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ORIGINAL ARTICLE

Respiratory parameters in elite athletes – does sport have an influence?

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Abstract
Introduction: Unlike large population studies about cardiovascular components and how they adapt to intensive physical activity, there is less research into the causes of enlargement of the respiratory system in athletes (e.g. vital capacity, maximum flow rates and pulmonary diffusion capacity). The purpose of this research was to study and compare pulmonary function in different types of sports and compare them with controls in order to find out which sports improve lung function the most.
Materials and method: Pulmonary functional capacities, vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and maximum voluntary ventilation (MVV) of 493 top athletes belonging to 15 different sports disciplines and of 16 sedentary individuals were studied. Pulmonary function test was performed according to ATS/ERS guidelines.
Results: Basketball, water polo players and rowers had statistically higher vital capacity (VC), forced vital capacity (FVC), forced expiratory volume in one second (FEV1) than the healthy sedentary control individuals. Football and volleyball players had lower VC while FVC was higher in the football group compared to controls. Peak expiratory flow was lower in boxing, kayak, rugby, handball, taekwondo and tennis. The maximum voluntary ventilation (MVV) was significantly higher in water polo players and rowers. Boxers had statistically lower MVV than the controls. Players of other sports did not differ from the control group.

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Conclusion: The study suggests that specific type of training used in basketball, water polo or rowing could have potential for improving pulmonary function and rehabilitation.

Introduction

Lung function tests provide qualitative and quantitative evaluation of pulmonary function and are of the highest importance in estimating the fitness of an individual from a physiological point of view.[1] Spirometry is a physiological test that measures how an individual inhales or exhales volumes of air as a function of time. It is the most commonly used pulmonary function test in the objective assessment of respiratory system function.[2] Lung volume is fairly well predicted on the basis of age, height and weight, but lung volumes which are larger than predicted have been repeatedly observed in athletes compared to their control counterparts who are not engaged in any kind of regular physical exercise.[3,4] There are some physiological explanations as to why athletes have higher lung volumes, but still, this is an uncharted field.[5] Studies about athletes' respiratory functions are rather limited or have been tested on too small number of participants, mostly related to individual sports.[6,7] There is also a lack of up-to-date interventional studies in the field.

The aim of this study, therefore, was to examine the pulmonary functional capacities of the different groups of top athletes, discover in which sports the respiratory parameters are the best and to compare them with sedentary controls.

Materials and methods

Participants

Four hundred and ninety three asymptomatic Caucasian international level competitors (18–34 years of age; mean age 21 ± 4) who attended a regular check-up programme over a four-year period were included in the study. The study involved athletes who had actively played competitive sports for at least five years and trained at least 15 h a week. Spirometric data for each participant were consecutively collected for that period of time. Participants were not considered eligible for the study if they had a training break of more than 6 months during their athletic career.

The study included the following sports: athletics (n = 12), cycling (n = 39), boxing (n = 19), football (n = 19), kayak (n = 34), kickboxing (n = 10), basketball (n = 67), volleyball (n = 70), rugby (n = 43), handball (n = 102), wrestling (n = 10), taekwondo (n = 10), tennis (n = 13), water polo (n = 14) and rowing (n = 15).

The admission criteria for the 16 sedentary controls were they were not connected with any particular sport and did not have a regular exercise programme. All participants were non-smokers, and none had a history of recurrent respiratory illness, such as asthma or a chronic cough.

Ethical approvement

The study was approved by Ethics Committee of the School of Medicine University of Belgrade.

Design

Before being tested, examinees were asked to have a light dinner before 8 PM and light breakfast before 8 AM. No intake of stimulants such as alcohol or caffeine or any other drug was allowed in the 12 h before testing. Information on participant age, date of birth, and the number of years of training was obtained verbally. Participants were informed of research requirements prior to attendance and signed consent forms on arrival for testing. It was made clear that they could discontinue the testing at any time.

The testing took place in laboratory settings, at the same time of day (morning 09–11 AM), using the same instruments and techniques. Measurements were carried out under standard environmental conditions; comfort temperature (between 18 and 22 °C), atmospheric pressure of 760 mmHg, and relative atmospheric humidity of 30–60%. The temperature, humidity and atmospheric pressure were continuously measured at the lab.

Spirometry was performed using the (Turninac, Pneumotah) Pony FX (Cosmed Pulmonary Function Equipment; Italy). Pulmonary function test followed the ATS/ERS guidelines.[8] Spirometry was performed in a sitting position in arm chairs at the place of training before any warm-up, wearing light clothing and a nose clip. Pulmonary function tests were performed three times for each participant and the best technique was accepted. The highest level for forced vital capacity (FVC) and forced expiratory volume in one second (FEV1), were taken independently from the three curves.

Body mass (kg; Seca 761 scales, ±0.5 kg; Seca Co., Germany) and stature (m; Cranlea JP60 portable stadiometer, +0.001 m; Cranlea & Co) were also measured using standardised anthropometric techniques. Body mass index (BMI) was calculated for all the participants as the ratio of body mass (kilograms) divided by body height (metres) squared. The participants percentage of body fat (BF%) was measured using the bioimpedance segmental body composition analyzer (BC-418 Segmental Body Composition Analyzer, Tanita, Illinois, USA).

Statistics

Continuous data are expressed as mean ± SD. Categorical data are expressed as frequencies. Statistical significance was set for a 2-tailed p value < 0.05. The mean values of anthropometric characteristics and of pulmonary functional capacities of different groups of athletes have been