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DIFFERENCES IN FUNCTIONAL ABILITIES OF BOYS AGED 10 TO 13

Original scientific paper

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Abstract

The research was conducted with the aim to determine the differences in functional abilities of boys aged 10 to 13 who were divided into groups: football players, karate players and non-athletes from the area of city the of East Sarajevo. Athletes from the sports club "Tango", karate club "Igman" and pupils from elementary schools "Sveti Sava", "Petar Petrović Njegoš", "Aleksa Šantić" and Jovan Dučić" took part in the research. Total sample of participants consisted of 84 boys. The sample was divided into three groups: Football players (24 boys from FC "Tango"); Karate players (23 boys from KC "Igman"); Non-athletes (37 boys who only attend PE classes at school). Boys who are athletes (football players and karate players) are involved in sport activities for at least four years. After statistical processing of the data, research has shown that there are statistically significant differences in functional abilities between the participants.

Keywords: *physical loads, karate players, football players, non-athletes, PE classes, resting heart rate, maximum oxygen consumption after load, functional tests, analysis of variance, discriminative analysis*

INTRODUCTION

The functional ability of human being is very complex, and besides the heart and blood vessels it depends on many other factors, firstly from the neuro-vegetative and endocrine system. It is considered that there is no common functional ability of cardio-vascular system which is common to all life situations but it is a strain of specific abilities for various activities and situations (Malacko and Rađa 2004).

The functional abilities take very important part in anthropological dimensions of athletes in both training and competition period. In each sport and sport discipline the coefficient of participation of functional abilities in the equation of specification is great, especially in sports where the success depends on the high level of energy capacity of aerobic and anaerobic work. Each activity of human being is connected to the energy expenditure. Maximum amount of oxygen which a human being can intake within one minute characterizes one's oxidative power (aerobic power, anaerobic ability). From the physiological point of view, we say that the functional abilities are aerobic and anaerobic abilities. In the organism there are two manners of energy creation: *aerobic and anaerobic.* In aerobic manner energy is provided by burning glucose and free fatty acids. For that purpose the oxygen from the air is used. The amount of energy that an organism is able to create in a time unit depends on the ability of pulmonary system. The more able the organism is to spend oxygen in time unit, the greater amount of energy for functioning will be created. The anaerobic abilities are an indicator of the maximum muscle stress. The tests for their diagnostics are based on complex procedures, primarily bio-chemical procedures of measuring the concentration of lactates in the blood of the participant. During increased muscle activity the amount of lactates increases (normal blood values are between 0.5 and1.3 mmol1/1). Higher concentration of lactates in the blood is reverse proportional to the level of training of the individual and it is measured by direct methods. For anaerobic source there are two fractions, depending on which the substance is used for energy creation: non-lactate and lactate. Anaerobic abilities depend on the ability of the organism to create energy under the conditions of hypoxia.

Under the physical load various changes occur in the organism, where multiple metabolic processes take place simultaneously with the increase in the activity of certain organs and systems of organs (Purpević, 1981). Systematic physical loads lead to physiological adaptivity of the organs and systems of organs to these loads which also increases efficiency in the functioning of these systems. The adaptivity of whole organism with systematic physical overload is being performed by increase in functional ability of all systems of organs, especially the cardio-vascular system (Đurašković, 2002). Maximum oxygen intake is a good measure of functional working efficiency of the organism and it changes the heart frequency. Besides other indicators, they are most frequently used for the assessment of the adaptivity of organism for physical loads (Medved, 1997).

The subject of this paper are differences in functional abilities of boys aged 10-13 divided into groups: football players, karate players and non-athletes from the territory of city of East Sarajevo. The aim of the research was to assess the effects of subsequent changes of children who besides the regular PE classes also take part in sport activities for at least four years (football and karate players) in comparison to children who only attend PE classes at school (non-athletes) as well as the differences in the functional abilities between the athletes (football and karate players) .

METHODS

The population that the sample was taken from is defined as the population of pupils from four elementary school on

the territory of East Sarajevo, aged 10-13 (± 6 months), and clinically healthy, male gender and without pronounced psycho-physical aberrations. Pupils from elementary schools "Sveti Sava", "Petar Petrović Njegoš", "Aleksa Šantić" and Jovan Dučić" took part in the research. Total sample consisted of 84 boys. The sample was divided into three groups:

1. Football players (24 boys from FC "Tango")
2. Karate players (23 boys from KC "Igman") and
3. Non-athletes (37 boys who only attend PE classes at school)..

Boys who are athletes (football players and karate players) are involved in sport activities for at least four years.

During the selection of instrument we took care of their reliability, objectivity and validity. For the purpose of this research we determined the sample of two variables for evaluation of functional abilities.

1. Resting heart rate (FPUM)
2. Maximum oxygen consumption after load (FFPPOP)

RESULTS

Baseline statistic parameters

In Figures 1., 2. and 3. are descriptive statistical parameters of functional abilities for the sample of boys aged 10 to 13, divided into groups Football players, Karate players and Non-athletes.

After the inspection and according to values of skewness (Skew.) and flatness (Kurt.) of the result distribution curve we can draw a conclusion that the results of all functional abilities are normally distributed which is a basic prerequisite for further application of multi-variant and uni-variant methods for determining differences between functional abilities of these groups

After the analysis of mean values, the range between minimum and maximum result, standard deviation (Figure 1.), as well as skewness of curve of the functional abilities of the group Football players, we can note reduced homogeneity in the measured abilities, considering the fact that within the range there are no approximately six standard deviations and the value of flatness of the results' distribution is negative or low (Kurt.≤2.75).

After the analysis of mean values, range between minimum and maximum result, standard deviation (Figure 2.), as well as skewness of curve of the functional abilities of the group Karate players, we can note reduced homogeneity in the measured abilities, considering the fact that within the range there are no approximately six standard deviations and the value of flatness of the results' distribution is negative or low (Kurt.≤2.75).

After the analysis of mean values, range between minimum and maximum result, standard deviation (Figure 3.), as well as skewness of curve of the functional abilities of the group Non-athletes, we can note reduced homogeneity in the measured abilities, considering the fact that within the range there are no approximately six standard deviations and the value of flatness of the results' distribution is negative or low (Kurt.≤2.75).

Analysis of variance

After the calculation of all the arithmetic means of all the functional abilities of boys aged 10 to 13, using the multi-variant analysis of variance in Figure 4. are the results for group centroides at multi-variant level. Inspecting the results provides the insight that, at multi-variant level, for entire sample of functional abilities, statistically significant difference of group centroides was noted (Q= .000).

As the value of coefficients of significance of differences of centroides in the groups at multi-variant level is statistically significantly greater the than limit value (Q≤ .05), it would be realistic to probe at uni-variant level in which functional abilities is the difference between the groups.

Table 1. Descriptive statistical parameters of functional abilities of FOOTBALL PLAYERS

Variable	N	Mean	Min.	Max.	Std. Dev.	Skew.	Kurt.
FPUM	24	87.50	60.00	114.00	15.85	-0.38	-0.55
FFPPOP	24	70.75	52.00	90.00	12.17	0.05	-1.42

Legend: N – number of participants; Mean – arithmetic mean; Min. – minimal result; Max. – maximum result; Std. Dev. – standard deviation of arithmetic mean; Skew.– skewness of results' curve; Kurt. – flatness of results' distribution curve

Table. 2. Descriptive statistical parameters of functional abilities of KARATE PLAYERS

Variable	N	Mean	Min.	Max.	Std. Dev.	Skew.	Kurt.
FPUM	23	89.74	68.00	114.00	14.17	-0.02	-1.31
FFPPOP	23	76.22	59.00	92.00	10.22	-0.07	-1.17

Legend: N – number of participants; Mean – arithmetic mean; Min. – minimal result; Max. – maximum result; Std. Dev. – standard deviation of arithmetic mean;;Skew.– skewness of results' curve; Kurt. – flatness of results' distribution curve

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Table 3. Descriptive statistical parameters of functional abilities of NON-ATHLETES

Varijabla	N	Mean	Min.	Max.	Std. Dev.	Skew.	Kurt.
FPUM	37	109.03	66.00	168.00	24.02	0.39	-0.12
FFPPOP	37	46.05	32.00	56.00	5.59	-0.09	0.07

Legend: N – number of participants; Mean – arithmetic mean; Min. – minimal result; Max. – maximum result; Std. Dev. – standard deviation of arithmetic mean; Skew.– skewness of results' curve; Kurt. – flatness of results' distribution curve

Table 4. Multi-variant analysis of the variance of functional abilities

Wilks Lambda	F	Effect - df	Error - df	Q
0.276	36.15	4	160	0.000*

Legend: Wilks lambda– value of coefficient of the Wilks tes for equality of groups' centroides; F– value of coefficient of F test used for testing significance of differences; Effect df, Error df – levels of liberty; Q– coeeficient of significance of differences of groups' centroides; *- statistically significant level of differences of measuring centroides

Table 5. Uni-variant analysis of functional ability variance

Variable	Mean Football players	Mean Karate players	Mean Control	F (2; 81)	p	Fisher LSD
FPUM	87.50	89.74	109.03	11.38	0.000*	(F-N) (K-N)
FFPPOP	70.75	76.22	46.05	94.08	0.000*	(F-N) (K-N)

Legenda: Mean Football players: arithmetic mean of football players group; Mean Karate players- arithmetic mean of karate players group; Mean Non athletes- arithmetic mean of non athletes group; F–value of coefficient of F-test for testing significance of differences; df 1, df 2– liberty levels; p– coefficient of significance of differences in arithmetic means; *- statistically significant level of differences of means; Fisher LSD – analysis of differences between the groups using Fisherr LSD test; (F-K) –difference between football players and karate players; (K-N) –difference between karate players and non-athletes; (F-N) – difference between football players and non-athletes

Table 6. Differences in functional abilities between Football players and Karate players (T-test)

Variable	Mean Football players	Mean Karate players	t- value	Df	p
FPUM	87.50	89.74	-0.51	45	0.613
FFPPOP	70.75	76.22	-1.66	45	0.103

Legend: Mean Football players: arithmetic mean of football players group; Mean Karate players- arithmetic mean of karate players group; t value– value of t-test coefficient for testing significance levels; Df –liberty levels; p– coefficient of significance of differences in arithmetic means *- statistically significant level of differences of means

Table 7. Differences in functional abilities between Karate players and Non-athletes (T-test)

Variable	Mean Karate players	Mean Non-athletes	t- value	Df	p
FPUM	89.74	109.03	-3.49	58	0.001*
FFPPOP	76.22	46.05	14.79	58	0.000*

Legend: Mean karate players: arithmetic mean of karate players group; Mean Non-athletes- arithmetic mean of non athletes group; t value– value of t-test coefficient for testing significance levels; Df –liberty levels; p – coefficient of significance of differences in arithmetic means *- statistically significant level of differences of means

Table 8. Differences in functional abilities between Football players and Non-athletes (T-test)

Varijabla	Mean Fudbaleri	Mean Nesportisti	t- value	Df	p
FPUM	87.50	109.03	-3.87	59	0.000*
FFPPOP	70.75	46.05	10.75	59	0.000*

Legend: Mean football players: arithmetic mean of karate players group; Mean Non-athletes- arithmetic mean of non athletes group; t value– value of t-test coefficient for testing significance levels; Df –liberty levels; p– coefficient of significance of differences in arithmetic means *- statistically significant level of differences of means

Figure 9. Significance of discriminative functions of functional abilities

Disc.F	Eigenvalue	Canonicl-R	Wilks'-Lambda	Chi Sqr.	df	p-level
1	2.576	0.849	0.276	103.65	4	0.000*
2	0.013	0.115	0.987	1.07	1	0.301

Legend: Disc.F – discriminative function; Eigenvalue – explained variance of discriminative function; Canonicl-R – percentage of the explained variance of discriminative function; Wilks'-Lambda – value of coefficient of Wilks test for testing the significance of contribution of the variables to the discriminative function; Chi-Sqr.–value of Hi square test for testing the significance of discriminative function; df – freedom levels; p-level – coefficient of significance of discriminative function; *- statistically significant level of discriminative function

Inspecting the Figure 5., where the results of analysis of variance at uni-variant level one can draw a conclusion that there is a statistically significant difference between the gr-oups in the tests of functional abilities. Results of the boys who practice sports are statistically significantly better than the results of the boys who do not practice any sport in the area of functional abilities. When we observe the differe-nces between the groups using Post hoc ana-

lysis of Fisher LSD test, we can draw a conclusion that the boys who are football players and karate players are statistically significantly better than the boys who are non-athletes in the measured functional abilities, but no difference between the football players and karate players. Boys who practice football had statistically best results for resting heart rate (FPUM), and boys from the group of Karate players had the best variables in maximum oxygen consumption (FFPPOP). Noted differences are at the significance level of $p \leq 0.00$ for all the variables.

Student's t-test

After the calculation of arithmetic means of functional abilities of boys aged 10 to 13, using Student's t-test for independent samples, we calculated their differences for the couples from the groups, e.g. difference between the parameters between the groups Football players and Karate players, then between the groups Karate players and Non-athletes and at the end between the groups Football players and Non athletes. (Figures 6., 7. and 8.).

The inspection of Figure 6. provides an insight into the results of the student's T-test for calculation of differences between the groups Football players and Karate players in functional abilities. We can draw a conclusion that there is no statistically significant difference between the groups in the area of functional abilities, although a numerical difference for variable resting heart rate (FPUM - the lower the resting heart rate, the better), where Football players have a bit lower heart rate and for the variable 'maximum oxygen consumption' Karate players have higher values for O^2 consumption. The T-test results are in consistency with the variance analysis results where statistically significant differences were not noted in the same dimension of functional area.

Analysis of Figure 7. which contains the results for Student's T-test for calculation of differences between the groups Karate players and Non-athletes provides us with the conclusion that there is statistically significant difference in functional abilities which were the subject of this research, namely resting heart rate (FPUM) and maximum oxygen consumption (FFPPOP) at the level of significance of $p \leq 0.00$.

The T-test results are consistent with the results of variance analysis, where statistically significant differences were noted in the tested functional abilities, where the boys from the group Karate players had significantly better results.

Analyzing the Figure 8., where the results of student's T-test for calculation of significance of differences between the groups Football players and Non-athletes are presented, leads us to conclusion that there is a statistically significant difference in the area of functional abilities, where better results were noted in the group of Football players at the level of significance of $p \leq 0.00$.

The T-test results are consistent with the results of analysis of variance, where statistically significant differences were noted in the tested functional abilities, where boys from the group Football players had significantly better results in variables resting heart rate (FPUM) and maximum oxygen consumption (FFPPOP).

Discriminative analysis

Differences between the three groups in the area of functional abilities are presented in Figures 9.-12.

In Figure 9. are square values of discrimination coefficient (Eigenvalue), coefficients of canonical co-relation (Canonicl R), values of Wilks test for testing the significance of contribution of variables to discriminative function (Wilks'Lambda), values of Bertlet square test (Chi-Sqr.), levels of freedom (df) and value of error probability while rejecting the hypothesis that real value of canonical corelation equal to zero (p-level) for both isolated discriminative functions.

As it is evident from the results in figure 9., only the first discriminative function is statistically significant. The above mentioned discriminative strength of the variables is stated through the test (Wilks-Lambda), which is in this case high for discriminative function (.276), and value of Chi square test is (103.65), which confirms that the differences between the three groups of participants significant in the area of functional abilities because their level of significance is above the probability threshold in the significant discriminative function (p-level=0.000).

In the further interpretation in the area of manifestation, it is important to identify statistically significant differences between the three groups in order to compare their values of functional abilities, especially because the level of significance of the first discriminative function is high (p-level=.000).

Figure 10. Structure of discriminative functions of the functional abilities

Variables	Disc.F 1
FPUM	0.32*
FFPPOP	-0.95*

Legend: Disc. F 1 – first significant discriminatory function; *- statistically significant correlation coefficient

In Figure 10. is provided the structure of the first discriminative function and participation of variables of functional abilities in the forming of the discriminative function. They present in which correlation is the set of data according to which the discriminative function of the results obtained was performed. The greatest significant contribution to the first discriminative function (Figure 10.) is by maximum oxygen consumption [FFPPOP=(-0.95)], and somewhat weaker but yet statistically significant is the resting heart rate (FPUM=0.32).

Table 11. Centroids of functional abilities of the groups

Respondents	Discriminative F 1
FOOTBALL PLAYERS	-1.03
KARATE PLAYERS	-1.29
NON-ATHLETES	1.76

Legend: Disc. F 1 – the first significant discriminative function

Group centroids themselves (Figure 11.) in this case are arithmetic means of the three groups. It is clear that the group Football players has the highest values in the variable Resting heart rate (FPUM), considering the fact that the centroid of the group is located in the quadrant with the negative value (-1.03). The lowest values of the groups has the group Non-athletes because its centroid is located in the quadrant with a positive value (1.76). The reason is that the lower values of resting heart rate are better values. Group

Karate players has better results in this ability than Non-athletes, but less favorable than the Football players.

Discriminative analysis results match the ones obtained by analysis of variance and the Student's T-test, that the group Non-athletes has the lowest values of all the functional abilities, whereas the group Football players has the highest values in resting heart rate, while for the maximum oxygen consumption group Karate players has the highest values.

That the previous claim is true is evident from Figure 12. where are presented the values of homogeneity of the groups, as well as the belonging of the participants to certain groups according to their functional abilities. We can state that the group Non-athletes is the most homogenous because according to the functional abilities all 37 members belong to the group (100%). A bit less homogenous is the group Karate players where only 14 of its members belong there according to their functional abilities (60.87%), and 9 (39.13%) belong to the group Football players. The least homogenous group is Football players where according to the characteristics only 10 of their members belong there (41.67%), and as much as 11 (45.83%) to the group Karate players and 3 (12.50%) to the group Non athletes.

DISCUSSION AND CONCLUSION

Analysis of the gathered data of the differences in functional ability leads us to the conclusion that the group Non-athletes has the lowest levels of all functional abilities whereas the group Football players has the highest values for resting heart rate and the group of Karate players for maximum oxygen consumption. Such results were expected considering the fact that training process in sports increases maximum oxygen consumption as well as the reduction of values for heart rate while resting.

Resting heart rate (average values) for boys non-athletes are a bit higher than the average values for athletes (football and karate players). This is explained by the fact that non-athletes were not loaded to sub-maximum and maximum loads at PE classes and hence parasympathicus (n. vagus) could not overtake the sympathicus (Đurašković. 2002). It is also known that programmed and well-dosed physical activity leads to bradicardia (Đurđević, 1981), and that can explain the lower resting heart rate of the athletes in comparison to boys who do not actively perform physical activity. Similar results were obtained by Đurđević (1981), Đurašković (2002) and Živanić (2004) in their research.

There are, of course, many open questions which require adequate answers. One of them is establishing which exercises in particular led to established differences between the groups. The second question relates to the ratio of other free time activities of the participants which can to great extent influence the positive or negative reactions of the organism and which could not be under control. Following or similar research can follow up greater number of measuring instruments and more factors which influence the dimensions which are subject to research and to keep them under control.

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