TANAFFOS

Prevalence of Asthma and Respiratory Symptoms among University Students in Sari (North of Iran)

**Moslem Mohammadi [1], Behzad Parsi [2],
Naghi Shahabi Majd [2]**

[1] Molecular and Cell Biology Research Center, Department of Physiology & Pharmacology, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran, [2] Department of Physiology & Pharmacology, Faculty of Medicine, Mazandaran University of Medical Sciences, Sari, Iran.

Correspondence to: Mohammadi M
Address: Molecular and Cell Biology Research Center, Department of Physiology & Pharmacology, Faculty of Medicine, KM 17 Khazarabad Road, Khazar Sq, Sari, Iran.
Email address: Mohammadimo@yahoo.com

Background: Despite widely available data about childhood asthma, there are limited data about the prevalence of asthma among young adults in Iran. The aim of this study was to determine the prevalence of asthma and respiratory symptoms among medical students in the city of Sari in Northern Iran.

Materials and Methods: The prevalence of asthma and respiratory symptoms was studied using a standard questionnaire. Based on the information obtained from the questionnaires, the study participants were divided into two groups of asthmatics and non-asthmatics. Pulmonary function tests including forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) before, and after salbutamol inhalation were measured in all subjects with asthma and approximately 10% of those without asthma.

Results: A total of 1,011 subjects (374 males, 637 females) participated in this study. Asthma was found in 3.5% of the subjects (3.2% males and 3.6% females). The 12-month prevalence of wheezing, coughing at rest, coughing at night, breathlessness at rest, exercise-induced wheezing, and exercise-induced coughing in the entire study population was 11.1%, 12.4%, 13.4%, 13.3%, 17.7%, and 16.7%, respectively. The prevalence of all asthma-related symptoms was significantly higher among asthmatics compared to non-asthmatics. Moreover, asthmatic subjects showed lower FEV1 and FVC values compared to non-asthmatic subjects (P<0.001). Smoking and family history of asthma were statistically significant risk factors for developing asthma.

Conclusion: The high prevalence of asthma related symptoms in the present study strongly suggests that asthma is under diagnosed and under treated among participants.

Key words: Adult, Asthma, Prevalence, Pulmonary function test, Wheeze

INTRODUCTION

Asthma is a chronic inflammatory disorder of the airways. In susceptible individuals symptoms are caused by airway inflammation and include wheezing, breathlessness, and coughing. These symptoms are usually associated with variable limitation to airflow, which can be partially reversed either spontaneously or with treatment.

The inflammation also leads to increased airway responsiveness to a variety of stimuli (1, 2).

The reported worldwide prevalence of asthma has dramatically increased in developed and developing countries over the past few decades (3-5). Asthma prevalence increased from 7.2% in 2000 to 8.4% in 2009 in

the United States (6), and in Africa it increased from 11.7% in 1990 to 12.8% in 2010 (7). Several factors have been proposed to be related to the increased prevalence of asthma observed during the past decades, including increased awareness and early diagnosis of this condition (4), environmental factors (8), exposure to cigarette smoke (9), and increased prevalence of obesity (10, 11). In addition, epidemiological studies have also found substantial variations in the prevalence of asthma between, and within countries (12, 13).

The prevalence of asthma in Iran has been reported in several previous studies. International Study of Asthma and Allergies in Children (ISAAC) data in Iran reported the prevalence of asthma to be 2.1 - 6.8% in 6 - 7 year olds and 2.1 - 9.8% in children between 12 - 14 (14-17). Despite widely available data about childhood asthma in Iran, there is a scarcity of data on the prevalence of asthma among Iranian adults, and to the best of our knowledge there are no data on its prevalence in the city of Sari (the capital city of the Mazandaran province in Northern Iran). Studies conducted in different provinces of Iran have reported the prevalence of asthma among Iranian adults varies from 1.4 - 6.1% (18-20). However, most of these studies were based on subjective symptoms and diagnosis of asthma was not made based on lung functions tests.

The aim of this study was to determine the prevalence of asthma and respiratory symptoms among medical students at Mazandaran University of Medical Sciences in Sari, using a questionnaire as well as spirometry. Pulmonary function tests were performed to confirm the results obtained from the questionnaires.

MATERIALS AND METHODS

Study population and questionnaire

This cross-sectional study was carried out in Mazandaran University of Medical Sciences (Sari, Iran) from March 2013 to June 2014. The survey was conducted according to the principles expressed in the World Medical Association Declaration of Helsinki. The study was approved by the Ethics Committee of the Mazandaran

University of Medical Sciences and informed consent was obtained from each subject.

A total of 1,145 students were asked to fill out a questionnaire in Farsi evaluating asthma and asthma-related symptoms. All students who participated in the study had a physiology class within the aforementioned time interval. Participants in this study were medical students, so their knowledge of asthma may enhance the accuracy of self-reported asthma and related symptoms.

The questionnaire was designed based on questionnaires used in several previous studies (18, 19). It had been validated and used extensively as the postal questionnaire of the European Community Respiratory Health Survey (ECRHS) (21). Subjects who had been diagnosed with asthma by a physician during the previous 12 months were considered as asthmatic.

Our questionnaire assessed the presence of the following symptoms during the last 12 months: wheezing, coughing at rest, coughing at night, breathlessness at rest, exercise-induced wheezing, and exercise-induced coughing. Information about smoking status, family history of asthma and/or smoking, current use of rescue inhalers, and cardiopulmonary diseases were also gathered.

Pulmonary function test and reversibility assessment

Based on the data from the questionnaires, the study subjects were divided into two groups: those with current asthma, and non-asthmatics. Pulmonary function tests were subsequently performed on all asthmatics and about 10% of non-asthmatics, in random order.

Two trained and certified technicians demonstrated the required maneuvers prior to performing pulmonary function tests and obtained all the measurements. Forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) were measured using a spirometer (Model ST150, Fukuda Sangyo Co. Ltd, Japan). To ensure quality, all tests were performed according to the American Thoracic Society criteria with subjects in seated position and wearing nose clips (22). Lung function measurements were performed both before (pre-) and 15 min after (post-)

inhalation of salbutamol. Reversible airway constriction was defined as an increase of 12% and 200 mL from baseline FEV1 (23). Each student performed a minimum of 3 acceptable spirometry efforts. The highest values for FVC and FEV1 were taken independently from the three measurements. Two indices of bronchodilator responsiveness were computed for FEV1 and for FVC: absolute change from pre-bronchodilator value (absolute difference between pre- and post- values in L), and percentage change relative to predicted value (the difference between pre- and post- values over the predicted value and expressed as a %) (24).

Height and weight were measured in all subjects without wearing shoes by a calibrated scale and stadiometer, and BMI was calculated for each subject.

The data were analyzed using SPSS version 19. Statistical significance of differences was assessed by t-test and Chi squared test. Logistic regression was used to calculate odds ratios (OR). Statistical significance was set at $P < 0.05$.

RESULTS

Subject characteristics

From the 1,145 students initially invited to participate, 1,019 successfully completed and returned the questionnaires (response rate of 89%). Eight subjects were excluded due to having a history of heart failure and/or chronic obstructive pulmonary disease (COPD). Results for the remaining 1,011 subjects (374 males and 637 females) are reported. There were more females included in our study than males (63% vs. 37%).

Table 1 shows the anthropometric data for the participants. The average age of the subjects was 19.9 ± 1.9 years (17-35). Mean age was 20.5 ± 2.4 years for males and 19.6 ± 1.4 years for females. The mean height, weight, and BMI of the subjects were 168.2 ± 9.4 years (range: 146-195), 64.6 ± 13.9 cm (range: 39-124), and 22.7 ± 3.8 kg/m² (range: 14.4-37.7), respectively.

Table 1. Anthropometric characteristic of the participants

Parameters	Males n= 374	Females n= 637	Total n= 1011
Age (years)	20.5 ± 2.4 (18-35)	19.6 ± 1.4 (17-29)	19.9 ± 1.9 (17-35)
Height (cm)	177.6±6.1 (161-195)	162.7±6.1 (146-180)	168.2±9.4 (146-195)
Weight (kg)	73.9±13.8 (43-124)	59.1±10.7 (39-109)	64.6±13.9 (39-124)
BMI (kg/m²)	23.4±4.1 (14.4-3 7.7)	22.3±3.7 (15.2-37.3)	22.7±3.8 (14.4-37.7)

Data are represented as mean ± SD; BMI: body mass index

Prevalence of asthma and respiratory symptoms

Reported prevalence of asthma and respiratory symptoms are summarized in Table 2. The prevalence of asthma was 3.5% (95% CI: 2.2 - 5); 3.2% in male and 3.6% in female subjects. Among asthmatic subjects, 34.3% were males and 65.7% were females. There was a higher prevalence of asthma in females than in males, but this difference did not reach statistical significance (P = 0.63).

Respiratory symptoms during the last 12 months including wheezing, coughing at rest, coughing at night, breathlessness at rest, exercise-induced wheezing, and exercise-induced coughing were found in 11.1%, 12.4%, 13.4%, 13.3%, 17.7% and 16.7% of the subjects, respectively (Table 2). Except for exercise induced wheezing (P < 0.05), there were no differences in the prevalence of other respiratory symptoms between males and females. All asthma-related symptoms were significantly more common in those with a confirmed diagnosis of asthma at the time of enrollment compared with normal subjects (Table 3).

Only 19 subjects with asthma (54%) were under treatment with respiratory medications at the time of this study.

Risk factors of asthma

Prevalence of cigarette smoking was 2.1% (21 subjects) including 1.7% in males and 0.4% in female subjects. 11.4% of asthmatic subjects (4 of 35 subjects) were smokers. As indicated in Table 4, asthma was seen in 19% of smoker subjects versus 3.1% of non-smoker subjects (OR=7.28,

P<0.001). This indicated that smoking is associated with an increased risk for asthma.

There were positive correlations between asthma and family history of asthma and family history of smoking (OR=2.47, P<0.05; and OR=2.01, P<0.05, respectively).

Bronchodilator responses

Lung function was measured in 35 subjects with current diagnosis of asthma, and a 10% random sample (n=90) of non-asthmatic subjects. Descriptive statistics of spirometric indices before and after administration of salbutamol are presented in table 5. The baseline spirometry results in asthma group were: mean FEV1: 2.76 ± 0.6 L and 68.5 ± 4.9%, mean FVC: 3.70 ± 0.8 L and 78.7 ± 5.5%, and FEV1/FVC: 74.6 ± 2.7%. The baseline spirometry results in non-asthmatic patients were: mean FEV1: 3.23 ± 0.5 L and 85.5 ± 4.5%, mean FVC: 3.86 ± 0.7 L and 87.1 ± 6.2%, and FEV1/FVC: 82.7 ± 3.7%. The asthmatic and non-asthmatic groups had comparable baseline pre-bronchodilator pulmonary function tests. The pre-bronchodilator FEV1 (% predicted), FVC (% predicted), and FEV1/FVC ratio were significantly lower (P < 0.001) in the asthmatic group (Table 5).

Table 2. Prevalence (%) of current asthma and respiratory symptoms among study participants

Symptoms	Males n=374	Females n=637	Total n=1011	95% CI	*P*-value
Current asthma	3.2	3.6	3.5	2.2-5	0.63
12-month prevalence of:					
Wheezing	9.6	12.1	11.1	8.5-13.3	0.15
Coughing at rest	13.4	11.8	12.4	10.1-14.9	0.72
Coughing at night	13.9	13.1	13.4	11.7-15.1	0.81
Breathlessness at rest	12.1	14.1	13.3	10.5-16.8	0.18
Exercise-induced wheezing	12.6	20.7	17.7	11.1-22.3	0.04
Exercise-induced coughing	20.8	14.2	16.7	12.4-23.1	0.09

CI: Confidence interval

Table 3. Prevalence (%) of respiratory symptoms among participants with or without asthma

Symptoms	With asthma n=35	Without asthma n=976	P value
12-month prevalence of:			
Wheezing	25.7	10.6	0.02
Coughing at rest	37.1	11.5	0.001
Coughing at night	28.6	12.8	0.02
Breathlessness at rest	22.8	13	0.04
Exercise-induced wheezing	48.6	16.6	0.001
Exercise-induced coughing	42.9	15.8	0.001

Table 4. Prevalence of asthma risk factors in groups with and without current asthma

Risk factors	With asthma	Without asthma	Total	OR	P value
Smoking					
Yes	4(19%)	17(81%)	21	7.28	< 0.001
No	31(3.1%)	959(96.9)	990		
Family history of asthma					
Yes	12(6.6%)	172(93.4%)	184	2.47	< 0.05
No	23(2.8%)	804(97.2%)	827		
Family history of smoking					
Yes	10(6.2%)	162(93.8%)	172	2.01	< 0.05
No	25(3%)	814(97%)	839		

OR: Odds Ratio

Table 5. Pulmonary function test results pre- and post- bronchodilator test in subjects with or without asthma

Spirometric parameters	With asthma (n=35)			Without asthma (n=90)		
	Pre- Bd.	Post- Bd.	Change	Pre- Bd.	Post- Bd.	Change
FEV1						
Mean ± SD (L)	2.76 ± 0.6	3.38 ± 0.7	0.62 ± 0.3	3.23 ± 0.5	3.33 ± 0.6	0.10 ± 0.4
% Predicted ± SD	68.5 ± 4.9	84.2 ± 5.3	15.8 ± 7.1	85.5 ± 4.5	88.1 ± 6.1	4.2 ± 10.1
FVC						
Mean ± SD (L)	3.70 ± 0.8	4.01 ± 0.9	0.31± 0.3	3.86 ± 0.7	4.01 ± 0.8	0.14 ± 0.5
% Predicted ± SD	78.7 ± 5.5	85.2 ± 6.7	6.5 ± 5.4	87.1 ± 6.2	91.5 ± 7.4	4.4 ± 12.5
FEV1/FVC						
Mean ± SD (%)	74.6 ± 2.7	82.9 ± 2.6	8.3 ± 3.5	82.7 ± 3.7	83.56 ± 3.7	0.89 ± 4.6

Bd: Bronchodilator; FEV1: Forced expiratory volume in one second; FVC: Forced vital capacity

The asthmatic subjects exhibited a pre-bronchodilator FEV1 and FVC (% predicted) that were 16% and 9% lower than those of non-asthmatic participants, respectively.

After salbutamol inhalation, there were statistically significant increases in all flow volume curve parameters in the asthmatic group, but not in the non-asthmatic group. The mean responses were significantly greater for FEV1. A positive reversibility test with salbutamol was found in the asthmatic group (change in FEV1% predicted >15% and FEV1 absolute change > 600 mL). There was no significant difference in FEV1 (% predicted) between asthmatics and non-asthmatics after salbutamol inhalation (84.2 ± 5.3 and 88.1 ± 6.1, respectively).

Analysis of data for FEV1/FVC revealed that pre- and post-bronchodilator FEV1/FVC ratios remained almost the same in the non-asthmatic group.

DISCUSSION

The prevalence of asthma in our sample was 3.5%, without any significant difference between male and female participants. The prevalence of respiratory symptoms was much higher than that of asthma (11-17%).

The prevalence of asthma and respiratory symptoms in adults has many epidemiological variations. The published data on the prevalence of asthma among adults in Iran mainly comes from a study by Golshan et al. in Isfahan, where the prevalence of asthma was 5.9 and 5.5% among 21 - 35 year olds, and 21 - 51 year olds, respectively (19), and from another study performed by Boskabady and

Kolahdoz in Mashhad, in which the prevalence of asthma was 2.8%among adult subjects (18). More recently, Rahimi-Rad et al. reported the prevalence of asthma to be 1.4% in 20 - 44 year old subjects in Urmia (20). The prevalence of asthma in our study was similar to that reported by Golshan et al., but higher than those reported by Boskabady and Rahimi-Rad et al.

Among university students in Urmia, a 12-month prevalence of wheezing, breathlessness, and exercise-induced coughing was 19.7%, 10.2%, and 16.5%, respectively (25). In a study by Özdemir et al, among university students in Turkey (26), the prevalence of asthma and wheezing was lower than that found in our study (0.7% and 8.1% vs. 3.5% and 11.1%, respectively). In university students in Bangkok, the prevalence of asthma and wheezing was reported to be 8.8% and 10.1%, respectively (27). In another study conducted by Uthaisangsook in Thailand (28), the prevalence of asthma and wheezing was higher than the results of our study (11.6% and 17.7%, respectively). The prevalence of adulthood asthma in the USA and Denmark was found to be 4.7% and 4.8%, respectively (29, 30).

The prevalence of asthma has been reported to be different between the two sexes. Before puberty, asthma seems to be more common in girls, while the trend usually reverses around puberty (31-33). In our study, the prevalence of asthma was also higher among female students, but the difference was not statistically significant.

Although the exact mechanisms for sex-related differences in asthma have not been fully determined, hormonal influences (34-36), as well as greater susceptibility to smoking in women (37,38) have been proposed as potential reasons. However, our results cannot be attributed to differences in smoking status as smoking was less common among female students.

In this study, exercise-induced wheezing had the highest prevalence (17.7%). The most common respiratory symptom in asthmatic subjects was exercise-induced wheezing (48.6%), followed by exercise-induced coughing (42.9%), while wheezing was reported only in 25.7% of subjects. In a similar study performed by Boskabady and Kolahdoz (18) the prevalence of wheezing, coughing at rest, coughing at night, breathlessness at rest, exercise-induced wheezing, and exercise-induced coughing in asthmatic subjects was 82.9%, 74.7%, 75.9%, 86.7%, 79.7%, and 75.3%, respectively, which are much higher than those we found in our study population.

In accordance with our results, several studies have reported that asthmatic subjects show reduced lung function compared to non-asthmatics (39, 40). Reversibility test is an important tool to confirm the diagnosis of asthma. In bronchodilator test, subjects with asthma showed a greater improvement than non-asthmatic subjects with a higher baseline values. Due to a greater FEV1 compared to FVC response in the asthmatic group, the FEV1/FVC ratio significantly increased ($P<0.001$) in the asthmatic group, but remained almost the same in the non-asthmatic group after administering the bronchodilator.

In the present study, the proportion of asthmatic subjects reporting daily use of asthma medications was substantially lower than that found in the survey conducted by Boskabady and Kolahdoz (18) in Iranian adults (54% vs. 76%). At least part of the lung function deficit observed among asthmatics might be due to suboptimal asthma control.

Smoking increases the severity of airway inflammation and related respiratory symptoms in both asthmatic and normal subjects. In this study, cigarette smoking was an independent risk factor for developing asthma. The prevalence of asthma was 7 times higher in the smokers than that in non-smokers. Our results were in agreement with the results of many previous studies confirming that asthma is strongly related to smoking (41, 42).

The prevalence of smoking was much lower in this study (2.1%) than that in similar studies conducted in different cities in Iran. The prevalence of smoking was 7.2% in Isfahan (19), 12.7% in Mashhad (43), and 16.4% in Urmia (20). The prevalence of smoking among Sari medical students was also lower than that in university students in Urmia (8.1%)(25), and Turkey (18%) (26).

Our results also indicated a strong relationship between asthma and a family history of asthma and smoking. Asthma was seen in 6.6% of subjects with positive family history of asthma vs. 2.8% of those without family history of asthma. Similarly, asthma was present in 6.2% of subjects with positive family history of smoking vs. 3% of those without family history of smoking.

In conclusion, the high prevalence of symptoms associated with asthma in asthmatics strongly suggests that asthma control in this population is inadequate. Respiratory symptoms were also reported in a significant proportion of subjects without asthma. As these subjects were not diagnosed with asthma, they may represent a group at high risk for developing asthma or with yet undiagnosed asthma. There is a need for Iranian government to consider challenges in diagnosing and managing asthma.

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