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Estimation of evaluation some spirometric's parameters of football players during preparation period

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Summary

Introduction

Spirometric parameters are influenced by, among other things level of fitness.

Aim

The aim of the study was to evaluate the formation of selected spirometric parameters of the football players in the preparatory period.

Material and methods

The selected spirometry parameters FVC, FVC%, FEV1, FEV1%, FEV1 / VC were evaluated in 20 players 17-18 years old. The results were related to the value of the reference population studies. The evaluation was performed at the beginning and at the end of preparatory period.

Results and Conclusions

Preparation players in the preparatory period does not increase significantly the level of respondents respiratory parameters FVC, FVC%, FEV1, FEV1%. The three-month training of football players during the preparation period does not significantly increase the level of respiratory parameters tested.

Key words: adaptation, spirometry, training, football players

Introduction

The parameters often used to assess the physiological abilities of the respiratory system are: FVC (forced vital capacity), FEV1 (forced expiratory volume in one second), FEV1 / VC (forced expiratory volume in one second of the equivalent vital capacity) [1, 2, 3].

The basis for a good form of sports players is the formation of aerobic capacity. A number of tests confirm that increasing the level of maximum oxygen uptake (VO_{2max}), improves the sports performance of the game. The player lengthens the distance run during the match, the intensity of the globally performed work increases, the number of sprints increases and the number of actions with the ball increases [4].

The preparatory period in the structure of training in football is based mainly on increasing the aerobic capacity of players, it is mainly aerobic endurance training [5]. As a result of such training there are many adaptive changes that mainly concern the body functions related to oxygen consumption, thermoregulation, water and electrolyte balance and numerous mechanisms of neurohumoral regulation, which causes the autonomic system to shift towards the parasympathetic part. Among other things, the effect of these adaptive changes is to increase VO_{2max} [6]. In non-trained people undertaking oxygen training for three months, with a frequency of three times a week after one hour, an increase in VO_{2max} by approximately 21% can be obtained [7]. As a result of increasing the ability of oxygen transformation in some people adapted to endurance exercise, the vital capacity, maximal ventilation and diffusion capacity are increased [6]. There is probably a strong relationship between VO_{2max} and FVC [8]. It has been reported that FVC is a limiting factor

in aerobic capacity [9]. Trained people usually have greater mobility of the chest and strength of the respiratory muscles than people who have not been trained. As a result of this, increased life capacity of the lungs is observed in trained patients. This parameter also depends on the height and weight [10]. Not all authors confirm differences in FVC between trained and unreserved or changes in this indicator during training [11]. Research indicates that players who are training for a few or more years have above-average values of spirometric parameters in relation to the normalized values evaluated in the average non-training population [12]. It seems interesting are post-training changes in FVC, FEV1 important for increasing the efficiency of aerobic equipment during physical efforts to such an extent that it is possible to determine the change in these parameters after the three-month preparatory period for players.

Aim

The aim of work was to assess the formation of selected spirometric parameters in footballers during the preparatory period.

Material and Methods

FVC, FVC%, FEV1, FEV1%, FEV1 / VC were evaluated in 20 players of the youth team, juniors of the Municipal Sports Club, Border of Bogatynia. The subjects declared that they are non-smokers. The age range of the respondents was 17-18 years. Written informed consent was obtained screening from was completed and signed by the participants prior to the commencement of the study. Ethics approval for this research was obtained from the Karkonosze College in Jelenia Góra. In the study group, training sessions were held four times a week for two hours. Players have been practicing football for a minimum of five years. The research took place in the studio of the Karkonosze State Higher School in Jelenia Góra. The Spirometer BTL - 08 Spiro Pro was used to assess the spirometric parameters. This device is equipped with sensors for measuring ambient temperature, atmospheric pressure and relative humidity. The device itself corrects the parameters for the BTPS conditions (pressure, temperature, water saturation). The apparatus meets the requirements of ATS / ERS (American Thoracic Society / European Respiratory Society) 2005 and contains the European standard for spirometers EN 13826.

The device has a built-in table of reference values for a given population, taking into account: age, sex, body weight, body height, smoking or no cigarettes. The test was based on a table of reference values recommended for the European race ECCS (European Community for Coal and Steel) for steel ERS 1993. Each competitor performed three measurements during the tests of the same spirometric parameters according to the methodology of spirometry standardization [1]. The best of the three tests performed was selected for the analysis. The tests were carried out at the beginning and after the preparatory period, which mainly influenced the aerobic performance of the players. The preparatory period began from 4.01.2017 to 4.04.2017. During the tests, the height and weight of the athletes were measured. A medical weight WPT 150 OW with a built-in telescopic altimeter was used to measure weight and height.

The research was subjected to statistical analysis. After the basic statistics were calculated, the compatibility of the distribution of features in the studied groups with the model normal distribution was evaluated. The assessment was made taking into account skewness and kurtosis values, features and histograms and results of the Kolmogorov-Smirnov test. As a result of the analysis, it was found that the distributions of features in the studied groups do not differ significantly from the model normal distribution, and therefore the Student's T-test for independent variables was used to assess the significance of differences between average values of features in the studied groups. In the subjects at the beginning and end of the preparatory period, mean body mass and height values were compared and BMI was determined.

Ressults

Lung volumes measured in dynamic conditions reflect the condition of the airways and the explosive force of the expiratory muscles.

Tab. 1 Basic characteristics statistics in the studied groups. grA1 - tests carried out at the beginning of the preparatory period, group A2 - tests carried out at the end of the preparatory period. FVC - lung vital capacity in liters, FEV1 - one-second intensive lung capacity in liters, FVC% - percentage value of vital capacity of lungs with reference values for untraining healthy people, FEV1% - percentage of one-second increase in lung capacity in reference to reference values for the

population of untraining healthy people, FEV1 / VC - ratio of the percentage of forced expiratory volume in 1 second to the vital capacity

	N	Average	Min.	Max.	Wariancja	Standard Deviations	Slant	Kurtosis
grA1measurement **FVC**	20	5,34	3,97	6,28	0,42	0,65	-0,71	-0,23
grA1measurement **FEV1**	20	4,67	3,49	5,27	0,21	0,46	-1,21	1,25
grA1measurement **FVC%**	20	114,45	94,27	137,12	128,82	11,35	0,34	-0,26
grA1measurement **FEV1%**	20	117,53	96,76	158,86	250,34	15,82	0,66	0,84
grA1measurement **FEV1/VC**	20	87,40	71,95	100,00	56,28	7,50	-0,18	-0,20
grA2measurement **FVC**	20	5,28	4,19	6,23	0,30	0,55	-0,49	-0,08
grA2measurement **FEV1**	20	4,58	3,65	5,14	0,19	0,44	-0,76	-0,31
grA2measurement **FVC%**	20	107,60	95,75	127,87	82,24	9,07	0,86	-0,05
grA2measurement **FEV1%**	20	109,62	87,84	137,83	182,48	13,51	0,33	-0,76
grA2measurement **FEV1/VC**	20	86,78	78,00	97,50	46,89	6,85	0,34	-1,17

Tab. 2 The results of the Student's T-test (t) for the studied groups. grA1 - tests carried out at the beginning of the preparatory period, group A2 - tests carried out at the end of the preparatory period. FVC - lung vital capacity in liters, FEV1 - one-second intensive lung capacity in liters, FVC% - percentage value of vital capacity of lungs with reference values for non-healthy people, FEV1% - percentage of one-second increase in lung capacity in reference to reference values for the population of untraining healthy people, FEV1 / VC - ratio of the percentage of forced expiratory volume in 1 second to the vital capacity

	Average A1	Average A2	t	df	p
grA1 FVC vs. grA2 FVC	5,34	5,28	0,29	38	0,775
grA1 FEV1 vs. grA2 FEV1	4,67	4,58	0,60	38	0,553
grA1 FVC% vs. grA2 FVC%	114,45	107,60	2,11	38	0,041
grA1 FEV1% vs. grA2 FEV1%	117,53	109,62	1,70	38	0,097
grA1 FEV1/VC vs. grA2 FEV1/VC	87,40	86,78	0,27	38	0,786

The comparison of average values showed a slight decrease trend in the average values of the analyzed parameters during the preparatory period. Because there were no statistically significant differences, it can be assumed that the three-month preparatory period did not affect the size of the parameters examined. However, only for one characteristic (FVC%), the change in the parameter turned out to be statistically significant (for $p = 0.042$). The value indicates a decrease of this parameter by 7.91% on average. This is a slight change. Because there are no significant differences in the evaluation of the FVC parameter, and the results obtained in competitors before and after the preparation period exceed the average population norm, it can be assumed that adaptive changes under the influence of football training favorably improve respiratory efficiency, and the preparatory period itself is too short to capture important adaptive changes. [Tab.2]

Tab.3 Body Mass Index values BMI = m.c. [kg] / h [m] 2, h- body height, m.c.-body weight. I measurement - pre-preparatory examination, II measurement - examination after the preparatory period

	Average I measurement	Average II measurement
BMI	21,8 (± 2,1)	21,6 (± 2,2)
h [cm]	173,9 (± 9,1)	174 (± 9)
m.c. [kg]	66,4 (± 9,7)	65,5 (±7,2)

The average BMI value in the studied population decreased after the preparatory period by 0.2, body weight by 0.9 kg. However, the mean body height value increased by 0.1 cm [Tab.3]. Because the changes of the above parameters during the three-month research program in the subjects were so insignificant, they were not subjected to statistical analysis with regard to spirometric parameters.

Discussion

Referring to the calculations, the obtained results of spirometric parameters measured before and after the preparatory period did not show any significant differences, which probably indicates too short a time span of the training to register significant changes. Tests conducted on players up to 17 years of professional training show the obtained FVC value in the range of 3.5-6 liters. This value varies among others depending on the level of training. The more-trained FVC tends to get a higher value. This is closely related to the more efficient delivery of oxygen to working muscles [8]. The preparation period is closely related to football with the development of aerobic capacity [10]. There is a very strong relationship between VO_{2max} and FVC as well as FEV1. FEV1 is associated with an increase in the explosive strength of the respiratory muscles [8]. It is stated that one of the limiting parameters of VO_{2max} is FVC [9]. The research carried out by footballers indicates their high level of spirometric parameters. Tests conducted on professional football players training eight years old at 18.1 (± 0.8) indicate a mean FVC of 5.14 liters (± 0.88) with an FEV1 / VC value of 88.5 (± 3 2) [4]. In this study, the players in the comparable age group obtained values measured at the end of the preparatory period at 5.3 (± 0.55) and FEV1 / VC at 86.8 (± 6.8). Authors of many studies emphasize that professional footballers have above average results of spirometric parameters in relation to values normalized for the average non-training male population. In the group of seventeen-year-old professional footballers in Scotland, the measured FEV1% parameter was on the level of 113.61 (± 7.9) [12]. In the conducted studies at the end of the preparatory period in this work, the subjects obtained an FEV1% also above the reference values, at the level of 109.6 (± 13.5). These values are higher than for Scottish swimmers (83.9%) in the same age range [13]. The tested footballers have higher values of spirometric parameters in relation to the competition of sailors [14]. Nineteen-year professional cyclists and triathletes achieve

somewhat higher average FVC values (117%) compared to professional players in the same age group (105%). However, in the same group of subjects, the players have higher mean FEV1 (116%) than in cyclists and triathletes (112%) [15]. The players have adaptive changes related to the basic feature of aerobic fitness, but also emphasizes the annual training cycle on speed and high speed endurance. The average work intensity during a ninety-minute match is close to the lactate threshold. However, during the match there are many situations where there are efforts in anaerobic zones. The Triathlonists and cyclists in the study group were mainly focused on aerobic endurance. This is probably why there are the above differences in the presented spirometric parameters, where FVC is closely related to aerobic capacity, and FEV1 also with the component of anaerobic efforts [9]. FVC depends on the constitutional structure, on the weight and height of the body [10]. Increases to approximately twenty-five years of age. In the study population of the players in this study, the three-month period did not cause significant changes in body height and weight, which probably did not have a significant impact on the development of the spirometric parameters being studied. However, the impact of training on the respiratory system is extremely important. Physical effort forces the development of the chest, respiratory system in young players, which makes the chest has a larger capacity, and the breathing muscles are strengthened. There is more economic breathing, both at rest and during physical exercise. It improves the strength of the respiratory muscles, increases the function of lung ventilation, bronchodilation, and bronchioles. As a result, roads connected with oxygen flow and transport are more active. The enlargement of the bronchi and bronchioles following training is the result of the probably reduced impact of the parasympathetic part of the autonomic system [12]. Therefore, among other things, it is important in the process of adaptation of the respiratory system, what kind and what intensity of training was carried out. The selected FEV1% parameter was compared in the professional groups of Scottish players in the age ranges of 15, 17 and 19 years. The mean values of the measured parameter in all three groups were higher than the average FEV1% compared to professional nineteen-year-old players from Hong Kong [16] . It can be assumed that this difference resulted from the level of training. It is not disputed that the size and function of the respiratory system increases with height and weight. Comparing the average values of selected spirometric parameters: FVC% and FEV1% in the group of

professional players aged 15, 17, 19, a systematic trend of increasing these parameters is observed. Between the group of fifteen and nineteen-year-olds, a statistically significant difference is emerging between these parameters, while observing the BMI, the significant difference only occurs between the group of fifteen- and seventeen-year-olds [12]. This is probably related to the high dynamics of aerobic capacity development between the fifteenth and nineteenth years of age in boys, as well as the dynamics of weight gain and body height is greater between 15 and 17 years in boys than after 17 years of age [12].

Conclusions

1. The training conducted during the preparatory period does not significantly change the level of respiratory parameters tested (FVC, FEV1, FEV1 / VC). It is probably too short period.

2. For footballers who have been training football for a minimum of 5 years, the values of the FVC, FEV1 parameters tested above the reference values for a non-training healthy population are observed. It can be assumed that adaptive training changes affect the improvement of these indicators

3. In the subjects, no airflow obstruction was noticed, which indicates that there is no tendency for footballers to have obstructive pulmonary disease (all tested values of FEV1 / VC were above 70%)

Bibliography

1. Miller M.R., Hankinson J., Brusasco V. et al Standarisation of spiroometry. Eur. Respir. J. 2005; 26(2): 319-38.

2. Pellegrino R., Viegi GV., Brusasco RO. et al Interpretative strategies for lung function tests. Eur. Respir. J. 2005; 26: 948-958.

3. Wang X., Dockery D., Wypij D. Pulmonary function between 6 and 18 years of age. Pediatr. Pulmonol. 1993; 15: 75-88.

4. Helgerud J., Engen C.L., Wisloff U. et al Aerobic endurance training improves soccer performance. Med. Sci. Sports Exerc. 2001; 33(11): 1925–1931.

5. Michalczyk M., Kłapcińska B., Poprzęcki S. et al Aerobic capacity and sprint velocity of Leagues I and IV fotball players. Biomedical Human Kinetics 2010; 2: 9-14

6. Górski J. Fizjologia wysiłku i treningu fizycznego. Warszawa: PZWL; 2012.

7. Fortuna M. Podstawy kształtowania I kontroli zdolności wysiłkowej tlenowej i beztlenowej. Jelenia Góra: Kolegium Karkonoskie w Jeleniej Górze; 2008.

8. Collins K..J., Roberts D.F. Capacity for work in the Tropics. UK: Cambridge University Press; 2009

9. Narvani A., Thomas P., Lynn B . Key Clinical Topics in Sports and Exercise Medicine. UK: J.P. Medical Ltd; 2014.

10. Zerf M., Houar A., Mime M. et al (2016) Height versus weight which cassel parameter determine pulmonary functions fitness among the Algerians soccer players. Journal of Pulmonary & Respiratory Medicine 2016; 6(3): 353-356

11. Kozłowski S., Nazar K. Wprowadzenie do fizjologii klinicznej. Warszawa: PZWL; 1999

12. Erceg M., Jelaska I., Maleś B. Ventilation characteristics of young soccer players. Homo Sporticus Scientific Journal of Sport and Physical Education 2011; 13(2): 5-9.

13. McKay E.E., Braund R.W., Chalmers R.J. et al Physical work capacity and lung function in competitive swimmers. British Journal of Sports Medicine 1983; 17:.27-33.

14. Uljević O., Erceg M., Tocilj Z. Diferenes in ventilation parameters of soccer players and dinghy sailors. Procedings of the 3rd International Conference Contemporary Kinesiology, Mostar, Boris Maleś (editor in chief), Faculty of Kinesiology – University of Split, Faculty of Natural Science, Mathematics and Education – University of Mostar,

Faculty of Sport – University of Ljublijana 2008; 214-217.
15. Kippelen P., Caillaud C., Robert E. et al Effect of endurance training on lung function a year study. British Journal of Sports Mrdicine 2005; 39: 617-21.
16. Chin M.K., Lo Y.S.A., Li C.T. et al Physio – logical profiles of Hong Kong elite soccer players. British Journal of Sports Medicine 1992*;* 26(4): 262-266.