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Prevalence of Exercise-Induced Bronchospasm in Long Distance Runners Trained in Cold Weather

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Abstract. We investigated whether regular training in cold weather has an effect on the development of exercise-induced bronchospasm. Nineteen sedentary males and 20 male long distance runners who were regularly training in Erzurum participated in this study. They had no history of asthma, atopy or allergic rhinitis. Pre- and post-exercise spirometry was performed in the participants in room temperature. EIB was defined as at least a ≥10% fall in FEV_1 or a ≥15% fall in $FEF_{25\text{-}75\%}$ or a ≥25% fall in PEFR. EIB was established in 7 of 20 athletes and in 1 of 19 sedentaries. Prevalence of EIB will be higher even if it is established in room temperature when training for the sports like long distance running which is not a cold weather sport. We conclude that it will be more convenient to establish EIB in room temperature and in the laboratory since the exercise test and spirometry can be performed more accurately under more standard conditions.

Key words: Exercise-induced asthma—Pulmonary function—Spirometry—Athletes—Cold weather.

Exercise-induced bronchospasm (EIB) is a phenomenon of transient airflow obstruction associated with physical exertion [18]. Heat and water loss from the airway surface caused by hyperventilation are main factors in the pathophysiological mechanism of EIB [4, 5, 12, 31, 36]. Symptoms typically occur shortly after the cessation of exercise and may persist for several hours [24]. Dry and cold air is the strongest triggering mechanism of bronchospasm for the people predisposed to EIB [1, 14, 34]. The clinical symptoms are coughing, wheezing, dyspnea, and excessive mucus [10]. A mismatch between fitness level and performance, "heavy

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legs" [24], muscle cramps, headache, abdominal pain and fatigue [33] may also be observed.

EIB, which has negative effects on physical performance and health, is frequently observed in athletes [24]. Self-reported symptoms by elite athletes are not reliable in identifying EIB [6, 22, 23], so it is advisable to diagnose it with pulmonary function measurements before and after exercise [22]. EIB frequently goes undiagnosed [18] and had formerly not been established during routine screening methods [28]. The lack of high sensitivity or specificity demonstrates that self-reported symptoms are poor indices of pulmonary dysfunction [23]. Some of the athletes did report a history of treated asthma [13].

The aim of this study was to investigate whether regular training in cold weather has an effect on the development of exercise-induced bronchospasm.

Materials and Methods

Nineteen sedentary males and 20 male long distance runners aged 18 – 25 yrs volunteered to participate in this study. The long distance runners were the athletes who were training in Erzurum regularly and had taken part in both national and international races. Sedentary males had not performed regular exercise or any job requiring heavy physical activity. EIB had not been diagnosed either by physicians or had not been detected in the previous scanning tests of the participants. They had no history of asthma, atopy or allergic rhinitis. Mean age, height and weight of the sedentaries and athletes were 18.8 ± 1.9 and 18.6 ± 2.0 yrs, 174.1 ± 6.1 and 178.7 ± 7.9 cm, 72.3 ± 6.4 and 76.0 ± 6.3 kg, respectively.

The tests were performed at room temperature in March. The pulmonary function tests were applied to the participants pre-exercise using Biopac's MP100 Data Acquisition System. The system calibrated before each use in the laboratory. The measured pulmonary parameters were FVC, FEV_1, $FEF_{25\text{-}75\%}$ and PEFR. The intensity of the exercise on the treadmill (Powerfit 1000, Sports Art) was increased until heart rate was increased 80–90% of the maximum heart rate (220–age ± 10) and continued an extra 5 minutes. Pulmonary function tests were repeated immediately after the exercise. The criteria for the assessment of EIB was ≥10% fall in FEV_1 or ≥15% fall in $FEF_{25\text{-}75\%}$ or ≥25% fall in PEFR. Statistical analysis was applied using SPSS 10.0.1 for Windows. The differences between the groups were evaluated with the X^2 test after Yates' correction. The significance level was considered as $P < 0.05$.

Results

EIB was established in 7 of 20 athletes and in 1 of 19 sedentaries (Table 1). The difference between the groups was significant ($p = 0.044$). Participants who had ≥10% fall in FEV_1 (5 athletes) had an average fall of 27% in FEV_1, participants who had ≥15% fall in $FEF_{25\text{-}75\%}$ (4 athletes) had an average fall of 26% in $FEF_{25\text{-}75\%}$. The fall rate in the sedentaries who had ≥ 25% fall in PEFR was 33%.

Discussion

The most commonly used criteria for the assessment of EIB is 10% decrease in FEV_1 [10, 16, 19, 22, 23, 25, 26, 28]. Post-exercise falls of 15–25% [24] or 12.5%

Table 1. Results of the pulmonary function tests in athletes and sedentaries

	Athletes (n = 20)	Sedentaries (n = 19)
≥ 10% in FEV_1	5	–
≥ 15% fall in $FEF_{25\text{-}75\%}$	4	–
≥ 25% fall in PEFR	–	1
Participants diagnosed as EIB	7*	1

Two of the participants who had ≥ 10% fall in FEV_1 also had ≥ 15% fall in $FEF_{25\text{-}75\%}$
$^*p = 0.044$

[23] in $FEF_{25\text{-}75\%}$ is a criteria for EIB. Authors also used 15% [13], 18% [16] or 25% [17] decrease in PEFR for the assessment of EIB.

The prevalence of EIB is 4–20% in the general population [24] and 3–35% [11] or 10–50% in athletes [32]. In the literature, EIB prevalence is greater in athletes [16, 19–21, 27–29, 37] than in the sedentaries [2, 3, 7]. The present study suggested that prevalence of EIB in the long distance runners is higher than in non-athletes. There was no study in the literature investigating both athletes and sedentaries, so we suggest that our study is the first in this field. Future studies about prevalence of EIB in the larger population of athletes and non-athletes together may give more accurate results.

EIB is more common in cold weather sports [33]. Provost-Craig et al. [21] found the prevalence of EIB to be 30% in 100 ice-skaters. Rundell and Spiering [25] established EIB in 30% of the athletes exposed to cold and dry weather exercise. Mannix et al. [16] found EIB prevalence to be 35% in elite ice-skaters. Rundell et al. [26] determined 10% and more fall of FEV_1 in 9 of 18 [50%] cross-country skiers. Ogston and Butcher [19] established EIB with spirometry in 28 of 99 cross-country skiers after 15-minute cross-country skiing exercise. EIB was determined in 23% of the athletes taking part in the Winter Olympic Games 1998 [38]. The prevalence of EIB in our study (35%) is similar to that of cold weather sports. However, the fact that Helenius et al. [9] found that exercise in subzero temperature had almost no effect on pulmonary function of elite runners was not in agreement with our study.

In the studies on cold weather athletes, the exercise tests on which the diagnosis of EIB was based were performed in cold weather conditions [2, 16, 19, 21, 25, 26]. Helenius et al. [10] stated that exercise tests should be performed in cold weather in order to establish EIB in elite athletes. Leuppi et al. [15] found the prevalence of EIB to be 11.5% in ice hockey players and 4.2% in ground ball players and suggested that exercising in low temperatures was a risk factor for prevalence of EIB. In 18 of 23 athletes who were diagnosed as EIB in cold weather field exercise tests, Rundell et al. [22] found post-exercise spirometry results of the laboratory exercise tests performed in room temperature as normal, and reported that a laboratory exercise challenge at room temperature is not appropriate for assessment of EIB in elite cold weather athletes, and it will likely result in false-negative evaluations. The duration of field exercises varied between 80 seconds to 1 hour in Rundell et al.'s study [22] and the duration of laboratory exercises was limited to 8 minutes, so we suggest that the results of EIB can be affected by the duration difference along with cold weather. The exercise test should be performed under laboratory conditions in diagnosing EIB since the temperature and humidity can not be controlled in the field exercise and everyone cannot be perform field exercises [33]. In this study, the exercise tests were performed in a cold climate and during winter months but at room temperature. Contrary to the suggestion, we think that when the long distance runners exercising regularly in cold weather are exposed to an exercise test in room temperature, the prevalence of EIB is not different from that in cold weather.

The prevalence of EIB is lower in warm weather sports [33]. Hammerman et al. [8] have determined EIB in 49 of 755 athletes who had no previous history of asthma or EIB. Schoene et al. [29] have established EIB in 10% of the male elite track and field athletes, Thole et al. [35] found EIB prevalence to be 14% of the cross-country runners trained in Los Angeles, California which is not as cold as Erzurum. The studies mentioned above had not been applied to the cold weather athletes and the fact that the prevalence of EIB in our study was higher than that of these studies can be attributed to athletes trained in cold weather in Erzurum in our study.

The greatest fall in the post-exercise pulmonary volume is observed in the least conditioned athletes [30]. The prevalence of EIB is higher in the asthmatic patients [3] and patients who have atopy [3, 10] and allergic rhinitis [28]. In this study, although the risk factors mentioned above did not exist in the history of the participants and their physical conditions were good, the effect of cold weather was of great importance in the higher prevalence of EIB.

We suggest that prevalence of EIB will be higher even if it is established in room temperature when training for sports like long distance running, which is not a cold-weather sport, is performed in cold weather. We are of the opinion that it will be more convenient to establish EIB in room temperature and in the laboratory since the exercise test and spirometry can be performed more accurately under more standard conditions.

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