

Original article

THE EFFECT OF CHRONIC EXERCISE ON LUNG FUNCTION AND BASAL METABOLIC RATE IN SOME NIGERIAN ATHLETES

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The present study was carried out to investigate and establish any relationship between chronic exercise and lung function as well as basal oxygen consumption rate in a Nigerian setting. This was done by determining some lung volumes and capacities (tidal volume, TV, forced vital capacity, FVC, and forced expiratory volume in the first second FEV₁%) and basal metabolic rate (BMR) in athletes and non-athletes. A total of 45 students from the University of Lagos were studied. 20 were athletes who had exercised daily in the past 2-3 years, and the remaining 25 were non-exercising non-athletes who served as controls. The subjects were divided into male and female groups. Results from the study showed that TV and FVC, but not FEV were significantly higher in male athletes than in male non-athletes. TV, FVC and FEV were not significantly different in the two female groups. BMR was not found to be significantly different in athletes and their non-exercising counterparts in both sexes. These results suggest that the respiratory functional capacity of athletes in Nigeria could be generally superior to that of non-athletes as a result of increased development of respiratory musculature incidental to the physical training whose intensity is a strong determining factor. The enhanced respiratory functional capacity however does not lead to an enhancement of their basal metabolic functions.

Key words: exercise, lung function, BMR, athletes, students

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INTRODUCTION

Pulmonary ventilation is generally known to have a linear relationship with oxygen consumption at different levels of exercise. Oxygen consumption is also known to increase the resting state and intense exercise. Lung function parameters tend to have a relationship with lifestyle such as regular exercise and non-exercise (Wasserman et al, 1995; Twisk et al, 1998). Due to regular exercise, athletes tend to have an increase in pulmonary capacity when compared to non-exercising individuals, especially when the exercise is strenuous. This Ventilatory adaptation to exercise may differ in different populations such as in Black and Caucasian subjects (Cerny, 1987) particularly under different climatic conditions i.e. it may be related to ethnic and environmental factors.

Lung function tests provide qualitative and quantitative evaluation of pulmonary function and are therefore of definitive value in the diagnosis and therapy of patients with cardiopulmonary disorders as well as those with obstructive and restrictive lung disease (Belman & Mittman, 1980; Robinson & Kjeldgaard, 1982).

The parameters used to describe lung function are the lung volumes and lung capacities. While the various lung volumes reflect the individual's ability to increase the depth of breathing the capacities is simply a combination of two or more lung volumes. All energy metabolisms in the body ultimately depends on the utilization of oxygen, and oxygen consumption measured under fairly

stringent conditions is generally used to determine the basal metabolic rate (BMR) of an individual. Since it is possible for lung function to affect the BMR of an individual through its effect on oxygen consumption, and with exercise being a significant determining factor, the present study was designed to investigate this possibility in local athletes who have regularly exercised for two to three years (chronic exercise), thus establishing possible ventilatory adaptation to exercise as well as a relationship to BMR in a local Nigerian setting.

METHODOLOGY

Lung function and Basal Metabolic Rate (BMR) were measured in athletes and non-athletes of both sexes. The parameters used as the determinants of lung function were tidal volume (TV), forced vital capacity (FVC) and percentage forced expiratory volume in the first second (FEV₁%)

A total of 45 subjects, all students of the University of Lagos, participated in the study. They were aged 21-25 years. There were two groups of experimental subjects, male athletes and female athletes (since lung function parameters are usually slightly lower in females than in males), and two control groups of male and female non-exercising, non-athlete subjects. The athletes were made up of exercising trained footballers, basketball and volleyball players.

Lung volumes and capacities were measured according to established methods with the use of spirometers. Subjects were made to breathe into the spirometers containing room air during which period tracings of the individuals respiration were recorded.

Basal metabolic Rate (B M R) of the same subjects were measured using the indirect connection method by measuring oxygen consumption rate under established basal condition of complete rest and fasting. Measurements were taken between 9.00 a.m. and 12 noon each day.

Data obtained were reduced to single observations of mean and standard error of mean values, while the students t-test was used to identify the significance of difference between the mean values.

RESULTS

Results from the present study showed significant difference in the lung function parameters of male athlete subjects and those of male non-athletes.

Mean tidal volume (TV) for male athlete (0.81 ± 0.04 litres) was significantly higher than that of male non-athletes (0.55 ± 0.02 litres) but the difference between mean TV values of female athletes and non-athletes was not significant (fig. 1a).

As shown in fig.1b FVC of male athletes (4.69 ± 0.04 litres) was significantly higher than that of male non-athletes (4.04 ± 0.04 litres). Again, there was no significant difference between mean FVC values of female athletes and non-athletes. (fig 1b). No significant difference was observed in the mean FEV values of both male and female athletes and non-athletes (Fig. 1c)

BMR measurements showed no significant difference between athletes and non-athletes of both sexes (fig. 1 d)

DISCUSSION

Results obtained from the present study showed male athlete having a significantly higher tidal volume (TV) and forced vital capacity (FVC) than male non -athletes, while in females there was no difference. These findings, although in contrast to those of Hagberg (1988), are similar to those of some other previous workers (Cordain, 1990). Hagberg reported that values for static lung volumes (TV and FVC) of accomplished marathoners and and other endurance trained athletes were no different from those of untrained controls of comparable body size. However, Cordain (1990) reported larger larger than normal static lung volumes in swimmers and divers when compared to normal no-athletes.

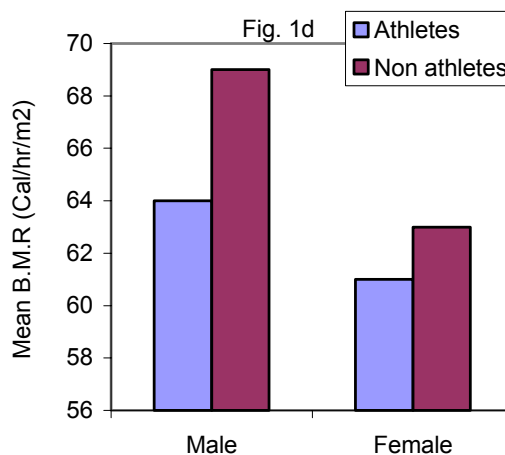
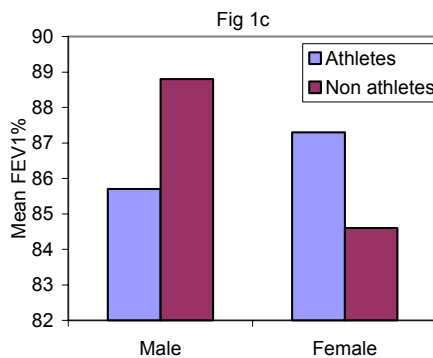
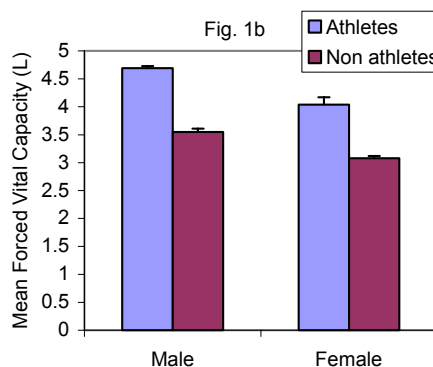
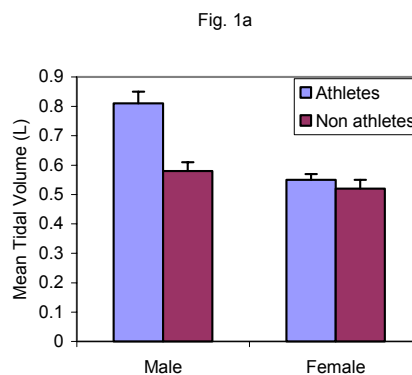


Fig. 1 Tidal Volume (a), Forced Vital Capacity (b), Percentage Forced Expiratory Volume (c) and Basal Metabolic Rate (d) in athletes and non athletes.

This was attributed to the strengthening of the inspiratory muscles as they work against additional resistance caused by the weight of water that compresses the thoracic cage. Reports from other workers (Onadoko et al, 1976; Bjorstrom, 1987) also indicate a significantly higher vital capacity in athletes when compared with non-athletes.

The conflicting findings may be due to genetic and ethnic factors as suggested by LaKhera and Klain (1995) who compared pulmonary function amongst athletes in different Indian populations. The lung function parameters were found to vary in the different settings with results suggesting that the size of the lung is governed by genetic, environmental and nutritional factors.

Results from the present study strongly suggest that the intensity or severity of the sports engaged in by the athletes probably determines the extent of strengthening of the respiratory muscles with a resultant increase in the lung volumes. This view is supported by the fact that all the studies reported no significant difference in the lung volumes of female athletes when compared to female non-athletes. Female sports and exercises are known to be generally less strenuous than those engaged in by males.

Measurements of FEV₁% (a dynamic lung volume that indicates any impairment of airway resistance) in the present study showed no significant difference in both male and female athletes and non-athletes. This finding suggests that the exercises undertaken by the subjects may have straightened the respiratory muscles but have not affected the airway. It may however be speculated that exercise may reduce any predisposition or the severity of obstructive and restrictive lung disease, since exercise is known to increase ventilatory capacity. A previous study on Nigerian sportsmen (Odunuga et al, 1957) reported that among male athletes only the male shot-putters had a significantly higher vital capacity than male non-athletes.

Basal Metabolic Rate (BMR) measurements in the present study showed similar values for both athletes and non-athletes of both sexes, an indication that oxygen consumption is about the same in both groups of subjects. This may be explained by the findings of some previous workers (Melby et al, 1993; Williams, 1994) who studied oxygen consumption with physical training and reported that although training does increase the maximum oxygen uptake, the improvement is not proportional to the quality and duration of training as the elevated energy expenditure may

only last for a few hours after which it declines. The present findings imply that exercise may increase maximum oxygen consumption, but has no effect on oxygen uptake measured under basal conditions and used for basal autonomic body functions. Again the quality and duration of training might be influential to the obtained results.

Results of the present study therefore suggest that chronic exercise may cause an increase in the respiratory function which could be due to increased development of respiratory musculature incidental to physical training, but this, is not accompanied by an increase the basal metabolic rate.

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