthmatic participants showed that a gain in weight increased the risk of asthma in adults and adolescents [10,11]. Finally, some studies in asthmatic patients showed that weight loss resulted in an improvement in lung function, symptoms, and health status [12,13]. Nevertheless, the relationship between obesity and asthma remains controversial [14] as some studies could not disclose any significant correlation between asthma as defined by bronchial hyper-responsiveness and obesity, and explained that the reported association between asthma and obesity might be due to a misinterpretation of noisy breathing in overweight subjects [15,16]. The obesity is a potentially modifiable risk factor, in which its relationship to asthma incidence should be clarified [17].

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This study was conducted to determine whether obesity, as measured by body mass index (BMI), was associated with a higher prevalence of asthma symptoms. Possible differences between boys and girls were also evaluated.

### Methods

In the autumn of 2009, we studied a random sample of children in the city of Ahvaz, Iran. The sampling frame included primary schools that were randomly selected from different parts of Ahvaz to obtain the required number of children. All children aged 7 to 11 years at each selected school were invited to participate and were studied after their parents' informed consent was obtained. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire [18] was used to identify the children currently suffering from asthma. Standard guidelines for translation of the questionnaire from English into the Persian was used [19]. The questionnaires were distributed to parents of 1000 children. The questionnaire included questions on demographic characteristics, wheeze ever, current history of wheezing, diagnosed asthma, exercise-induced wheezing, and nocturnal cough. The questionnaire was completed at the schools by the children's parents and researchers. In this study, wheeze ever is defined as any history of wheezy breathing; current wheezing is a history of at least 1 attack of wheezing during the last 12 months; diagnosed asthma is the same as wheeze ever plus a doctor's diagnosis of asthma.

Allergic rhinitis was diagnosed by enquiring with questions such as history of sneezing or blocked nose during the last 12 months when he/she did not have a cold or flu and has your child ever had hay fever? Questions concerning the diagnosis of eczema were as follows: has your child ever had a recurrent itchy rash for at least 6 months and has your child ever had eczema.

The height and weight of all the children were measured. BMI was calculated by dividing weight in kg by the square of the height in meters ( $\text{kg}/\text{m}^2$ ) [20]. The BMI was found to be the single best predictor of body fatness in children [21]. The BMI values of the patients in the study were compared with the international cut-off points per age and sex provided by Cole et al [22]. Overweight was defined as BMI of the age- and sex-specific  $>85^{\text{th}}$  to  $<95^{\text{th}}$  percentile, and obesity as BMI greater than the  $95^{\text{th}}$  percentile [23]. The sample size was 750, and was calculated using the following formula:

$$n = \frac{z^2 \times p(1 - p)}{d^2}$$

In our study,  $d = 0.012$ ,  $z = 1.96$ , and  $p = 0.028$  (according to the prevalence of asthma symptoms and

obesity among school children in other studies) [24]. The results were analyzed statistically by applying the Student's t-test and the chi-square test;  $p < 0.05$  was considered significant.

### Results

Parents of 903 children responded to the questionnaire (response rate, 90.3%). Approximately 34% of the children were male and 66% were female. The median age was 8.95 years. The lifetime prevalence of wheezing (wheeze ever) was 21.56%. The current prevalence of wheezing was 8.7% and of doctor-diagnosed asthma was 2% (Table 1).

In this study, prevalence of current wheezing during the past 12 months decreased with increasing age ( $p < 0.02$ ) (Table 2), and current prevalence of wheezing was higher among boys than girls (12% vs. 7%, respectively;  $p = 0.012$ ) (Table 3). The prevalence of obesity and overweight among the children was 6.87% and 9.5%, respectively. The prevalence of obesity and overweight among girls and boys was found to be different (Table 4).

The current prevalence of wheezing among obese children was 68.75% and among overweight children was 37%, and there was a statistical association between

**Table 1 Prevalence of asthma symptoms among school-age children**

Symptoms	No.	%
Wheeze ever	194	21.56
Wheeze in the past year	79	8.7
Doctor-diagnosed asthma ever	17	2
Night cough	65	7.2
Exercise-induced wheeze	31	3.4

**Table 2 Prevalence of wheeze in the past year in different ages**

Age (yrs)	No.	Wheeze in the Past Year	
		No.	%
7	193	25	13
8	180	20	11.1
9	183	15	8.2
10	172	11	6.4
11	175	8	4.6

**Table 3 Prevalence of wheeze in the past year with significant difference in the both sexes**

Wheeze in the Past Year	Boy	Girl	Total
	N = 308	N = 595	N = 903
	No. (%)	No. (%)	No. (%)
12-month prevalence of wheezing	37 (12)	42 (7)	79 (8.7)

**Table 4 Prevalence of obesity and overweight in school-age children by sex**

Sex	Prevalence		%	
	Overweight		Obesity	
	No.	%	No.	%
Both	86	9.5	62	6.87
Boys	34	11	29	9.4
Girls	52	8.73	33	5.54

prevalence of current wheezing and obesity ( $p < 0.001$ ). Current wheezing during the past 12 months increased with increasing weight (Table 5).

There was no statistical association between obese and overweight children with current wheeze in either sex ( $p = 0.18$ ).

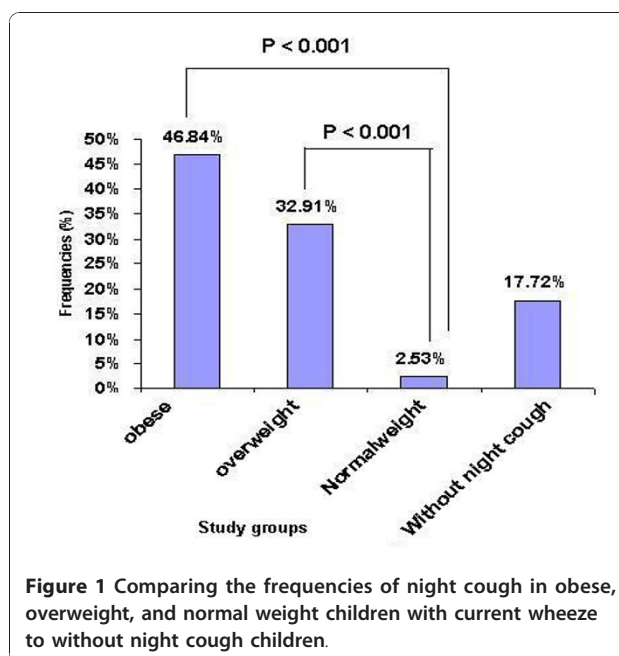
The frequencies of night cough among obese and overweight children with current wheezing was 37 (46.84%) and 26 (32.91%) respectively, but among normal-weight children with current wheezing it was 2 (2.53%) ( $p < 0.001$ ,  $P < 0.001$ , respectively) followed by 14 (17.72%) cases without night cough (Figure 1). The prevalence of night cough was higher in obese and overweight children than in normal-weight children ( $p < 0.001$ ).

Our analysis showed that 23.4% of obese children and 15.5% of overweight children had current symptoms of exercise-induced wheeze, but only 0.4% of non-obese children had current symptoms of exercise-induced wheeze ( $p = 0.009$ ) (Table 5).

Our study demonstrated that 4.6% of obese children and 5% of overweight and normal-weight children had a history of allergic rhinoconjunctivitis, and the prevalence of eczema among obese, overweight, and normal-weight children was 1.5%, 2.3%, and 2.6%, respectively. There was no significant statistical association between obese, overweight, and normal-weight children in eczema and allergic rhinoconjunctivitis ( $p > 0.05$ ).

### Discussion

This study showed that obese children had significantly higher prevalence of current wheezing than children of normal weight (68.7% vs. 0.53%). Also, the prevalence of current wheezing among overweight children was higher than in normal-weight children (37% vs. 0.53%). These associations are consistent with other studies [11,25-32].



**Figure 1** Comparing the frequencies of night cough in obese, overweight, and normal weight children with current wheeze to without night cough children.

Our findings demonstrated an increased prevalence of exercise-induced wheezing among overweight and obese children compared with that in normal-weight children. Obese children had 58 times the prevalence of exercise-induced wheezing than normal-weight children (23.4% vs. 0.4%), and there was 38 times the prevalence of exercise-induced wheezing among overweight children in comparison with normal-weight children (15.5% vs. 0.4%). Our findings are consistent with other studies [33,34].

Exertional wheeze in overweight and obese subjects may be due to an increase in the work of breathing, with upper airway collapse or changes in lung mechanics increasing the load on the upper airways. Other proposed mechanisms of exercise-induced wheezing include: 1) mucosal drying and increased osmolality stimulating mast cell degranulation, and 2) rapid airway rewarming after exercise causing vascular congestion, increased permeability, and edema leading to obstruction [35].

In our study, the relationship between current wheezing and obesity and overweight was independent of sex ( $p = 0.18$ ). This finding was consistent with reports by others [26,30,36-38], but some reports have noted the

**Table 5 Prevalence of current wheezing and exercise-induced wheezing among obese, overweight and normal weight school-age children**

Symptoms	Obesity N = 64		Overweight N = 84		Normal weight N = 755		p value
	No.	%	No.	%	No	%	
Wheeze in the past year	44	68.75	31	37	4	0.53	<0.001
Exercise-induced wheeze	15	23.4	13	15.5	3	0.4	0.009

association only in women, or that it was stronger in women [8,11,39,40]. This inconsistency in results for boys and girls between studies may be attributed to differences in study populations, the age distribution of participants, and different definitions of asthma used.

Despite a strong association of obesity with current wheezing and exercise-induced wheezing, no association was found between obesity and allergic rhinoconjunctivitis and eczema. This contradicts results from some studies [41,42], but is consistent with results from some other studies [27,43].

If one assumes that subjects without a history of allergy are less likely to have allergic asthma, our observations suggest that excessive symptoms of current wheezing and exercise-induced wheezing among overweight and obese children may be due to causes other than allergy. Obesity and overweight are associated with an increase in the occurrence of both gastro-esophageal reflux and sleep apnea [44], and both of these conditions may mimic the symptoms of wheeze or cough without changes in lung function or airway responsiveness [45].

On the basis of these findings, overweight and obesity seem to be significant risk factors for current wheezing and exercise-induced wheezing; if these can be considered to be modifiable risk factors, interventions that affect weight loss could be associated with a decrease in asthma symptoms. Thus, children with co-morbid asthma and obesity should be encouraged to increase physical activity and lose weight.

There are several limitations in this study because it is a cross-sectional study; the data did not provide direct information on whether obesity preceded the development of asthma, which has been discussed in previous studies [10,11]. A measurement of airway responsiveness is desirable but not practical in studies like ours, and we did not have objective measures for the allergic status.

In conclusion, the results of this study suggest that in our region there is a strong association between asthma symptoms and both overweight and obesity in both sexes among school-age children.

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#### Authors' contributions

All authors contributed to all aspects, including searching the literature and writing the article. All authors have read and approved the final manuscript.

#### Competing interests

The authors declare that they have no competing interests.

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