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Letter to the Editor

THE PREVALANCE OF EXERCISE INDUCED BRONCHOCONSTRICTION IN ELITE ATHLETES

Dear Editor-in-Chief

For years exercise induced bronchoconstriction (EIB) has been considered as a form of asthma which can be provoked by exercise and air pollution. However, further studies indicated that EIB was not only restricted to asthmatic patients, but could also be seen in healthy individuals. EIB was described as an acute and reversible bronchoconstriction induced 5 to 15 minutes after exercise in certain susceptible individuals (Rundell and Jenkinson, 2002). According to Storms (1999) and Wilber et al. (2000) there are 2 potential mechanisms for EIB: The first one is the hyperosmolarity hypothesis which proposes that prolonged breathing of cold and dry air causes decreased heat and humidity, increased osmolarity, and induced release of constrictor mediators in the bronchial epithelium. The second hypothesis is the thermal expenditure one which suggests that the breathing of cold and dry air results in decreased heat in the bronchial vessels during exercise, and subsequent reactive hyperemia in the airways provokes bronchospasm. Whatever the reason, EIB results in coughing, wheezing, chest pain and dyspnoea following the exercise.

The incidence of EIB is more than twice as high among athletes (11-50%) compared to the normal population (4-20%) (Anderson and Daviskas, 1997). Furthermore, its prevalence is twice as high among winter sports' athletes compared to summer sports' athletes (Rundell and Jenkinson, 2002). The purpose of this cross-sectional study is to evaluate the prevalence of EIB among elite athletes.

The study population consists of 126 male elite athletes (85 soccer players, 25 karateist, 11 swimmers, and 5 wrestlers) (height 177 ± 9 cm, weight 73 ± 10 kg, age 23 ± 5 years).

Before exercise testing and warm-up, the athletes were informed in detail about the tests. Respiratory function test was carried out on a Spirobank Spirometer (Mir, Roma, Italy). All the tests were performed under the following ambient conditions: humidity 40% to 45%, temperature 20^0C to 25^0C, atmospheric pressure 750 to 760 mmHg. The athletes performed the test three times and the best result was taken into consideration.

After performing the respiratory function tests, athletes exercised on a treadmill (Quinton 65) according to the Bruce protocol (Quinton-5000). The speed and the grade of the treadmill increased every 3 minutes according to the protocol until the exhaustion. Electrocardiography (ECG) and blood pressure were continuously monitored, as oxygen uptake was being measured with the "breath by breath" system (Sensor-Medics 2900C, USA) during the test.

The preferred method of diagnosing EIB is by observing changes in airways following the exercise testing. As EIB becomes evident 5 to 15 minutes after exercise, respiratory function tests are applied 5, 10 and 15 minutes after maximal tests. The most valued parameters in the diagnosis of EIB are >10% decrease in forced expiratory volume 1 second (FEV1), >15% decrease in forced expiratory flow from 25% to 75% (FEF25-75%) and peak expiratory flow (PEF) (Rundell and Jenkinson, 2002). Therefore, the respiratory functional test parameters of forced vital capacity (FVC), FEV1, the ratio FEV1/FVC, FEF 25-75%, PEF, inspiratory capacity (IC), and maximal voluntary ventilation (MVV) were determined at 5th, 10th and 15th minutes following the tests. Maximal exercise duration and peak oxygen uptake (VO_{2peak}) were also recorded.

Repeated measures were tested with the ANOVA test, while statistical differences between the groups were analyzed using the independent samples t-test. $P < 0.05$ was accepted as significant.

In the present study, it was observed that 11% (n=14), 14% (n=18), and 11% (n=14) of the athletes had >10% decrease in FEV1, >15% decrease in FEF25-75%, and >15% decrease in PEF respectively (Figure 1). There was no significant difference for FVC, FEV1/FVC, MVV, and IC among athletes with or without EIB. Additionally, there was no significant difference between athletes with or without EIB regarding height, weight and age.

Voy (1984) conducted the first research on the prevalence of EIB among the 1984 US Summer Olympics Team members. Based on the question-naire used for his study, he reported that the rate of

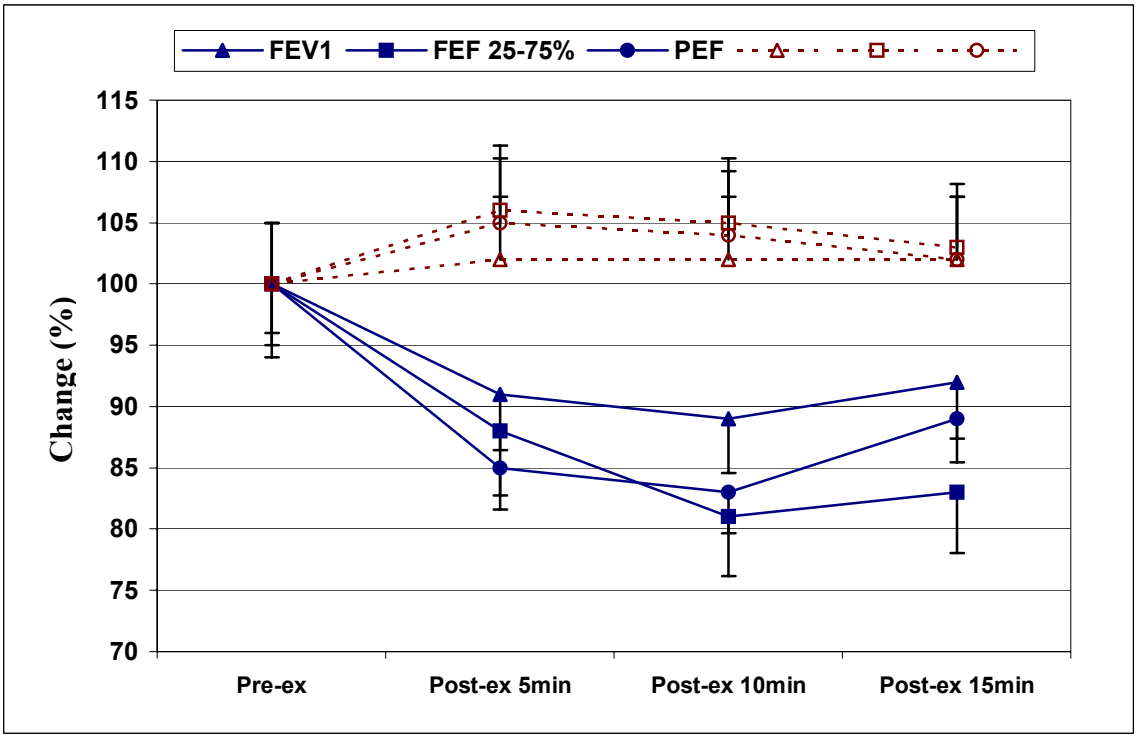

Figure 1: Respiratory function test results of EIB + (n=18) and EIB – (n=108) athletes. Filled and empty symbols indicate EIB+ and EIB- athletes', whereas triangle, square and circle specify FEV1, FEF25-75% and PEF values, respectively.
$P < 0.05$ between EIB+ and EIB- groups for FEF25-75% at post-ex 5min, 10min and 15min.
$P < 0.05$ compared to pre-exercise value for FEV1, FEF25-75% and PEF in EIB+ group at post-ex 5min, 10min and 15min.

EIB or asthma was 11%. Other researchers, who also used the same questionnaire, stated that the prevalence of EIB is 4-11% in the general population, 17% in endurance runners and 17% in the 1996 US Summer Olympics team (Weiler and Ryan, 1998, Rundell and Jenkinson, 2002).

The EIB depends on the rigor and duration of exercise, the humidity and temperature of the testing environment. To provoke EIB; the duration of exercise should be at least 6 to 8 minutes, exercise intensity should aim to rise heart rate over 85% of the maximal heart rate (MHR) in sedentary individuals and 95%-100% of the MHR in athletes (Anderson and Daviskas, 1997). The test duration and load used in the present study were chosen according to the above criteria (Table 1). In addition, the test duration and load were similar for athletes with and without EIB. The VO_{2peak} value was also close between the groups (Table 1).

The prevalence of EIB (11-14%) for the elite athletes participated in this study is similar to the results of previous studies. Nysland et al. (2000), who used the same method to diagnose EIB, reported a rate of 10% in a group of 1620 elite Norwegian athletes. Helenius et al. (2000) reported that the prevalence of EIB is 17%in endurance runners and 8% in sprinters. Rundell and Jenkinson (2002) reported that the prevalence of EIB is 23% among the athletes of the 1998 Winter Olympics.

Table 1. Maximal exercise test results of elite athletes. Data are means (SD).

	EIB+ (n=18)	**EIB- (n=108)**
VO_{2peak} ($ml \cdot kg^{-1} \cdot min^{-1}$)	62.9 (7.2)	65.1 (10.3)
Test duration (min)	14.12 (2.4)	14.67 (2.8)
Test load (% MHR)	97.5	97.6

Abbreviations: EIB = Exercise induced broncho-constriction, MHR= Maximal heart rate
No significant differences between the groups.

Although, EIB is reversible at the early stages, it progresses to become irreversible by time. This may be due to a remodeling of the surface epithelium of the small airways. Therefore, winter sports athletes show 78% higher rate of EIB compared to summer sports athletes, although the levels of exercise and endurance are similar, and they are tested in corresponding surroundings (as in humidity 50%, temperature 21°C), and under the same work load (Rundell and Jenkinson, 2002).

The main limitation of studies in this area seems to be the method to provoke EIB. In a study by Rundell and Jenkinson (2002), only 5 in 23 athletes presented EIB in laboratory conditions despite of the fact that 18 of the same 23 athletes had shown EIB in tests applied in the training ground. Therefore, as the present study was performed in laboratory conditions that some athletes with EIB have been missed.

Thus, it is concluded that 11% to 14% of the elite athletes have EIB when they are tested in laboratory conditions. However, there is no statistical difference in athletic performance (exercise duration and VO_{2peak}) between the groups. Nevertheless, further studies are needed to test athletes in the field and to examine whether the mechanisms may differ between atopic and non-atopic individuals and how airway remodeling affects EIB.

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