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Estimating the level of aerobic capacity at the players during the preparatory period

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Summary

Introduction: Aerobic fitness is changing under the influence of, among others, the level of training.

Purpose of the work: The purpose of this study was to assess the level of development of the aerobic capacity of soccer players during the preparatory period.

Material and method: Twenty-four players were tested at the beginning and at the end of the preparatory period. Group of respondents was in the age range 17 - 18 years. Trainings were held three - four times a week and a half - two hours. In the subjects, VO_{2max} was assessed using the Astrand test.

Results: Average VO_{2max} at the beginning of the preparatory period was (49.11 ± 7.18) compared with the average value at the end (52.67 ± 6.58). A trend of increasing the oxygen ceiling after the preparatory period has been observed. Comparison of VO_{2max} measured at

the beginning of the preparatory period and at the end of the preparatory period did not show statistically significant differences (p = 0.077)

Conclusions: For players who have been training for five years or more, we have observed high and very high values of the VO_{2max} parameter. The preparatory period in the test run indicates a trend of increase of the VO_{2max}, however difference in the value they are not statistically significant. It can be supposed that the level of training effect on the rate of growth VO_{2max} assessed after the application of a three-month training oxygen. With the increase in the level of training the dynamics of increase of the VO_{2max} is getting slower.

Keywords: aerobic capacity, footballers, training

One of the criteria for assessing the efficiency of the organism is $VO_{2max.}$ It is expressed in milliliters of oxygen per kilogram of body weight per minute [$ml \cdot kg^{-1}min^{-1}$]. Specifies the aerobic capacity of the body [1]. The most important factor determining VO_{2max} is the ability to transport oxygen to the muscles and the possibility of its use. This is depend of the state of the cardiovascular system, the respiratory system, the blood and the same muscles. In the process of training VO_{2max} gives important information about the body's ability to the aerobic efforts. VO_{2max} is largely genetically conditioned. With the skill performance aerobic endurance exhibited a higher maximal oxygen uptake. This means that the body is able to absorb more oxygen and thus produce at its participation more energy to working muscles [2].

Value $VO_{2\ max}$ increases with age in the human developmental period. In the 20-24 age range, it is likely to be at the highest level [3]. The level of this parameter is closely related to the skill performance, which can significantly change the value of maximal oxygen consumption [1].

Indirect method carried out in a systematic and comparable conditions can give results if tested by means peeled training stimulate the body in the correct direction [4].
It is known that football relies mainly on the oxygen system in the energy supply process, which accounts for around 90%. The basis for a good preparation of the player in football is well-formed aerobic capacity. Almost all players during the match work at the level of 70-75% VO_{2max}, close to the lactate threshold [5]. During the ninety-minute game, players

of the leading teams can run about 10 - 12 kilometers, with an average intensity around the threshold of anaerobic transitions, at 80-90% HR_{max} [6]. The distance covered depends on the position of the player, the tactics adopted and is highly correlated with VO_{2max} [7]. The high level of aerobic endurance allows to:

Developing high dynamics of the game. Quick returns after losing the ball in offensive actions. More frequent participation in "sprint actions". High tolerance and resistance to increasing fatigue. Frequent overcoming of the fatigue barrier during the championship match. A longer game in psychomotor comfort. Fast regeneration of the body during and after the game.

The low level of aerobic endurance is:

Little dynamics in the game. Large downtime in the game. Big difficulties in extracting technical and tactical skills of players. The effectiveness of the game is low. Frequent feeling of heaviness in legs. Low fatigue tolerance. Limited possibilities in overcoming the barrier of fatigue during the match effort. Large disturbances in psychomotor comfort in the game. Difficulty concentrating and mobilizing attention.

Aerobic endurance is the foundation for a high and stable sports form during the start-up period [7, 8, 9, 10, 11]. It is known that in the trained people, the maximal oxygen consumption is at a higher level than their peers leading an inactive lifestyle. One measure of aerobic capacity, and thus the assessment of the good training of the player is to assess VO_{2max} [12]. There are confirmed by testing the relationship between aerobic endurance, and a place in the ranking of competitive sports is what football team. Therefore, a training program in football generally includes aerobic training [8]. Interesting seems to be an attempt to assess the trend of changes in the level of aerobic capacity depending on the period of training the game of football.

The aim of the study was to assess the level of development of the aerobic capacity of soccer players during the preparatory period.

Material and methods

Twenty-four footballers of the junior youth team of the Municipal Sports Club – Granica Bogatynia between the ages of 17 and 18 years old volunteered to participate in the study. Written informed consent was obtained screening form 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. The study was conducted at the beginning and at the end of the preparatory period. All persons declared as non-smokers. The subjects trained football from a minimum of five years, they did not take other training parallel to football training. Prior to training football teams, they have carried out systematic training of a sports or recreation. The workouts were based on assumptions of annual training. The preparatory period began 04.01.2017, ended 04.04.2017. It was divided into two sub-periods: overall efficiency sub-period (01.04.2017 – 02.10.2017) and specific fitness sub-period (02.13.2017 - 04.03.2017). In the first sub-period training sessions were held three times a week for 1.5 hours. The premise of this sub-period was to prepare a comprehensive competitors, increase endurance and overall strength. The ratio of general development schedule targeted for specific and amounted to 75% to 25%. At that time there was not control games. In the general preparation sub-period in microcycles, the training unit on Monday included general development training, technical and tactical dedicated to game schene and tactic. It was based on two sets of the game, where players undertake tasks that performed later in the championship match. Training on Wednesday was devoted to shaping the speed and strength. He relied on interval training and circuit. Training on Friday was endurance training – tactical – based on: walking or running, jogging, running with exercises, running games. Special efficiency sub-period included special training three times a week for two hours. In addition, on Saturday the players participated in the tournament a hall. In this sub-period classes were held almost exclusively with balls. It was characterized by a higher stress level than in the preceding sub-period. The premise of the training sub-period performance special was the formation of motor skills, techniques, tactics for the game. The research took place in the studio Karkonoska State School in Jelenia Góra. Each subject performed aerobic Astrand's test. Åstrand’s test consisted of several minutes of operation on a stationary bike Monark 828E individually selected load in order to achieve dynamic equilibrium between the pulse of 130-150 beats per minute [13]. A Polar RS800 heart rate monitor was used to display subject heart rates during test. The VO_{2max} was calculated and interpreted using the program 818 Analysis Software Version 2.0 Copyright 1999 HUR Labs after obtaining the steady – state value. Resultse assignments were analyzed statistically. Basic statistics for

all parameters tested were calculated. Following the calculation of basic statistics compliance rated distribution characteristics in the two groups with normal distribution model. The assessment was made taking into account the value of skewness and kurtosis features and histograms and results of Kolmogorov-Smirnov test.

As a result of analysis, the distribution of the characteristics in the two groups did not differ significantly from the normal distribution model, therefore, to assess the significance of differences between mean values of the properties in the studied groups were student T-test for independent variables.

Results and discussion

Tab. 1 Statistics basic characteristics of VO_{2max} [$ml \cdot kg^{-1}min^{-1}$] in groups. grA1 measurement made at the beginning of the preparatory period, grA2 measurement made at the end of the preparatory period.

	N	Average	Min.	Max.	Variance	Std.	slant	kurtosis
grA1	24	49.11	41,35	73,68	51,50	7,18	1,76	4,84
grA2	24	52,67	41,07	70,58	43,35	6,58	0,66	1,09

Tab. 2 The results of the Student's T-test for the studied groups. grA1 measurement made at the beginning of the preparatory period, grA2 measurement made at the end of the preparatory period.

	Average	Std.	N	t	df	p
grA1	49,11	7,18				
grA2	52,67	6,58	24	-1,85	23	0,077

The Student's t test showed that the arithmetic means of the examined feature (VO_{2max}) are not significantly different ($p = 0.077$). There is a visible trend of increasing the oxygen level after the end of the preparatory period, however this change does not show significant differences of the VO_{2max} parameter before and after the preparatory period (Tab.2).

Discussion

The mean arithmetic features of the VO_{2max} obtained in this work in comparison of the studied groups of competitors before and at the end of the preparatory period are not significantly different from each other. Based on many studies, it is known that regardless of age, sex, race, you can always take training to improve your aerobic capacity and slow down the aging process. Oxygen training is a factor that raises efficiency. The subjects reported relatively high values of the maximal oxygen consumption. There are reports of authors that a three-month oxygen training conducted three times a week, one hour per day can lead to an increase in the level of oxygen up to 21% in people who have not previously trained. There are also reports that improving physical performance can result in systematic training at a frequency of twice a week. However, the largest progression of VO_{2max} is observed in the initial period of training, in subsequent stages these changes are less and less visible [1]. It is probably one of the factors that influenced the lack of registered differences between the studied groups. However, based on the studies of many authors, one can notice a change in the VO_{2max} parameter measured at different stages of the annual training. The biggest differences are observed between the beginning and the end of the preparatory period for the players of the leading teams. For footballers training 5 years and more football, high and very high values of this parameter are observed as a result of long-term adaptive changes. However, in this group of surveyed players training competitively, the period of three months is probably too short to observe significant changes in VO_{2max}. Differences in this parameter were observed between the beginning and the end of the preparatory period in the work of many authors investigating the players of the leading teams. The results of the VO_{2max} research carried out by the authors on the 26-27 year I league players presented before the preparatory period showed an average value of 53.9 (± 4.1), and after the preparatory period 54.8 (± 4.2). However, in the fourth league players, in the same age range, VO_{2max} was obtained before the preparatory period 52.3 (± 4.2) after its completion 53.2 (± 5.1). The compared results of the tested parameter before and after the preparatory period in the first and the fourth league of players did not show statistically significant differences [12]. In other studies, the authors presented a comparison of the results of players aged 14 - 15 years, before the preparatory period of 51, 47 (± 3.9) and at the end of the preparatory period 58.7 (± 4.4). In comparison of these values, a significant

statistical difference was noted. After the preparatory period, aerobic capacity significantly increased [14]. It is extremely important to properly train players with the right choice of training methods. These methods should take into account the rate of biological development of young footballers. Especially important are periods that favor the development of individual physical performance traits. The training process should be precisely monitored in order to ensure optimization of fitness and physical efficiency, and the results of tests should be used to improve, inter alia, aerobic efficiency and ultimately effectiveness of the game [15]. It is assumed that the amount and quality of training load used in young footballers has a direct impact on the development of their football skills, physical efficiency, including aerobic fitness. It is also assumed that a longer training period affects the increase in the value of VO_{2max} [7, 16]. A relatively high level of training is associated with a smaller progression of adaptive changes observed in a short period of time, which is the preparatory period. Despite the lack of significant differences in VO_{2max} measured in these studies, a trend of increasing this parameter was observed (mean VO_{2max} at the beginning of the preparatory period 49.11 ± 7.2 and at the end of this period 52.67 ± 6.6). The average values of VO_{2max} obtained by many authors in the conducted research (15-16 years) of the leading team of the United States amount to 54.5 - 56.2 [$ml \cdot kg^{-1}min^{-1}$] [16]. VO_{2max} on footballers (17 years) of Italy's leading team 53.3 [$ml \cdot kg^{-1}min^{-1}$] [17]. Other authors indicate that for highly trained young players aged 14-17, VO_{2max} ranges from 57.7 (± 6.8) to 62 (± 2) [18]. Similar results of the tested VO_{2max} parameter in the group of seventeen-year-old players, 62 (± 2) are confirmed by other studies [19]. Usually, the elite players of the VO_{2max} teams are between 55-65 [ml · kg-1min-1], stressing that this discipline requires that the players prepare well in order to shape a high level of aerobic efficiency [20]. The value of VO_{2max} 65 [$ml \cdot kg^{-1}min^{-1}$] is the minimum expected in the highest level of football matches [21]. It can be assumed that the tested players in this work have obtained relatively high values compared to the players of the leading teams. The observed trend of increasing the value of the VO_{2max} confirms the effectiveness of the conducted training during the preparatory period, and the lack of significant differences in the assessed parameter may be associated with a high level of training in the direction of aerobic fitness in footballers. The use of the Astrand test to assess aerobic fitness in athletes is also controversial. It is more accurate to perform spirometry tests directly. It is reported

that using the Astrand test to assess VO_{2max} in healthy individuals in fitness compared to the obtained results of direct gasometric evaluation, a deviation in relation to precise results, between 6.7-14.4% is obtained [22]. Åstrand test is one of the most commonly used tests to determine indirectly VO_{2max} in fitness. Also it is used to develop a training plan and its evaluation. The protocol uses a recording pulse, which is easy to measure, test, however, is limited margin of error obtained maximal oxygen consumption [23]. Some authors report that the read error VO_{2max} test Åstrand compared gasometry direct assessment conducted on the ergometer in the test averaged 8.5%. Organization of the American College of Sports Medicine has defined guidelines, submaximal testing that is safe in healthy subjects and in the presence of a doctor during the trial is not required. The use of direct measurement of expired gases is limited for a number of sports clubs in the form of availability and cost of equipment. Therefore an indirect method, Åstrand test is widely used to assess the aerobic efficiency [24]. Indirect assessment of VO_{2max} is a commonly used among children and youth, amateur football. The person tested in this method is subjected to smaller loads, which increases its safety. The use of submaximal aerobic test among children and youth football players is justified. It is important to observe the rules of proper testing. Conducting the same study protocol on the same hardware.

Conclusions

1. For players who are training for 5 years and longer football, high and very high values of the VO_{2max} parameter are observed.
2. The preparatory period in subjects indicates the trend of increase of the VO_{2max}, however differently they are not statistically significant.
3. It can be assumed that the level of training affect the rate of growth of VO_{2max} assessed after the application of a three-month training oxygen. With the increase in the level of training the dynamics of increase in the ceiling of oxygen is getting slower.

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