ASSESSMENT LEVEL OF AEROBIC CAPACITY AT THE PLAYERS DEPENDING ON LENGTH OF TRAINING

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- aerobic fitness
- football players
- level of training

Abstract:

AIM: The aim of the study was to assess the aerobic capacity of players depending on length of training.

MATERIALS AND METHODS: 8 footballers training 3 years and 14 players training over 7 years were compared. The group of respondents was 17-18 years old. In both groups the trainings were held three - four times a week for one and a half - two hours. In the subjects, VO_{2max} was assessed using the Astrand test.

RESULTS AND CONCLUSIONS: The mean arithmetic features of VO_{2max} in the studied groups are not significantly different from each other. For players training for 3 years, the average value of VO_{2max} was obtained at the beginning of the preparatory period at 48.5 (± 5.5), at the end of this period 55.2 (± 57.9). For players training over 7 years, the average value of VO_{2max} was obtained at the beginning of the preparatory period at 48.2 (± 7.9), at the end of this period 52.5 (± 56.4). In both groups, the differences in VO_{2max} measured at the beginning and end of the preparatory period are statistically significant. Over a seven-year period, the training of football does not have to significantly change the level of aerobic fitness compared to the athletes training only three years of this sport. Aerobic performance in athletes who practice football for several years is of a high standard. Training conducted during the preparatory period significantly raises the level of aerobic performance regardless of the training experience of footballers.

INTRODUCTION

An important parameter to assess the aerobic capacity of the body is the maximum oxygen uptake (VO_{2max}). It is expressed in milliliters of oxygen per kilogram of body mass per minute [ml · kg-1min-1] [Fortuna 2008: 24] One of the important factors determining VO_{2max} is the ability to transport oxygen to muscles and the ability to use it. It is depends on the condition of the circulatory system, respiratory system, blood and the muscles. In the training process, this parameter gives important information about the body's ability to do aerobic effort. VO_{2max} is genetically conditioned to a large extent. Many authors report that VO_{2max} increases under the influence of systematic aerobic training [Birch, MacLaren et al. 2008: 155-158]. This means that the body is able to absorb more oxygen and thus produce more energy for muscle work with it. VO_{2max} increases with ontogenetic development of man. In the 20-24 age range, it is likely to be at the highest level [Kozłowski, Nazar 1999: 300]. The value of this parameter is closely related to changes in adaptation in the training process,

which can significantly change the value of the $VO_{2max.}$ [Fortuna 2008: 28-42] VO_{2max} assessment using the indirect method, performed systematically and under comparable conditions may indicate how the training affects the formation of aerobic fitness. [Manzi et al 2010] The basis for a good preparation of the player in football is well-formed aerobic capacity. Almost all players during the match work at 70-75% VO_{2max}, near the lactate threshold. [Arnason et al 2004] During the ninety-minute game, footballers of leading teams can run about 10 - 12 kilometers, with an average intensity around the threshold of anaerobic transformation, at 80-90% of HRmax. [Stolen et al 2005] The distance covered depends on the player's position, the adopted tactics and is highly correlated with the VO_{2max} [Helgerad et al 2001].

The high level of aerobic endurance allows to:

Developing a high speed of the game.

Uick returns afyer 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 give:

Little dynamics during the game.

Large downtime during the game.

Big difficulties in extracting technical and tactical skills of players.

The effectivness of the game is low.

Frequent feeling of heaviness in legs.

Low tolerance of fatigue.

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 [Helgerad et al 2001; Impelizzeri et al 2005; Impellizzeri et al 2008; Rampinini et al 2008; Strøyer et al 2006].

It is known that in trained people the oxygen level is at a higher level than that of their peers leading an inactive lifestyle. One of the measures of aerobic fitness, and thus the assessment of a good training of the competitor is the assessment of VO_{2max}. [Michalczyk et al. 2010]. There is a correlation between aerobic efficiency confirmed by the study and the place in the ranking of sports rivalry that the football team occupies. Therefore, the training program in football generally includes aerobic training [Impelizzeri et al 2005]. It seems interesting to try to assess the trend of changes in aerobic fitness level depending on the length of continued football training in the years.

The aim of the work was to compare the assessment of aerobic fitness in footballers depending on the training experience.

MATERIAL AND METHOD

The youth football team players of the Municipal Sports Club - Granica Bogatynia participated in the research. We compared 8 players training 3 years and 14 players training over 7 years. The research was carried out at the beginning and at the end of the preparatory period. The group of respondents was in the 17-18 age range. All people declared themselves as nonsmokers. The respondents did not undertake other trainings parallel to football training. Before to training in football teams, they did not carry out systematic sports or recreational training. In both groups, the trainings were based on the same assumptions of the annual training. The preparatory period began on January 4, 2017, ended on April 4, 2017. It was divided into two sub-periods: the sub-period of general fitness (4.01.2017 – 10.02.2017) and the sub-period of special efficiency (13.02.2017 – 3.04.2017). In the first sub-period, trainings were held three times a week for 1.5 hours. The assumption of this sub-period was to prepare versatile players, increase overall strength and strength. The ratio of general developmental and special-purpose classes was 75% to 25%. At that time there were no control games. In the general preparation subprogram in microcycles, the training unit on Monday included general development training, technical and tactical devoted to schemata and tactics of the game. It was based on the play of two teams, where the players undertook tasks that they later performed in the championship match. Training on Wednesday was devoted to shaping speed and strength. It was based on interval and peripheral training. Training on Friday was a endurance and tactical training based on: marches, jogging, running with exercises, running games. The special efficiency sub-period covered training three times a week for two hours. Additionally, on Saturdays, competitors participated in the indoor tournament. In this sub-period, the exercises were almost exclusively with balls. It was characterized by a higher level of burdens than in the previous sub-period. The assumption of training in the special efficiency sub-period was to develop motor skills, techniques and tactics for the game. The research took place in the lab of the Karkonosze State Higher School in Jelenia Góra. Astrand test was carried out in the test, which consisted of a few minute work on a Monark 828E stationary bike with an individually selected load to achieve dynamic balance in the heart rate range 130-150 beats per minute [Astrand, Rhyming 1954]. The heart rate was measured using the Polar RS800. After obtaining the steady-state value, VO_{2max} was calculated and interpreted using the program 818 Analysis Software Version 2.0 Copyright 1999 HUR Labs. During the tests, the height and weight of the players were measured and the BMI was calculated. For weight and body height measurements, a WPT 150 OW medical scale with a built-in telescopic altimeter was used. The research was subjected to statistical analysis. In order to compare the arithmetic averages of $VO_{2max,}$ at the beginning and at the end of the preparatory period, the analysis of the compatibility of the distribution of the feature with the model normal distribution was performed - the W Shapiro-Wilk test. The results of the test showed that the distributions of features are not consistent with the model normal distribution. Therefore, the comparison of averages was made using a nonparametric test for dependent variables - the Wilcoxon pairs order test. In order to compare the arithmetic means of the examined parameter between the studied groups at the beginning and at the end of the preparatory period, first the analysis of the compatibility of the distribution of the feature with the model normal distribution was performed - Shapiro-Wilk test. The results of the test showed that the distributions of features are not consistent with the model normal distribution. Therefore, the comparison of averages was made using a non-parametric test for independent variables - the Mann-Whitney U test.

RESULTS

Table 1 shows the average values of VO_{2max} in the group of players training three years and over seven years at the beginning and end of the preparatory period. Similar values of this parameter were observed in both groups (Table 1).

Table 1. Basic statistics VO_{2max} [ml · kg-1min-1] in the studied groups, GrA1 - players training 3 years measurement at the beginning of the preparatory period, GRB1 - players training over 7 years measurement at the beginning of the preparatory period, GrA2 - players training 3 years measurement on the end of the preparatory period, GRB2 - players training over 7 years measurement at the end of the preparatory period sd - standard deviation

	average	**median**	**variance**	**sd**	**slant**	**kurtosis**
GrA1	48,5	47,2	29,91	5,47	0,35	-1,25
GrB1	48,22	46,86	62,12	7,88	1,78	3,75
GrA2	55,23	54,83	62,23	7,89	0,82	1,46
GrB2	52,63	53,11	40,94	6,4	0,02	-0,02

Table 2. Wilcoxon pairs test results for the studied groups at the beginning and end of the preparatory period. Difference test mean VO_{2max} parameter [ml · kg-1min-1] GrA1 - players training 3 years measurement at the beginning of the preparatory period, GRB1 - players training over 7 years measurement at the beginning of the preparatory period, GrA2 - players training 3 years measurement at the end of the preparatory period , GRB2 - players training over 7 years of measurement at the end of the preparatory period, p level of statistical significance

	p
GrA1 & GrA2	0,05
GrB1 & GrB2	0.04

In both comparisons, the difference is statistically significant - which means that at the end of the preparatory period the mean of the VO_{2max} parameter is significantly higher (Table 2). Comparisons of arithmetic means of the tested VO_{2max} parameter between the tested groups of players training 3 years and more than 7 years, at the beginning and end of the preparatory period showed no significant differences (Table 3, Table 4)

Table 3 The difference in mean VO_{2max} parameter [ml · kg-1min-1] between players training 3 years and players training over 7 years at the beginning of the preparatory period.

	Sum.rang	**Sum.rang**	**U**	**Z**	**level p**	**Z**	**level p**	**N**	**N**	**2*1str.**
Zmn1	99	154	49	0,48	**0,63**	0,48	0,63	8	14	0,66

Table 4. Difference in mean VO_{2max} parameter [ml · kg-1min-1] between players training 3 years and players training over 7 years at the end of the preparatory period

	Sum.rang	**Sum.rang**	**U**	**Z**	**level p**	**Z**	**level p**	**N**	**N**	**2*1str.**
Zmn1	103	150	45	0,75	**0,45**	0,75	0,45	8	14	0,48

Table 5. Descriptive statistics of selected morphological parameters in the studied groups at the beginning (1) and at the end (2) preparatory period in groups: GrA - players training 3 years, GrB - players training over 7 years, h- body height [cm], m.c. - body weight [kg] - BMI - Body Mass Index = m.c. [kg] / h [m] 2, p - significance level, sd - standard deviation.

	average	**median**	**variance**	**sd**	**slant**	**kurtosis**
GrAh1	175,00	174,50	12,29	3,51	0,42	-0,45
GrAm.c.1	70,57	70,65	30,76	5,55	-0,09	-2,47
GrABMI1	23,05	22,55	3,12	1,77	1,12	0,41
GrBh1	174,07	174,00	38,23	6,18	1,11	2,54
GrBm.c.1	65,03	61,80	106,19	10,30	1,31	1,87
GrBBMI1	21,19	20,90	4,90	2,21	0,57	-0,59
GrAh2	176,87	175,00	18,70	4,32	1,3	0,43
GrAm.c.2	66,79	65,85	64,59	8,04	0,03	-1,53
GrABMI2	21,71	21,35	5,13	2,26	0,29	0,36
GrBh2	174,71	175,00	34,99	5,92	1,16	2,44
GrBm.c.2	65,71	65,40	96,64	9,83	1,18	1,59

GrBBMI2	21,41	21,10	3,94	1,98	0,58	-0,54

Average BMI values indicate a lack of underweight, overweight or obesity among competitors, and rated somatic parameters in individual compared groups do not show large discrepancies.

DISCUSSION

The mean arithmetic features of VO_{2max} in comparison of the studied groups of players training three years and over seven years, at the beginning and at the end of the preparatory period do not differ significantly from each other. A longer training period for players than 3 years is not a key factor conditioning the level of aerobic fitness. 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 a relatively high and very similar values of the VO_{2max}. Based on the research of other authors, it is determined that a 12-week systematic training with the nature of aerobic training conducted three times a week may increase the VO_{2max} in the subjects by an average of 21%. There are also reports that improving physical performance can result in systematic training at a frequency of twice a week. However, the biggest progression of VO_{2max} is observed in the initial period of training, in subsequent stages these changes are less and less visible. [Fortuna 2008: .43] 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. In this study, a significant increase in VO2max was observed at the end of the preparatory period compared to the values measured at the beginning of this period. The above changes were noted both in the group of players training for three years (increase of VO2max from 48.5 ± 5.5 to 55.2 ± 7.9), as well as footballers training over seven years (increase of VO2max from 48.2 ± 7.9 to 52.6 ± 6.4). VO_{2max} research carried out by the authors on the 26 - 27 year old 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 fourth player league did not show statistically significant differences. [Michalczyk et al. 2010]. In other studies, the authors presented a comparison of the results of players aged 14 - 15, 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 efficiency significantly increased [Śliwowski et al. 2011] 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 performance, and the test results should be used to improve, inter alia, aerobic efficiency and ultimately the effectiveness of the game [Jastrzębski et al. 2011]. 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 contributes to the increase in the value of VO_{2max} [Helgerud et al 2001; Wilmor, Costill 2004]. This research has not confirmed this. The presented research results of other authors conducted on the players of the leading clubs in Albania (16-18 years ± 2.64) showed no significant differences between the measured VO_{2max} in a year's interval with the same players subjected to systematic sports training [Kurin et al 2015]. It can be assumed that in the tested players in this work, the quality of the conducted training had a significant impact on the obtained results (no significant differences in the comparison of the VO_{2max} parameter). The average values of VO_{2max} obtained by many players (15-16 years) of the top US teams obtained by many authors amount to 54.5 - 56.2 [ml · kg-1min-1], in players under 14 years to 52.9 [ml kg-1 min-1]. [Wilmor, Costill 2004] On the other hand, VO_{2max} among players (17 years) of Italy's leading team 53.3 [ml · kg-1min-1]. [Rampinini et al 2004] Other authors indicate that for highly trained young players aged 14-17, VO_{2max} ranges from 57.7 (± 6.8) to 62 (± 2) [Reilly et al 2000]. Similar results of the tested VO_{2max} parameter in the group of seventeen-year-old players, 62 (± 2) confirm further research [Gil et al 2007]. Tested players in this work obtained at the beginning of the preparatory period mean values VO_{2max} 48.2 - 48.5 [ml · kg-1min-1] these results are lower than those given in the studies of numerous authors. After the training at the end of the preparatory period, the mean VO_{2max} values were 52.6 - 55.2 [ml · kg-1min-1] A significant increase in the value of the oxygen ceiling confirms the effectiveness of the training in the preparatory period in both groups regardless of seniority. Values of the oxygen ceiling obtained in footballers in this study in comparison to the quoted values do not indicate such a high level of aerobic fitness. It can be assumed that the reason for this was less demanding training towards shaping the discussed capacity. Usually, the elite players of the VO_{2max} teams are between 55-65 [ml · kg-1min-1], stressing that this discipline requires that players are well prepared towards shaping a high level of aerobic efficiency [Silvestre et al 2006]. The value of VO_{2max} 65 [ml · kg-1min-1] is the minimum expected in the highest level of football matches [Vanfrachem et al 1993]. 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. [Swain et al 2004] The Astrand test is one of the most commonly used tests for indirectly determining VO_{2max} in fitness. It is also used to develop a training plan and its evaluation. The protocol uses heart rate recording, which is easy to measure, however the test limit is the margin of error for the oxygen value obtained [Noonan, Dean 2000]. Some authors report that the error of reading VO_{2max} in the Astrand test compared to the direct gasometric evaluation carried out on a cycloergometer was on average 8.5% in the subjects. The American College of Sports Medicine has set guidelines that submaximal testing is safe in healthy people and the presence of a physician is not required during the trial. The use of direct gas measurement is limited to many sports clubs in the form of equipment availability and costs. Therefore, the indirect method, the Astrand test is widely used to assess aerobic fitness [Grant et all 1999]. Indirect assessment VO_{2max} is commonly used among children and youth, football enthusiasts. The person tested in this method is subjected to lower loads, which increases its safety. The use of submaximal aerobic examinations among children and adolescents of football players is justified. It is important to keep the rules of correct testing. Perform the same test protocol on the same equipment. Which reduces the inaccuracy of the measurements carried out and gives the opportunity to observe the direction of changes in aerobic capacity [Michalczyk et al. 2010; Jastrzębski et al. 2011].

CONCLUSIONS

1. Over a seven-year period, the training of football does not have to significantly change the level of aerobic performance compared to the athletes training only three years of this sport
2. Aerobic performance in athletes who practice football for several years is of a high level.

3.Training conducted during the preparatory period significantly raises the level of aerobic performance regardless of the training experience of footballers

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