ASTHMA AND ATOPY IN TUNISIAN ATHLETES

ABSTRACT

The purpose of this study was to evaluate the risk of developing exercise induced asthma in atopic Tunisian athletes. The study population was composed by 326 athletes (age: 20.8±2.7 yrs –mean ± SD; 138women and 188 men) take out which 107 were elite athletes. The subjects underwent a skin prick test to check for atopy, completed an 8-min running test, and a lung function measure. Forced expiratory volume in one second (FEV1) was determined before and at the end of the exercise consisting of running 8-min at 80-85% HRmaxTheo. EIA was defined as a decrease of at least 15% in pre-exercise FEV1 at any time point after exercise. Results: Atopy was found in 26.9% (88/326) of the athletes. Post exercise spirometry revealed the presence of EIA in 9.8% (32/326) of the athletes among these we found that 14 (13 %) elite athletes suffered EIA; this study showed that 62.5% (20/32) among the all athletes were atopic. Conclusion: This study showed that atopic Tunisian athletes presented a higher risk of developing exercise induced asthma than non-atopic athletes. We suggest that early Atopy-diagnosis and appropriate treatments could help the athletes to reduce the risk of exercise induced asthma, and improve their performances.

Key-Words: Athletes – Atopy - Exercise induced asthma- FEV1- skin prick test.
INTRODUCTION

Many athletes have breathing difficulties during or after athletic events and practice. More recently, several reports clearly delineated a significantly high prevalence of asthma symptoms in athletes.[1-3] The condition is characterized by respiratory symptoms such as wheezing, dyspnoea; chest tightness, and cough.[1] In athletes, many triggers have been reported to induce the development of Exercise induced asthma (EIA), notably the exposure to cold and dry air; humidity [4], thermic phenomena [5], and atopic status also appear to be determinant. The reasons for this observation are still debated, but different mechanisms linked to the intensity of physical activity and atopies in athletes are probably involved.[6,7] Helenius et al. [7] indicated that the more severe the atopic disposition, the greater the risk for increased asthma. Atopy is that from of immunological reactivity of subject in which reaginic antibody is readily produced in response to ordinary exposure to common allergens of the subject’s environment [8]. The atopic reactivity can be verified by serologic tests and or by skin-prick tests to detect antigen-specific IgE antibodies.[9]

Only a few studies have used objective methods to detect atopic allergy in athletes. In the study by Zwick et al.[10] 9 of 14 swimmers had at least one positive reaction to a skin-prick test. Of 42 cross-country skiers studied by Larsson et al., [11], 29% were atopic according to result of skin-prick testing. Helnius et al found 48%of the athletes and 36% of the control studied subjects were atopic according to result of skin-prick testing. In North Africa, there are marked variations in the prevalence of asthma symptoms in the general population with up to 3-fold differences between the two periods pre- and post- 1990; with the increase of asthma prevalence being particularly marked during the last 10 years.[12] Tunisia a North-African country, is characterized by westernisation of lifestyle and epidemiological transition with recession of communicable diseases and emergence of non-communicable diseases; we speculate that the western lifestyle and pollution were factors associated with increased risk of
atopy.[12] However, the prevalence of EIA associated with increased risk of atopy is not known among the Tunisian athletes. Moreover, many athletes are reluctant to report asthma symptoms to a coach fearing that they will no longer be allowed to play or that they may be eliminated from the team or not be selected for events due to their EIA. In that context, when discussing asthma with athletes, it is important for them to be reassured that with accurate diagnosis and proper management, they can still participate, even at the highest levels of competition.

The aim of this study was (1) to estimate the prevalence of EIA among Tunisian athletes and evaluate the risk of developing an EIA in those presenting an atopy, and (2) describe a procedure for the diagnosis and management of EIA in athletes.

METHODS

This study was conducted from November to mid-December 2003. During the testing days, the mean temperature and relative humidity were 10±4 °C (Range 6 – 14 °C) and 45.6±12% (Range 38 – 55 %), respectively. Prior to exercising, a familiarisation session was conducted to collect demographic information and introduce subjects to the study and its field investigators. This session included a skin-prick test, a review of the study protocol, and a pre-test of spirometry.

Subjects

Three hundred and twenty six athletes (188 males and 138 females) of which 107 elite athletes training regularly (mean weekly training duration: 18.3 ± 1.9 h/wk, range 16 – 21 h/wk), and 219 athletes regularly involved in regional championships (mean weekly training duration: 10 ± 1.7 h/wk, range 8 – 12 h/wk) participated in the study.

The athletes were divided into three groups according to their type of sport: 1) speed and power sport athletes (n = 114), Endurance athletes (n = 54), and team sport athletes (n = 158).
The main events of speed and power athletes were weightlifting ($n = 13$), sprinting (100 to 400 meters, hurdles; $n = 31$), jumping ($n = 15$), taekwondo = 27), (judo = 18), and gymnastics ($n = 10$). The Endurance athletes were the long-distance runners competition event from 800 meters to marathon ($n = 54$). The team sport athletes were handball ($n = 28$), basketball ($n = 25$), soccer ($n = 44$), rugby ($n = 33$), and volleyball ($n = 28$).

Each participant underwent a skin-prick test and a resting spirometry testing before and after exercise. The study was approved by the University Ethics Committee, and all participants volunteered to participate and were fully informed about the nature of the testing as well as the associated risks, and signed written consent forms before the experiments.

**Procedures**

1. Skin-Prick Test

Skin-Prick Test were performed with seven common air borne allergens and positive (histamine dihydrochloride, 10 mg/ml) and negative (solvent) control solutions from ALK (Soluprick SQ, 10 histamine equivalent pricks (HEP); Allergologisk Laboratorium, Horsholm, Denmark). The allergens were as follows: birch, timothy, meadow fescue, and mugwort pollen and cow dander; the mite Dermatophagoides pteronyssinus; and mould spores of Cladosporium herbarum. We considered an allergen-specific skin test response positive if the skin test panel was valid and the difference between the mean of the wheal’s length and width for the allergen-specific test and the negative control was at least 3 mm. A skin test panel was considered valid if the difference between the mean wheal diameters of the positive and negative controls was at least 1 mm.

2. Expiratory volume in one second (FEV1) measurements

FEV1 is the volume of air that can be forced out in one second after taking a deep breath; this value considered as an important measure of pulmonary function which can indicate airway obstruction. FEV1 test was carried out on a portable spirometer (Auto Spiro Pal; Minato
Medical Science, Co., LTD, Japan). This spirometer is equipped with a flow hot-wire anemometer sensor, and the range of flow linearity is 0.01-16.00 L/sec with an accuracy of ± 3% between 0.01 and 12.00 L/sec. The spirometer was calibrated before all testing occasions with a 2 liter syringe. The athletes performed the baseline test three times and the best result was taken into consideration. The subject was seated comfortably, she/he was instructed to take a full breath in, then to close the lips around the mouth tube and blow out as hard and fast as possible. Inspiration had to be full and unhurried, and tested expiration had to be continuous without pause. The technique was demonstrated to each subject and the result was expressed in litres per second. FEV1 was measured at rest (pre-exercise) and at 0, 5, 10, 15, 20, and 30 min after completion of exercise.

In all EIA tests recognised by the IOC-MC (International Olympic Committee—Medical Commission), FEV1 is the parameter by which changes in maximal expiratory function are assessed. Dickinson et al. [13] suggested that a more global measure of maximal expiratory airflow, i.e. FEV1, provides the most sensitive and specific diagnosis of EIA, especially when the severity of the disease is thought to be mild. To measure EIA, the maximal change in FEV1 was calculated as 100% (post-exercise FEV1 - pre-exercise FEV1)/pre-exercise FEV1).

As a measure of exercise induced asthma we used the maximal value of the percentage change in FEV1 (positive or negative). The subjects were diagnosed with asthma if any of the post-exercise FEV1 value was at least 15% lower as compared with the pre-exercise FEV1 measurement. This level of 15% was chosen as to the recommendations of the American Thoracic Society suggesting that this level is optimal for outdoor conditions.[14]

3. Exercise

The athlete ran for 8 minutes at 80-85% of the estimated maximum heart rate (HRmaxTheo).[15] The exercise was performed without any prior warm-up and subjects ran in groups of 4 subjects along an outdoor track. During the run, subjects were equipped with
portable heart rate monitors (Polar S610, Oy, Kempele, Finland) set to record HR at 5 s intervals. Before exercise, each subject was informed about the range of HR at which she/he had to run as to his HRmaxTheo that was calculated according to Crapo et al.[14]:

HRmaxTheo = (220-age) bpm. Target HR zones were pre-set on the programmable HR monitors so that the athletes were guided by audio alarms to keep their HRs between 80-85% of estimated HRmax. From the beginning of the run, subjects attained the target zone in 45-60 sec and remained in it for the remaining of the 8 minutes run.

Statistical Analysis

Student’s t-test for independent samples was used to determine the differences between the averages of the two groups’ variables (demographic variables and FEV1). The Chi-square test was used to assess the association between atopic and non atopic athletes (percentage). Significance was set at an alpha level of 0.05, and all statistical analyses were conducted using the statistical package for the Social Sciences (SPSS, Version 13.0, SPSS Inc, Chicago, IL).

The positive predictive value (Tool of medical-statistical calculations allowing the evaluation of the value Diagnostic).[16]

RESULTS

All of the 326 studied athletes (mean age 20.8 ± 2.7yr; range 17- 24 years) completed the Skin-Prick Test, the Spirometric, and the Running tests. Anthropometric and lung function data recorded at rest are presented in (Table 1). Exercise Induced Asthma was observed in 9.8% (32 out of 326) of athletes of which 13% (14 of 107) of elite athletes. When individual data for each subject were pooled and analyzed by parametric statistical analysis (Student’s t-test), no significant intergroup differences were observed in demographic variables or in pre-exercise FEV1 (Table2).
Atopy according to skin-prick test results was found in 26.9% (88 out of 326) of all athletes, of these, 20 subjects presented EIA. Chi–square indicated that the frequency of atopy in athletes with EIA was higher in athletes without EIA [62.5 % (20/32) vs 23.1 % (68/294)]. Table 3 indicates the occurrence of atopy in athletes and presents the positive predictive value.

**DISCUSSION**

This study showed that atopic Tunisian athletes presented a higher risk of developing exercise induced asthma than non-atopic athletes. Post-exercise spirometry revealed the presence of EIA in 9.8% (32/326) of the Tunisian athletes, this prevalence of EIA is greater than that of the general population.[12] In North Africa, different studies aimed to determine the prevalence of asthma but marked differences are found among studies probably due to differences in methodology. The prevalence ranged from 2.4 to 3.4% in studies before 1990 and from 6 to 12% in the later studies.[12] In the most recent study with "International Study of Asthma and Allergies in Childhood" (ISAAC) methodology conducted in Tunis region in children aged 13 to 14 years-old, the prevalence was found to be 5.4.[12] Prevalence of asthma has ranged from 4% to 59% in various athlete studies. The observed large variation is mainly due to different types of training and training environments. Also differences in the definition and diagnosis of asthma may have had some impact on the variation of these results. An especially high prevalence of asthma has been found among those athletes competing in endurance events, such as cycling, swimming, cross-country skiing, and long-distance running.[2-4,6,7] In elite athletes we found that 13 % (14/107) suffered EIA. Many studies have shown that the risk of developing EIA is increased in elite athletic population.[2-4,17,18] The initial report concerning the incidence of EIA in the elite athletes included somewhat surprising finding
that 11% of the US 1984 Summer Olympic Team experienced EIA.[17] In the 2000 summer Olympic Games in Sydney, 607 athletes (5.5% of the total) used inhaled B2-adrenoceptor agonists (B2-agonists) for the treatment of active asthma.[18] There was a significant increase with respect to the preceding 1996 summer Olympic Games in Atlanta, when only 383 athletes (3.6% of total) provided notification of use of B2-agonists.[18] Recently, Alaranta et al. [2] reported that physician-diagnosed asthma and use of asthma medication were more common among Olympic level athletes than in Finnish general population of the same age. Endurance athletes such as cross-country skiers, long-distance runners and swimmers had asthma more often than athletes in other events.

The diagnosis is usually fairly straightforward, and all athletes should be followed to make sure that the correct diagnosis is made. Appropriate procedures for accurate and reliable diagnoses have been debated. Current thinking suggests that diagnosis should be based on an objective measurement of variable or partially reversible airflow obstruction, using an appropriate challenge with pre-and post-spirometry. The use of spirometry to identify EIA typically involves baseline spirometry, an EIA-provoking challenge and a series of spirometric measurements following the challenge. Individuals are evaluated by comparing post-challenge result to the pre-challenge results and calculating a percentage change from baseline.

Helenius et al. [7] indicated that atopy is a major risk factor for EIA. In the present study, the diagnosis of atopy is based on the positive response to skin tests to which all of the subjects were submitted. A more objective evaluation of the blood tests for the specific circulating IgE would probably allow detecting more atopic subjects, however the skin-prick test is much more easy to administer “on the field” in large populations. In total, 326 athletes underwent skin tests; atopy was identified in 26.9 % (88/326). This prevalence of atopy among Tunisian athlete did not greatly differ from the general population.[19] In the literature this prevalence
of skin-prick test positive-response in different populations vary from 4 to 64%.[20] For some authors, the atopy in athletes may be partly related to extreme or particular environmental conditions in which the physical exercise is performed that may favour its expression in the predisposed subjects.[21,22] Environmental factors involving the type and content of the inhaled air could play an important role. Even if most sports are practised in various air conditions all year long, many sports are predominantly practised either in cold, dry or humid air.[23] For athletes who train outdoors, the quality of the inhaled air varies and the presence of different pollutants may contribute to the development of EIA.[23] For the athletes who practice their sport in indoor areas, the exposure to such contaminants and a variety of organic volatile compounds could contribute to certain respiratory problems.[24] Zwick and al. [10] indicated that swimming at high levels of performance constitutes the best example for that chronic exposure to products and chloride derivates used for the disinfection of the swimming pools that may stimulate allergic mechanisms and facilitate the sensitisation for different allergens.

The present study has shown that twenty of the Tunisian athletes with EIA examined presented clinical signs of atopy (20/32: 62.5%). Hence this prevalence is significantly greater than that of the athletes without EIA (62.5 % vs. 23.1 %) (p <.001). The Positive predictive value is estimated at 22.73%. This value shows the high probability of the individual with positive-Atopic test, to suffer from EIA. In a recent study, Helenius et al.[7] demonstrated that there exists a narrow correlation between the onset of an EIA and the number of positive responses to the skin allergic test in athletes: for one to two positive allergic responses, the risk of an EIA is multiplied by 3.25 whereas for five positive reactions or more, this risk is multiplied by 4.69. The severity of the EIA may moreover be correlated to the atopy score defined by the addition of the average diameters of the papules for all of the evaluated allergens.[11, 25] In this regard Kaelin and brandli [26] administered a
questionnaire on allergy and respiratory symptoms related to exercise to 1530 Swiss athletes at national and international levels. This study showed a significant correlation between atopy and respiratory symptoms. Helenius et al. [25] in another study including 58 runners belonging to the national Finnish team demonstrated that the occurrence of an EIA is well correlated with the seasonal variability. Whereas for certain athletes, the EIA happens only in winter, for others it happens only in pollinic periods. These variations of the bronchial responses may be explained by a shift of the pulmonary inflammatory state in pollinic period. In this context, it was noted an increase of the number of eosinophils and eosinophil cationic protein (ECP) in the bronchiolo-alveolar lavage fluid in high pollinisation period in pollen allergic asthmatics.[27] The ideal solution is to perform systematic screening of the atopy thanks to a questionnaire associated to skin-prick test, at the moment of recruitment of all of the athletes, notably those who should be trained massively in order to improve their performances. The best treatment and preventive measures of asthma aims at achieving optimal control of the disease through athlete education, and environment control. The education of athletes, their families and their coaches is an important component of the non-pharmacological management of EIA. To demystify this disease, athletes need to be informed that their condition is common among those in high-level competition and will not limit their performance if it is treated adequately. Environmental control is important too, whenever possible. This applies to the home environment of athletes, where avoidance of exposure to relevant allergens and to irritants should be suggested. It also applies to the training environment; for example, better ventilation systems in arenas and indoor pools could possibly help reducing the adverse effects of the numerous contaminants in suspension in ambient air. Among the non-pharmacological approaches to EIA, a warm-up period prior to training or sports events can be effective in decreasing the degree of bronchoconstriction through
induction of a refractory period, during which airways become less responsive to exercise.[23]
A 10- to 15-minute warm-up at 60%VO2max can then significantly reduce post-exercise asthma in athletes.[28]

CONCLUSION
This study suggests that an atopic field constitutes certainly a major risk factor for the development of an EIA. Predictive found value of the atopy shows the high probability of the in Tunisian athletes with positive-Atopic test; to suffer from EIA. The increasing prevalence of respiratory asthma-like symptoms in athlete is opening new paths for research into airway physiology in extreme conditions. We suggest that early diagnosis and appropriate treatments could help the athletes to reduce the risk of exercise induced asthma, and improve their performances.

REFERENCES


FIGURE LEGENDS

Figure 1: Spirometric results (mean) for the EIA(+) group (athletes who developed exercise induced asthma, n=32) and EIA(-) group (athletes with no observed EIA, n=294). No significant inter-group differences in criterion variables were observed during pre-exercise measurements. Intergroup comparisons of all data points indicated that EIA(+) had significantly lower FEV1 than EIA(-) group. *: p<0.05; **: p<0.001.
Table 1: Characteristics of the study population

Table 2: Mean ± SD anthropometric and spirometric variables of the studied group
Legend: EIA (+) having shown EIA (Exercise Induced Asthma); EIA (-) did not show EIA

Table 3: Occurrence of atopy in athletes with and without EIA
Legend: Positive predictive value “if I know that the individual has a positive test, which is the probability that the individual suffers from EIA”
Additional files provided with this submission:

Additional file 1: tab1.doc, 27K
http://www.biomedcentral.com/imedia/2090363192011966/supp1.doc
Additional file 2: tab2.doc, 27K
http://www.biomedcentral.com/imedia/6399777892011966/supp2.doc
Additional file 3: tab3.doc, 27K
http://www.biomedcentral.com/imedia/1152239207201196/supp3.doc