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COMPARISON OF ANAEROBIC EFFICIENCY RATING IN FOOTBALL PLAYERS GROUPS OF AGE RANGE 12 – 14 AND 17 – 18 YEARS BASED ON WINGATE TEST

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Key words: aerobic fitness; footballers; Wingate test

Abstract

Introduction
One of the features shaped in football training along with aerobic fitness is anaerobic capacity. Speed is closely related to the genotype, developmental age and especially to the level of training.
Aim
The aim was to compare the rate of anaerobic effciency in grups of football players of age range 12-14 and 17-18 based on Wingate test.
Material and methods:
We compared 36 football players 12-14 years old and 28 football players 17-18 years old. Grups of respondents rated: time and power level to obtain the maximum duration of maximum power and the rate of decline in power. During the tests, the height and weight of the athletes were measured and the BMI was calculated.
Results and conclusions:
Maximum power level and the rate of decrease in power in the treated grups showed no significant differences. Arithmetic average time to obtain and maintain maximum power are statistically significant. The level of training of players has a significant impact on the formation of anaerobic capacity. The 12-14-year-old footballers, on the basis of better sport preparation, obtained a comparable, high level of maximum power and a shorter time of achieving it in comparison with the results of 17-18-year-old players. In football players aged 17-18, a longer time of maintaining the maximum power was noted, which indicates a higher non-lactic anaerobic capacity in this group compared to the group of

younger players. Lack of significant differences in the power drop index compared to the tested groups indicates similar possibilities related to the glycolytic capacity. For all somatic parameters tested, the players from the 17-18 age category are characterized by significantly higher values of the mean parameters tested.

Introduction

One of the features shaped in football training along with aerobic fitness is anaerobic capacity. It is important to shape not only a quick start and get a high speed, but also to maintain it for a long time. This gives the players the opportunity to perform a quick and effective action to win the ball in the game and keep it in the next stage of competition, which can ultimately have a decisive impact on the outcome of the match. Players spend 1-11% of the time of the entire match by doing a sprint. Shaping anaerobic capacity is extremely important in the whole training of players [1,2]. Shaping football players' speed is embedded as part of the annual training. Also included is the increase of aerobic capacity, which is the foundation for a high and stable sports form [3].

In boys, the age range 12-14 is referred to as middle school age and puberty. During this time, there is a rapid growth, muscle development progresses, and the pace of development processes does not proceed evenly for individual systems. The results of many authors' research indicate that the most favorable conditions for the development of speed are found for boys aged 10.5 - 15.5 years. The adolescence period ends at the age of 18, where the youthful period begins. During adolescence (14-18 years), the functions of the nervous system develop, the muscular system is strengthened, coordination skills increase, the cardiovascular system improves, creating better and better conditions for training.

Speed is closely related to the genotype, developmental age and especially to the level of training [4,5]. Authors' research indicates that boys only after the age of 12 have an increase in glycolytic power and capacity in response to the used training measures [6, p.84]. Therefore, it seems advisable to choose the age group of training players from the age of 12.

Anaerobic efficiency significantly increases after puberty. The ability to reach maximum power increases with the development of teenage boys. Anaerobic energy resources are systematically increasing from 11 to 16 years of age, which increases the ability to perform short efforts at maximum intensity [7].

One of the tests commonly used in training control to assess anaerobic capacity is the Wingate test. Many authors confirm its usefulness. The basis for the performance assessment is maximum power and work done. In addition, the course of changes in the rise and fall of power during the test is assessed [6,8,9,10].

The aim of the study was to compare the assessment of anaerobic capacity in footballers in the age category 12-14 years and 17-18 years based on the Wingate test.

A research hypothesis has been put forward that all Wingate test indices obtained in the subjects suggest a higher level of anaerobic capacity in the group of older players.

Material and methods

36 players were compared in the 12-14 age range and 28 in the 17-18 age range. The footballers of Jelenia Góra youth teams, juniors: "Granicy" Bogatynia, "Lotnik" Jeżów Sudecki, "Olimpia" Kowary and "KKS" Jelenia Góra participated in the research. In both groups, the trainings were held four times a week for two hours. Players have been training for a minimum of five years. All people declared themselves as nonsmokers. The respondents did not undertake other trainings parallel to football training. For all competitors, the trainings were based on comparable assumptions of the annual plan. The research took place in the KPSW lab in Jelenia Góra and included the beginning of the preparatory period in both groups of footballers.

The subjects underwent a 30 - second Wingate test on a Monark 884E cyclometer. The research was done by making the size of external resistance dependent on body weight. Among the features measured in the test, the following were distinguished:

- maximum power per kg. m. c. [W · kg-1] - [Pmax], means the highest power achieved during dynamic exercise
- time to obtain the maximum power [s] - [tPmax], the time during which the subject achieved the maximum pedaling frequency
- time to maintain the maximum power [s] - [Maintenance Pmax], i.e. the time to

maintain the maximum rhythm of pedaling.

- power drop indicator - [Power drop], i.e. the difference between the highest power value and the lowest one [6, pp. 42-45].

During the tests, the height and weight of the athletes 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, due to the nature of variable distributions (distributions are close to normal) in this part of the analysis Student's T-test for independent variables was used. In order to exclude the influence of morphological characteristics of competitors on the parameters of the Wingate test, Pearson's correlation coefficients were calculated. Values of the calculated coefficients indicate the lack of correlation of morphological traits with the Wingate test parameters.

During the statistical analysis of selected parameters of the Wingate test, after the basic statistics were calculated, the compatibility of distributions of the tested parameters with the model normal distribution was assessed. The assessment was made taking into account skewness and kurtosis values of the examined traits, as well as histograms and results of the Kolmogorow-Smirnov test.

As a result of the analysis, it was found that for the Pmax and Power drop characteristics, the distributions in the two groups did not differ significantly from the model normal distribution. On the other hand, the features: tPmax (in the younger group) and Maintenance Pmax (in the younger and older groups), the distributions proved oblique. Therefore, the Student's t-test for independent samples was used to assess the significance of differences between means for Pmax and Power drop, and for the tPmax and Maintenance Pmax characteristics of the Mann-Whitney U test.

Results

For all somatic parameters tested, the players from the 17-18 age category are characterized by significantly higher (at a very high level of significance) values of the mean parameters tested. The mean BMI values ,in 17-18 year-old players were 21.8 (± 2.2) compared to the obtained mean results in the younger group under study 19.8 (± 2.4)

(Table 1).

Tab.1 Basic statistics of the somatic parameters of the players from two age groups 12-14 and 17-18.

	Soccer players 12-14 years old	**Soccer players 17-18 years old**	**p**
	$\bar{x}$	$\bar{x}$	
body height [cm]	165,7 (±8,5)	173,9 (±5,4)	$p<0,001$ $t=4,51$
body weight [kg]	53,9 (±9,6)	66,3 (±8,6)	$p<0,001$ $t=5,39$
BMI	19,8 (±2,4)	21,8 (±2,2)	$p<0,001$ $t=3,42$

BMI - Body Mass Index = m.c. [kg] / h [m] 2, p - significance level, t - value of the test function

The obtained average test results for players 17-18 years were for the maximum power in [W · kg-1] 11.60 (± 2.06), for a power drop of 7.13 (± 2.19), for the time of obtaining the maximum power in [s] 3.28 (± 2.04) and for the time of maintaining the maximum power in [s] 1.41 (± 1.62) (Table 2). The obtained average test results for players 12-14 years were for the maximum power in [W · kg-1] 12.47 (± 1.5), for a power drop of 7.19 (± 2.31), for the time of obtaining maximum power in [s] 4.77 (± 2.08) and for the time of maintaining the maximum power in [s] 3.04 (± 1.99) (Table 3).

Table 2. Basic statistics of tested parameters of the Wingate test for footballers - age 12-14.

	$\bar{x}$	**Median**	**Wariance**	**SD**	**Slant**	**Kurtosis**
Pmax [W·kg^{-1}]	11,60	11,86	4,26	2,06	-0,28	-1,11
Power drop	7,13	7,25	4,81	2,19	0,55	0,78
tPmax [s]	3,28	2,20	4,16	2,04	1,80	4,54
maintenance Pmax [s[	1,41	0,90	2,62	1,62	2,3	4,90

tPmax - time to obtain maximum power, Pmax - maximum power

Table 3. Basic statistics of tested parameters of Wingate test for footballers - 17-18 years old

	$\bar{x}$	Median	Wariance	SD	Slant	Kurtosis
Pmax [W·kg^{-1}]	12,47	12,12	2,25	1,50	0,39	0,37
Power drop	7,19	6,80	5,34	2,31	0,61	0,90
tPmax [s]	4,77	5,00	4,31	2,08	-0,47	-0,68
maintenance Pmax [s]	3,04	2,25	3,96	1,99	1,13	0,08

tPmax - time to obtain maximum power, Pmax - maximum power

The obtained test results from the Wingate test in both groups subjected to the t-Student analysis showed that the arithmetic means of the Pmax and Power drop characteristics in the studied groups are not significantly different. (Tab.4)

Table 4. Student's t-test results for the studied groups.

	$\bar{x}$ 1	$\bar{x}$ 2	t	df	p	SD1	SD2
Pmax [W·kg^{-1}]	11,60	12,47	-1,87	62	0,07	2,06	1,50
Power drop	7,13	7,19	-0,11	62	0,91	2,19	2,31

$\bar{x}$ 1 - average for the group of 12-14 years, $\bar{x}$ 2 - average for the group of 17 - 18 years. SD1 - standard deviation for the group of 12-14 years, SD2 - standard deviation for the group of 17 - 18 years, Pmax - maximum power 1 - average for the group of 12-14 years, $\bar{x}$ 2 - average for the group of 17 - 18 years. SD1 - standard deviation for the group of 12-14 years, SD2 - standard deviation for the group of 17 - 18 years, Pmax - maximum power**.**

The Mann-Whitney U test showed that the arithmetic mean values of tPmax and Maintenance Pmax are significantly different. (Tab.5) This means that the values of both parameters are significantly higher in 17-18 year-old players.

Table 5. Mann-Whitney U test results for the studied groups.

	Suma rang 1	Suma rang 2	U	Z	Level p	N	N
tPmax [s]	956,00	1124,00	290,00	-2,90	0,004	36	28
Utrzymanie Pmax	838,50	1241,50	172,50	-4,49	0,000	36	28

tPmax - time to obtain maximum power, Pmax - maximum power

Discussion

The Wingate test is used to assess the anaerobic capacity at all stages of sports training. The reference of the characteristics of changes in the level of anaerobic capacity, typical for development in ontogeny, for the effects of sports training, allows for the actual assessment of the effectiveness of the sports training process, is the basic condition for controlling the training process [6, p.47, pp. 76-79]. Players should be properly trained with the right choice of training methods that would take into account the rate of biological development. It is especially important to take into account periods that favor the development of individual physical performance traits. Training control is recommended two to four times a year to assess adaptation changes. The analysis of the training load and its relationship with physical fitness, technique and tactics, aerobic and anaerobic capacity is an important element in the control of the training process. It is assumed that the quantity, quality of the training load used in young players has, among others, a direct impact on the development of anaerobic capacity. In 15 -16-year-old footballers the shaping of the maximum power in [W · kg-1] was analyzed based on the Wingate test. In subsequent studies conducted at the beginning of the starting season, the average results (10.7 ± 0.84), (11.2 ± 0.76), (10.9 ± 0.68) were obtained at the end of the preparatory season and at the end of the competition season. . This indicates that an important factor that can affect the level of players is the training load [11]. Similar results of maximum power in 16-year-old footballers were obtained in other studies carried out. These were average values ,in the range of 10.8 - 11.3 [W · kg-1] [12]. In subsequent studies of 17-18-year-old footballers with 5-6 years of training experience after the end of the preparatory period, average values were obtained: maximum power in [W · kg-1] at (10, 72 ± 0.7), power drop (18, 75 ± 4.34), the time of obtaining maximum power in (4.38 ± 0.59 [s]) and the time of maintaining maximum power in (4.11 ± 0.81 [s]) [6]. In the same age group for players in this work the average value of the maximum power was (12, 47 ± 1.5 [W · kg-1]). Relatively high values due to the conducted training were obtained by the players from the group of 12-14 year olds (11.6 ± 2.06 [W · kg-1]). This is evidenced by the fact that the results in both groups, older and younger, did not differ significantly. The maximum power in boys who do not train in the 12-14 age range according to the authors' research is in the range of 8-11 [W · kg-1] [13,14]. In the examined 17-18 year-old players in the above-mentioned work, the average values of the power drop were noted (7.19 ± 2.3) and in the younger group (7.13 ± 2.19). These values did not differ significantly. In one and the other group, a relatively high glycolytic capacity is observed, higher than in the studies of other authors in the group of 17-18 summer players (18.75 ± 4.34) [6, pp. 62-66]. The time of obtaining average values of the maximum power in the group of older players in the tests carried out in this work was (4.77 ± 2.07 [s]) and the time of maintaining the maximum power in (3.04 ± 2 [s]). The time of obtaining the average values of the maximum power in the group of younger players in the tests carried out in this work was (3.21 ± 2.04 [s]) and the time of maintaining the maximum power in (1.41 ± 1.62 [s]). In both groups of subjects, the time of obtaining the highest speed is shorter than in the obtained results in the group of 17-18-year-old players (4.38 ± 0.59 [s]) in the authors' research [6, p.66]. However, the time of maintaining the highest power is shorter in the examined younger group in this work, and comparable in the older group, in comparison with the research of other authors for the age group of 17-18 players (4.11 ± 0.81 [s]). The maximum power can be maintained by the best sprinters for 5-6 seconds [6, pp. 66-75]. It seems, therefore, that the result obtained by the 17-year-old players tested in this work is very good. Comparing the surveyed group of 12-14 year-old players and 17-18 year-olds, significant differences were observed in the time of obtaining the highest power in favor of the younger group and while maintaining the highest power in favor of the older group. It can be assumed that the favorable changes for the younger group were associated with more effective training. The eight-week sprint training for non-trained persons leads to a 60% increase in power [6, p.22]. Differences in anaerobic capacity of boys before and after puberty are related to the efficiency of anaerobic glycolysis mechanisms and the phosphagen system. This is confirmed by the change in maximum blood lactate in boys with development in the 12-18 age range. The reason for the above phenomenon is lower concentration of phosphofructokinase in muscle before puberty, an enzyme involved in anaerobic glucose distribution, as well as lower testosterone concentration. On the other hand, the phosphagen resources in muscles per unit of mass are similar to those of adults [6, pp. 34-37, 15, pp. 483]. A linear increase in the maximum lactate concentration is observed along with human biological development. The puberty period is a breakthrough in the development of anaerobic metabolism. It is assumed on the basis of research that boys before puberty have less predisposition to perform anaerobic efforts. The dynamics of anaerobic capacity in boys in ontogenesis is of uneven growth. The maturation period increases the efficiency of anaerobic metabolism. However, boys achieve the best speed results only between 15-17 years of age [6, pp. 37-37]. An important factor that motivates the dynamics of changes of this feature is the level of training towards increasing the anaerobic potential of the player. On the basis of the above-mentioned test results, significant differences in the phosphagen capacity were revealed in favor of the older group and at the time of obtaining the maximum power, where shorter time to obtain maximum power was observed in younger players. However, the amount of power obtained, as well as the power drop rate are comparable. It can be assumed based on the assumptions of ontogenetic development that in non-adolescent patients the results obtained in the younger group would indicate lower possibilities related to anaerobic capacity based on the tested indicators in the Wingate test. In this study, the training participants state that not all of the test indicators in the Wingate test are lower in the younger group. This does not confirm the previously accepted hypothesis at work. This suggests that the results obtained in these studies underline the significant impact of training loads on anaerobic capacity.

Conclusions

1. The level of training of players has a significant impact on the formation of anaerobic capacity.
2. The 12-14-year-old footballers, on the basis of better sport preparation, obtained a comparable, high level of maximum power and a shorter time of achieving it in comparison with the results of 17-18-year-old players.
3. In football players aged 17-18, a longer time of maintaining the maximum power was noted, which indicates a higher non-lactic anaerobic capacity in this group compared to the group of younger players.
4. Lack of significant differences in the power drop index compared to the tested groups indicates similar possibilities related to the glycolytic capacity.

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