ORIGINAL ARTICLE
Iran J Allergy Asthma Immunol
December 2011; 10(4): 273-279

Prevalence of Exercise Induced Asthma in Female School Students

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Received: 26 December 2010 ; Received in revised form: 16 April 2011 ; Accepted: 28 April 2011

ABSTRACT

The prevalence of exercise induced asthma (EIA) in Iran is not known. In the present study the prevalence of EIA among female students of guidance school in the city of Mashhad was evaluated.

A total of 1690 female students aged 12-14 years in ten randomly selected schools in north east of Iran (Mashhad) completed an asthma symptoms- specific questionnaire. One hundred forty four randomly selected students including 49 symptomatic and 95 asymptomatic cases participated in a 6 minutes free run test (until reaching 70-75% of MHR (maximum heart rate) for evaluating EIA. Pulmonary function tests (PFT) were measured before (baseline), immediately, 5 minutes and 15 minutes after exercise.

The prevalence of asthma symptoms among the studied students was 12.54%. There was not significant difference in any of PFT values between asymptomatic and symptomatic students. The results of exercise test showed that totally 61.22% of symptomatic students responded to exercise test (their post-exercise PFT values decline more than 15%) while only 16.82% of asymptomatic students were responders to exercise ($p<0.001$). However, in both asymptomatic and symptomatic responder students, all PFT values declined significantly after exercise compared to baseline values ($p<0.05$ to $p<0.001$) and there was not any significant difference between two groups.

The results showed that although higher number of symptomatic students showed EIA, some asymptomatic students also sowed EIA.

Keywords: Exercise induced asthma; Pulmonary function tests; Young girl students

INTRODUCTION

Exercise-induced bronchoconstriction (EIB) is highly prevalent in children with asthma,[1,2] even in those of controlled type of this disorder. This may be due to the high levels of physical activity in the childhood[3] and it is known that physical exercise may induce asthma symptoms in susceptible individuals.[3,4-7]

Exercise-induced asthma (EIA) is typically characterized by a history of coughing or wheezing,[8] or a history of shortness of breath with exercise.[9-11]

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EIA is the result of a post-exercise airway obstruction[1,4,12] with a reduction in forced expiratory volume in 1 second (FEV_1) of greater than 10% compared with pre-exercise values.[9]

Prevalence of EIA is different: 5% to 20% in general population, 30% to 70% in winter athletes and athletes who participate in summer endurance sports[13] and 90% in individuals with asthma.[4] EIA appears 5-15 minutes after initiation of exercise; however it can be seen even as long as 4-6 hours after exercise.[4]

There are few studies about the effects of exercise on respiratory systems in Iran. Therefore in the present study, the prevalence of EIA was evaluated in female students of guidance school in the city of Mashhad with or without asthma symptoms.

PATIENTS AND METHODS

Study Area and Population

A total of 1690 female students aged 12-14 years were included in the study. The subjects were recruited from 10 guidance schools, randomly selected from different regions of the city of Mashhad (north east of Iran) by electoral roll. Therefore the studied subjects were of different socio-economic classes and all were of Iranian ethnicity (Table 1). No subject had the history or symptoms of cardiovascular diseases that required treatment. The protocol was approved by the ethics committee of our institution and each subject/parents gave an informed consent before entering the study.

Protocol

Questionnaire. All participants completed a specific and standard questionnaire in Farsi language which was developed according to the previous studies.[14-18] The asthma symptoms in the questionnaire were: recurrent wheeze, recurrent cough or tightness at rest, night cough, wheeze or cough during exercise. Subjects with two symptoms or presence of previously diagnosed asthma were considered as having asthma symptoms.

Spirometric measurements. Standard pulmonary function tests (PFT) were performed in the morning, using a calibrated pneumotachograph spirometer (Model ST90, Fukuda, Sangyo Co., Ltd. Japan) in 23% of symptomatic and 6.5% of asymptomatic students in random order (Table 2).

Table 1. Absolute (No.) percentage (%) values of asymptomatic, symptomatic and total studied students and their age distribution

Age(years)	Asymptomatic		Symptomatic		Total studied students	
	No.	%	No.	%	N0.	%
12	410	86.32	65	13.68	475	28.11
13	428	87.35	62	12.65	490	29.00
14	640	88.28	85	11.72	725	42.90
Total	1478	87.45	212	12.54	1690	100

The percentage values of asymptomatic and symptomatic subjects are the percentages among the studied students of the same age group.

Table 2. Asymptomatic, symptomatic and total students undergone exercise test and PFT measurements and their age distribution

Age(years)	Asymptomatic		Symptomatic		Total students	
	No.	%	No.	%	No.	%
12	27	6.59	13	18.46	40	8.21
13	29	6.78	16	25.80	45	9.18
14	39	5.10	20	23.53	59	8.14
Total	95	6.42	49	23.11	144	8.52

Data are presented as absolute values (No.) and percentage (%) of studied students.

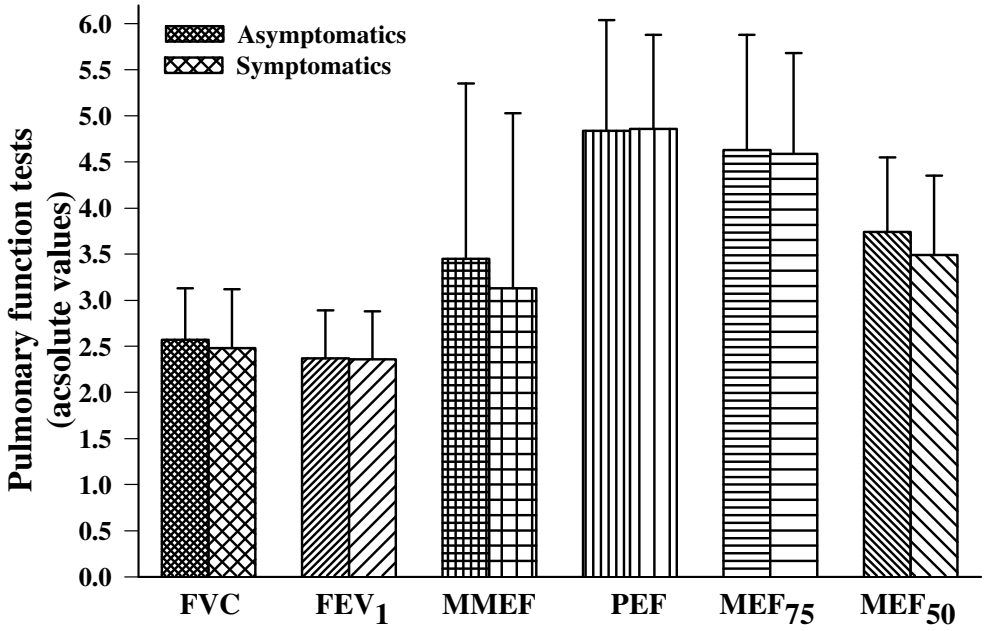

Figure 1. Comparison of baseline PFT values between asymptomatic and symptomatic subjects. FVC: Forced Vital Capacity, FEV_1: Forced Expiratory Volume in one second, MMEF: Maximal Mid Expiratory Flow, PEF: Peak Expiratory Flow, MEF_{75} and MEF_{50}: Maximal Expiratory Flow at 75% and 50% of the FVC, respectively. There was no significant difference in PFT values between asymptomatic and symptomatic subjects.

Prior to pulmonary function testing, the required manoeuvre was demonstrated by the operator, and subjects were encouraged and supervised throughout test performance. Pulmonary function testing was performed using the acceptability standards outlined by the American Thoracic Society (ATS) with subjects in a standing position and wearing nose clips.[19] Pulmonary function tests were performed three times in each subject with an acceptable technique. The highest level for Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV_1), Peak Expiratory Flow (PEF), Maximal Mid Expiratory Flow (MMEF) and Maximal Expiratory Flow at 75%, 50%, and 25% of the FVC (MEF_{75}, MEF_{50}, and MEF_{25} respectively) were taken independently from the three curves. Subjects were asked to avoid caffeinate beverages, theophylline or long acting β-agonist inhalers 12 hours and short acting β-agonist inhaler 6 hours before testing. Prior to pulmonary function, tests were measured before, immediately, 5 and 15 minutes after exercise test in each subject.

Exercise protocol. Exercise test was also performed in the students undergone PFT measurements (23% of symptomatic and 6.5% of asymptomatic students in random order). Each subject performed a 6 minutes free run exercise test with maximum effort and sufficient motivation of subject till reaching 70-75% MHR in the morning.[20,21] All exercise tests took place in April and June 2009 with air ambient temperature 20 ± 2^0C and relative humidity (RH) of 18±1%.

Statistical Analysis

All values are expressed as means ± SD. To compare the results of pre and post exercise, non-parametric tests of Mann Whitney-U and Wilcoxon signed ranks for independent and paired groups were used respectively. Differences in the responder students to exercise between symptomatic and asymptomatic students were tested by Chi-Squared analysis on 2×2 contingency tables. A two-sided *p* value of 0.05 was the criterion for statistical significance. All analyses were performed with SPSS software (version 11.5, SPSS Inc. USA).

RESULTS

Asthma Symptoms

The prevalence of asthma symptoms among the studied students was 12.54% which was higher among 12 years aged and lower among 14 years aged students (Table 1).

Pulmonary Function Tests

There was not significant difference in any of PFT values at rest (before exercise) between asymptomatic and symptomatic students (Figure 1).

Exercise Test

The results of exercise test showed that totally 61.22% of symptomatic and only 16.82% of asymptomatic students responded to exercise test (their post-exercise PFT values decline more than 15%) (p<0.001, Table 3). In addition the percentage of symptomatic students with decline in all PFT values due to exercise was significantly higher than asymptomatic students (p<0.01 to p<0.001, Table 3). However, in both symptomatic and asymptomatic responder students, all PFT values declined significantly after exercise compared to baseline values (p<0.05 to p<0.001, Figure 2).

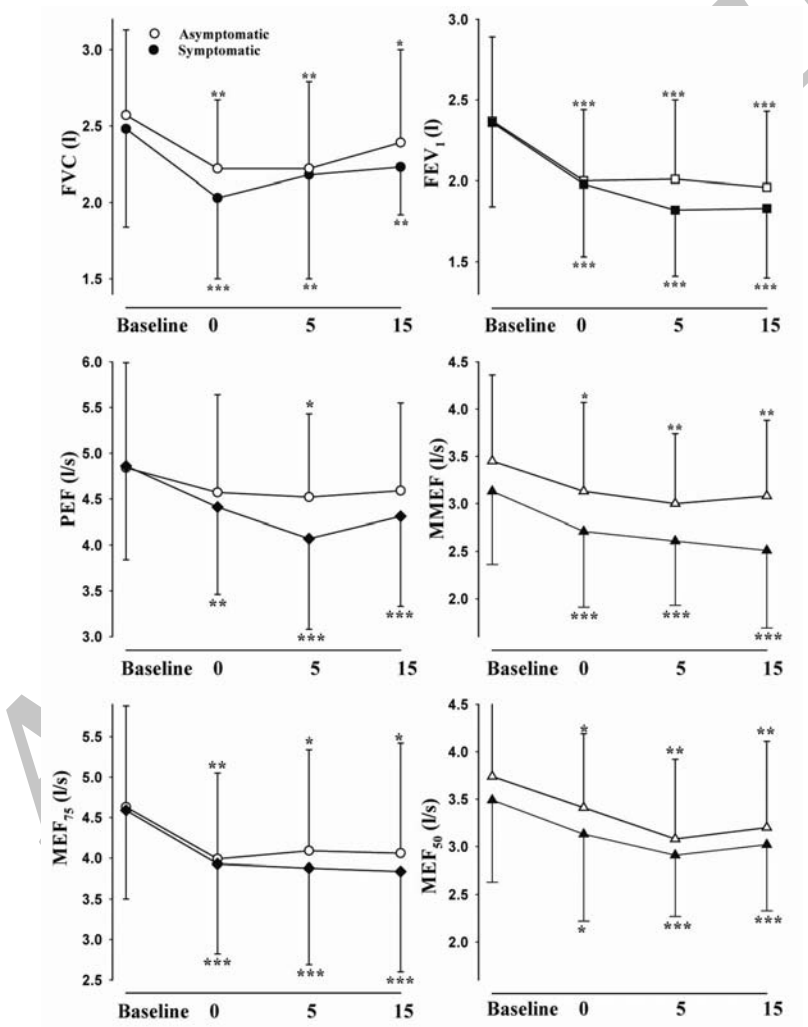

Figure 2. PFT values before (baseline) immediately, 5 and 10 minutes after exercise test in asymptomatic and symptomatic subjects. FVC: forced vital capacity, FEV_1: forced expiratory volume in one second, MMEF: maximal mid expiratory flow, PEF: peak expiratory flow, MEF_{75} and MEF_{50}: maximal expiratory flow at 75% and 50% of the FVC, respectively. Statistical change in post exercise PFT values compared to baseline. *:p<0.05, **: p<0.01, ***: p<0.001.

Table 3. Responders asymptomatic and symptomatic students to exercise test (exercise induced decline in different PFT values)

Topics / Age(years)		Asymptomatic				Symptomatic			
		12	13	14	Total	12	13	14	Total
FVC	No.	3	3	5	11	4	6	7	17 **
	%	11.11	10.34	12.85	11.59	30.77	37.50	35.00	34.69
FEV1	No.	4	4	6	14	6	8	9	23 ***
	%	14.81	13.79	15.38	14.74	45.15	50.00	45.00	46.94
MMEF	No.	4	4	5	13	5	7	8	20 ***
	%	14.81	13.79	12.82	13.68	38.46	43.75	40.00	40.82
PEF	No.	2	4	7	13	6	7	9	22 ***
	%	14.81	17.24	17.95	13.68	46.15	43.75	45.00	44.90
MEF75	No.	3	3	6	12	5	6	7	18 **
	%	11.11	10.34	15.38	12.63	38.46	37.50	35.00	36.73
MEF50	No.	3	4	5	12	4	8	9	21 ***
	%	11.11	13.79	12.82	12.63	30.77	50.00	45.00	42.82
Total	No.	4	5	7	16	8	10	12	30 ***
Responders	%	14.81	17.24	17.95	16.82	61.54	62.5	60.00	61.22

Data are presented as absolute values (No.) and percentage (%) of responders of each PFT value to exercise in proportion to students undergone exercise test in each age group. Statistical differences between responders in two groups; ***:$p<0.01$, **: $p<0.01$.

Although the decline of post-exercise PFT values in symptomatic students was more prominent than those of asymptomatic students, there was not significant difference between two groups (Figure 2).

DISCUSSION

The results of the present study showed a 12.5% prevalence of asthma symptoms among the young girl students. The results also indicated that most female students of guidance school in the city of Mashhad with asthma symptoms showed EIA (61%). However, the results also showed EIA in some asymptomatic young girl students (17%). Although asymptomatic students did not have respiratory symptoms, the PFT values were similar between symptomatic and asymptomatic students.

Asthma is characterized by constriction of airway along with inflammation and increase reaction of the airways to many stimuli including exercise. Exercise-induced asthma (EIA) may be defined as a airway constriction which accrued after exercise.[1,4,12]

Although the baseline PFT values of symptomatic and asymptomatic subjects were not significantly different, the prevalence of EIA in symptomatic subjects was significantly higher than asymptomatic students. These findings are supported by previous results indicating that baseline PFT values may be applied for asthma diagnosis, but can not predict EIA.[4,22] However respiratory symptoms are valuable for suggestion of EIA subjects which is also supported by the findings of Ricardo et al.[23]

The findings of the present study showed 61% prevalence of EIA among symptomatic girl students. These results are also supported by previous studies indicating the prevalence of EIA in 90% of individuals with asthma.[4]

The prevalence of EIA seen in this study was higher than some previous published articles. Ng'ang'a, et al. showed a prevalence of EIA in 22.9% of urban children in Africa.[24] However, significantly higher prevalence of EIA in children with moderate or severe persistent asthma compared to children with intermittent asthma was shown previously.[9,25-27] Although in the present study the severity of asthma was not classified and the existence of respiratory symptoms did not indicate the existence of asthma disease definitely, higher prevalence of EIA in symptomatic students seen in the present study supported by the above mentioned studies. Martin-Munoz et al. also showed a 31% prevalence of EIA in asthmatic children.[3] Kawabori et al showed similar prevalence of EIA in asthmatic

children (63%). The prevalence of EIA among university students in Tehran was 10.8%[10] which was close to the results of asymptomatic students of the present study. This study also showed that the frequency of respiratory symptoms among students with EIA was significantly higher than those without EIA.[10] Another study showed 18.4% EIA among soccer player children.[28] Significant reduction in pulmonary function in asthmatic patients was also shown in Iran.[29] Using respiratory symptoms (cough, wheeze) also 19.9% of subjects (age 7-16 year) showed EIA[30] indicating that respiratory symptoms could be used to determine EIA. In 50 healthy male subjects (age 19-26), a sub maximal incremental exercise test caused significant reduction in FEV1, and FEV1/FVC[31]which also support the results of our study.

One important finding of the present study was the existence of EIA in asymptomatic students (17%) which was also confirmed by some studies. A previous study showed the prevalence of EIA in non-asthmatic children[32] which was greater (41%) than the findings of the present study. The reason of discrepancy in EIA in different studies is uncertain to us. However, the differences in age, environment and genetic factors are the suggested reasons. For example the prevalence of EIA among students of Tehran University was lower (11%) than the present study[10] which is perhaps due to older age of the studied students of Tehran University.

In conclusion, although higher number of symptomatic students showed EIA, some asymptomatic students also showed EIA. In addition, the post exercise decline in PFT values in symptomatic and asymptomatic students with EIA were similar.

ACKNOWLEDGMENTS

This study was financially supported by the Research Council of Mashhad University of Medical Sciences. This paper is a part of M.SC. thesis. The authors wish to thank Ramin Sadeghi, MD for proof reading of the manuscript.

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