ORGINAL SCIENTIFIC PAPER

[1]Nebojša Mitrovic, [2]Dalibor Stevic
[1,2]Univerzitet in East Sarajevo, Teachers' Training Faculty;

UDK: 796.012-055.15
DOI: 10.7251/SIZ0117060M

DIFFERENCES IN FUNCTIONAL ABILITIES OF BOYS OF YOUNGER SCHOOL AGE AFTER APPLYING SOECIALLY PROGRAMMED TRANSFORMATION PROCESS

Abstract

The aim of this research was to evaluate the influence and the effect of special treatment of the activities of kinesiology based on taekwondo on the functional capabilities of boys of younger school age. Functional tests were carried out in a sample of 91 subjects, with the age of 11 (+/- 6 months), and divided into three groups - experimental, the first control and the second control group. The experimental group was subjected to a programmed exercise for the development of functional abilities. The control group (KI) was working according to the established curriculum provided for the school year by the Ministry of Education and Culture with additional sports activities (football, basketball, handball, volleyball) in school sections. The control group (KII) was working only by the curriculum provided for the school year by the Ministry of Education and Culture of the Republic of Srpska. Kinesiology program that was applied to the experimental group lasted for 32 hours, with the purpose of improving the above capacity. The results show that the subjects of the experimental group achieved good results in the reduction of aerobic and anaerobic capacity.

***Key words**: differences, functional abilities, younger school age.*

1. INTRODUCTION

Functional capabilities include abilities responsible for the transport and utilization of energy in the body. Functional capabilities can be aerobic and anaerobic functional abilities. Theyare developed by continuous training load. Some authors state that functional abilities are better developed in those children who, in addition to regular physical education classes also have additional directed training process (Granic and Krstić, 2006).

Any physical activity requires a large number of physiological and metabolic processes, and therefore contraindications when practicing physical activities can appear. Body involved in a physical activity responds to changes in almost all physiological systems, primarily musculoskeletal, cardio-vascular, respiratory, endocrine and immune system (Mišigoj-Durakovic, 2006).

Taekwondo serves more to improve competitive abilitiesthan to improve health (Bu, Haijun, Yong, Chaohui, Xiaoyuan, &Fiatarone Singh, 2010). The fact is that during the fight people who compete are in a stressful condition, depending on the “weight" of fights (Chiodo, Tessitore, Cortis, Cybele, Lupo, Ammendolia, De Rosas, &Capranica, 2009).

The size of energy capacity and the level of their use significantly differentiate particular persons during physical activities by the model of taekwondo exercises, and therefore those who do these activities. Knowing these characteristics is the basis for planning and

implementation of such a form of physical activity that will enable increased and optimal use of the energy capacity of the organism. The role of the energy system is the conversion of chemical energy into a usable form (adenosine triphosphate, ATP) for all cellular functions. There are very small quantities of ATP in the cells. In order to renew ATP and keep constant its concentration in the muscle cell, energy from chemical sources, which release energy in the absence of oxygen, has been exploited. These processes are anaerobic energy processes, in contrast to processes from chemical sources that require the presence of oxygen and they are called aerobic energy processes. In the creation of energy, i.e. in the renewing of ATP, participation of three systems for converting chemical energy into mechanical energy take part. They are anaerobic –alakatanisystem: the system of degradation of phosphocreatine (CP), anaerobic - lactate system: the system of decomposition of glucose by anaerobic glycolysis to pyruvic acid with the production of lactates and aerobic system: system of oxidative decomposition of carbohydrates and free fatty acids.

Taking into account the functional capabilities, the heart frequency and the amount of lactate in blood (Bouhlel, 2006; Buják, 2005; Butios, Tasika, 2007), suggest that physical activity by the model of taekwondo exercises leads to a high level of specific strength. These capabilities can be improved by doing physical exercises but intensive forms of physical activities that can be best used with children that for a long time have been engaged in such forms of physical activities because of easier adaptation to stress are needed.

Taekwondo demands of children to have greater muscle strength, a good sense of balance and use of dynamic energy. Combinations of basic movements and form develop the ability to change the speed and direction of movements in any direction, while the simulation battle develops concentration, peripheral vision, and courage. It is evident that this type of physical activities has a positive effect on physical and mental development of those children who are engaged in it (Capranica et al, 2012). The program of physical exercises based on the technical elements of taekwondo develops extraordinary mental and physical characteristics, such as muscle strength, the ability to quickly change the direction of movements, speed as the ability to quickly transfer the body from one place to another, flexibility, peripheral vision, concentration, understanding the mechanics and techniques of body movement. Young people seek and find in taekwondo a form of physical activity that allows them to develop their body and spirit through exercise and competition (Capranica et al, 2012).

2. METHOD

The research used empirical and statistical methods. The research was of a longitudinal guidance, by means of drafts with nonequivalent groups and with pretest - posttest. An experimental treatment in a period of 16 weeks on a sample of younger schoolchildren from Bijeljinawas conducted. The sample of children of younger school age is determined by the method of stratified quota sampling, on the population of five grades primary school students in Bijeljina. The total sample size depended on the questionnaire by which parents confirmed their children participation in testing which is in line with the Helsinki Declaration on Biomedical Research (1964). The sample included 91 subjects with the age of 11 (+/- 6 months). All subjects at the time of the initial measuring of functional abilities attended the second semester of the fifth grade of primary school.

To assess the functional abilities of younger schoolchildren following functional tests were used:

1) The vital lungscapacity (the maximum amount of air the subject can exhale after a previous maximum inhaling)

2) Lorentz test (adaptation of the organism to the physical demands on the basis of the parameters of heart rate at rest)

3) Shuttle run test (estimation of aerobic capacity, whichis based on the maximal oxygen uptake).

The program, which was implemented in the experimental group, lasted for 32 hours. Each program included the basic components of the preparation of movement, work on the biomechanics of movement, nerve stimulation and ultimately exercises that contributed to certain changes in the analyzed anthropological space. Four intensities based on the physiological characteristics of the planned activities were identified. Each of them was associated with the rhythm of activity, type of programmed modes of exercising, the method, and frequency of the heart (Foran, 2010). Five randomized subjects from each group (E1, K1, K2) were selected and load level on the basis of the heart rate by means of monitor of heart rate Polar FT7 was parallel monitored. Polar FT7 measured the number of heart beats per minute in real time (instantaneous, average and maximum heart rate), zone of the load, the combustion of body fat, calorie consumption and kept the results of measurements that were analyzed, during and after physical exercise and according to the results obtained the intensity of the planned activities was corrected.

The experimental group was subjected to a programmed exercise for the development of functional abilities. The control group (KI) was working according to the established curriculum provided for the analyzed age, with additional sports activities (football, basketball, handball, volleyball) in school sections, while the control group (KII) worked only by the curriculum provided for the school year and prescribed by the Ministry of Education and Culture.

Statistical analysis was carried out in several parts:

1. For all of the variables the basic descriptive statistics per groups at the initial and final measuring were determined: arithmetic mean (AM), the standard deviation (S), the minimum (MIN) and maximum measurement results (MAX), skewness – a measure of the symmetry of the distribution (SKEW) and kurtosis - a measure of homogeneity of distribution (KURT).
2. The normality of distribution for all variables Kolmogorov was tested - Smirnov test for initial and final measuring.
3. Statistically significant differences between groups of subjects in the initial measuring was tested for all analyzed variables using multivariate (MANOVA) and univariate (ANOVA) analysis of variance.
4. The effects of the treatment for all groups of subjects at the final measuring were tested using multivariate (MANCOVA) and univariate (ANCOVA) analysis of covariance.

3. RESULTS AND DISCUSSION

By analyzing the results of Table 1, it can be seen that in the functional variables of the experimental group in boys a good discrimination power measurement for all of the measured variables is represented. Thiscan be seen from a comparison of their arithmetic mean and standard deviations, where we can notice that all the analyzed variables, within a single arithmetic mean match three standard deviations in the initial measurement. Minimum and maximum measured values as well as their range of results are within normal limits. Skewness values indicate no significant asymmetry of distribution in any of the variables in the initial measurement in boys` functional abilities. Kurtosis values are in the zone of good and acceptable values in all variables except for the variables for testing the efficiency of the cardiovascular system Lorentz test, as seen from the negative and increased kurtosis coefficient that tells us about the increased dispersion of results and plat kurtosis distribution in this variable.

Table 1. Basic descriptive indication of the functional variables of the experimental group (E) in the initial measurement for boys

Gender	Variables	MIN	MAX	AS	S	Sk	Kurt	KS
	Lorentz test	28	60	44,83	9,706	-0,255	-1,21	0,404
M	Vital lungs capacity	1,6	4,7	2,947	0,6447	0,136	0,844	0,904
	Shuttle test (number of shares)	30	59	41,83	6,91	0,409	0,470	0,909

Legend: MIN– minimum recorded measurement result; MAX – maximum recorded measurement result; AS – arithmetic mean; S – standard deviation; Sk – skewness (inclination distribution results); Kurt – kurtosis (elongation distribution results); KS –significance of the Kolmogorov-Smirnov test

Not statistically significant deviation from the normal distribution in any of the analyzed variables of functional status of boys from experimental group was not found.

By analyzing the results of Table 2, we can see that in the operating variables of the first experimental group in boys a good discrimination power measurement for all of the measured variables is represented. This can be seen from a comparison of their arithmetic mean and standard deviations, where we can notice that all the analyzed variables, within a single arithmetic mean match three standard deviations in the initial measuring. Minimum and maximum measured values as well as their range of results are within normal limits.

Based on the results shown in Table 2, it we can conclude that in the functional variables of the first control group in boys good discrimination power measurement for all of the measured variables is represented. This can be seen from a comparison of their arithmetic mean and standard deviations, where we can see that in all the analyzed variables within an arithmetic mean there are three standard deviations at the initial measurement. By reviewing of minimum and maximum measured values as well as their range of results, we can see that all values are within the normal indicators. Skewness values are within acceptable or good results in all the variables,except in the variable for the assessment of vital lung capacity, where significantasymmetry of distribution is seen at the initial measuring of boys` functional capabilities. Kurtosis values are in the zone of good and acceptable values in all the variables except in the variable for measuring the vital capacity of lungs, as evidenced by the increased value of the positive kurtosis value, which tells about the increased clustering of results from the arithmetic mean and leptokurtosis distribution in this variable.

Table 2. Basic descriptive parameters of functional variables of the first control group (K1) in the initial measuring for boys

Gender	Variables	MIN	MAX	AS	S	Sk	Kurt	KS
	Lorentz test	35	61	46,83	7,437	0,20	-0,93	0,68
Boys	Vital lungs capacity	1,0	4,1	2,970	0,652	-1,01	1,711	0,05
	Shuttle test (number of shares)	29	52	42,78	5,381	-0,57	-0,10	0,72

Not statistically significant deviation from the normal distribution in any of the analyzed variables of functional status of boys from the first experimental group was not found.

By the examination of the results in Table 3, it can be concluded that in the functional variables of the other control group in boys good discrimination power measurement for all of the measured variables, is represented, which in turn may be seen by regular analyzes of their arithmetic mean and standard deviations, where in all the analyzed variables within the context of an arithmetic mean there are three standard deviations at the initial measurement. Minimum and maximum measured results and their range are in the area of normal. Skewness values indicate no significant asymmetry of distribution in any of the variables in the initial

measurement in boys` functional abilities. Kurtosis values are in the zone of good and acceptable levels in all the measured variables.

Table 3. Basic descriptive indication of the variables of the second control group (K2) in the initial measuring for boys

Gender	Variables	MIN	MAX	AS	S	Sk	Kurt	KS
M	Lorentz test	28	59	45,06	8,394	-0,17	-0,70	0,811
	Vital lungs capacity	1,2	4,2	2,729	0,632	-0,38	0,960	0,397
	Shuttle test (number of shares)	26	45	35,71	4,562	0,03	-0,23	0,971

Not statistically significant deviation from the normal distribution in any of the analyzed variables of functional status of boys from the second experimental group is not found.

Analysis of the differences between the groups in the functional variables has been performed using univariant variance analysis, considering that it is a relatively independent indicator of the functional abilities of children.

Based on the obtained results (Table 4) we can conclude that in male subjects a statistically significant difference in a variable Shuttle run test appeared with the higher effect of the difference according to the criterion Cohen. K2 group achieved prominently lower values than the other two groups in this test.

Table 4. Differences between groups in the functional abilities of boys at the initial measuring

Variables	Gender	Group	AS	S	f	p	η^2
Lorenz test	Male	E	44,83	9,71	0,492	0,613	0,011
		K1	46,83	7,44			
		K2	45,06	8,39			
Vital capacity		E	2,95	,64	1,308	0,276	0,029
		K1	2,97	,65			
		K2	2,73	,63			
Shutle run test		E	41,83	6,92	**13,937**	**0,000**	**0,241**
		K1	42,78	5,38			
		K2	35,71	4,56			

Legend: Group: E-experimental, K1-first control; K2-second control; AS- arithmetic mean; S – standard deviation; f-value of invariant f-test; p-level of statistical significant invariant f-test;η^2 – partial eta squared (effect size)

Presented analysis of the initial state and the difference in the observed abilities of one experimental and two control groups of male subjects, show that on initial testing there were some differences in the level of development of analyzed skills. Therefore, in the further analysis of the differences and of the effects of the experimental treatment, the application of the covariance analysis is fully justified, and statistical equation of the analyzed groups is ensured.

By examining the results in Table 5, where the values for the functional capacities of the boys of the experimental group on the final measurement are displayed we can conclude that there is a good discrimination power measurement in males in the functional variables, considering that in all tested variables three standard deviations may be classified into one arithmetic mean. Minimal and maximum values and their range are well distributed in all variables, so there was no abnormal value in any of the variables. Analyzing the values of skewness a significant asymmetry of distribution in any of the variables was not shown because all the results were good or acceptable. In Lorentz test, the variable for assessing the adaptation of the organism to the physical demands based on the parameters of heart rate at rest, kurtosis value indicates to an increased dispersion of the results, or the reduced homogeneity of distribution. In this case, the distribution curve is flattened at thetop.

Table 5. Basic descriptive indication of variables of the experimental group (E) at the final measuring for boys

Gender	Variables	MIN	MAX	AS	S	Sk	Kurt	KS
M	Lorentz test	28,00	59,00	44,26	9,40	-0,20	-1,235	0,40
	Vital lungs capacity	1,90	4,70	3,10	0,67	0,11	-0,128	0,90
	Shuttle test (number of shares)	30,50	58,50	42,23	6,53	0,58	0,693	0,90

After examining the results in Table 6, where the values displayed for the functional capacities of the boys of the control group at the final measurement are displayed, it can be concluded that there were good discrimination power measurements in males in the functional variables, as in all tested variables three standard deviations may be classified into one arithmetic mean. The range of minimum and maximum measured values is well distributed in all the variables. Significant asymmetry of distribution was not observed in any of the variables, as results are good and acceptable that can be seen based on skewness coefficients. The variable *vital lung capacity* for the evaluation of the maximum amount of air the subject can exhale after a previous maximum inhalation, is expressed by the grouping of results around the arithmetic mean and the increased homogeneity of the distribution are expressed, which is manifested by peaky curve.

Table 6.Basic descriptive indications of the performance variables of the first control group (K1) at the final measuring for boys

Gender	Variables	MIN	MAX	AS	S	Sk	Kurt	KS
Boys	Lorentz test	32,00	61,00	46,30	7,52	0,019	-0,81	0,76
	Vital lungs capacity	1,00	5,20	3,136	0,78	-0,24	2,022	0,12
	Shuttle test (number of shares)	30,00	52,00	42,98	5,30	-0,53	-0,34	0,81

By examining, the values in Table 7, where the results of the functional capacities of the other control group of boys at the final measuring are presented, the good sensitivity of measuring in boys in all functional variables are found. Three standard deviations can be classified into one arithmetic mean of all variables depicted. A range between the minimum and maximum measured results are distributed and even in this segment, there is no discrepancy. In reviewing the results of skewness no significant asymmetry of distribution in any of the variables was registered because all the results are good or acceptable. Variables for the evaluation of the maximum amount of air the subject can exhale after a previous maximum inhalation *Vital lungscapacity*by its increased positive coefficient expresses shows grouping of results around the arithmetic mean andincreasedhomogeneity distribution,

Tabela 7. Basic descriptive indicators of functional variables other control group (K2) at the final measuring for boys

Gender	Variables	MIN	MAX	AS	S	Sk	Kurt	KS
Boys	Lorentz test	28,00	60,00	45,61	8,00	0,021	-0,630	0,838
	Vitallungs capacity	1,10	4,20	2,72	0,62	-0,31	1,106	0,583
	Shuttle test (number of shares)	26,00	42,00	35,19	4,09	-0,31	-0,459	0,704

Tabela 8. Differences betwee groups in functional indicators of the boys at final measuring

Variables	Gender	Group	ASk	f	p	η^2
Lorents test	Boys	E	44,97	**4,760**	**0,011**	**0,101**
		K1	45,08			
		K2	46,11			
Vital capacity		E	3,06	**4,798**	**0,011**	**0,101**
		K1	3,09			
		K2	2,81			
Shuttle run test		E	40,57	**13,325**	**0,000**	**0,239**
		K1	40,47			
		K2	39,24			

Legend: Group: E-experimental, K1-first control; K2-second control; ASk – corrected arithmetic mean finally; f-value of univariant ftest; p-level of statistical significance of univariant ftest; η^2 – partial eta squared(effect size)

With male subjects in the variables for the evaluation of functional capacities at the final measuring (Table 8) statistically significant differences at the level of estimates of p <= 0.01, with much higher effect of the differential, especially in a variable Shuttle run test was shown.

4. CONCLUSION

With male subjects in the functional abilities at the final measuring, significant differences were obtained with a lot of higher effect of the differential, especially in a variable *Shuttle run test.* In the variable *Vital capacit*y, there was no significant difference. Analysis of quantitative changes between the initial and final measuring for the functional variables showed that experimental group boys in all three variables achieved significantly higher average values. In the first control group, significant differences in male subjects in the variables Lorenz test and Shuttle test run were received. Another control group achieved better average values in the variable Shuttle run test at the male subjects. At a dosage of the training process, and the duration, extracurricular acyclic activities improve functional abilities of the participants if this activity was carried out three times a week during five weeks (Ouergui, et al., 2014; Diamond, & Lee, 2011), which is in accordance with the results obtained in this study. It is also demonstrated that 10 minutes a day, three times a week, has a positive effect on metabolic processes in children (Nogueira, Weeks, & Beck, 2014).

Finally it can be noted that the subjects of the experimental group that had an additional program of physical exercises based on taekwondo (extracurricular acyclic activities) implemented and focused on the development of functional abilities, gave good results in the reduction of aerobic and anaerobic capacity, which dominated in the program of additional physical exercises

Sublimating results achieved by programmed physical activities for boys in the control group one, good results in terms of reduction of functional abilities are also achieved.

In children, in a control group that did not have any additional physical exercises, there were not major changes, which indicate that the compulsory program of physical education in elementary schools is not sufficient stimulus for changes and improvement of some parts of the anthropological status of the students, in this case specifically functional abilities.

5. REFERENCES

1. Bouhlel, E., Jouini, A., Gmada, N., et al. (2006). Heart rate and blood lactate responses duringTaekwondo training and competition. *Science & Sports*, 21, 285–290.
2. Bu B., Haijun, H., Yong, L., Chaohui, Z., Xiaoyuan, Y., & Fiatarone Singh M. (2010). Effects of martial arts on health status: A systematic review. *Journal of Evidence-Based Medicine, 3,* 205–219.
3. Bujak, Z. (2005). Analysis of Taekwon-do Exercise Performed by Students. *Physical Education and Sport*, 49, 114-117.

4. Butios, S, & Tasika, N. (2007). Changes in heart rate and blood lactate concentration as intensity parameters during simulated Taekwondo competition. *Journal of Sports MedicinePhysical Fitness*, 47(2), 179-185.
5. Capranica, L., Lupo, C., Cortis, C., Chiodo, S., Cibelli, G., Tessitore, A. (2012). Salivary cortisoland alpha-amylase reactivity to taekwondo competition in children. *Europe JournalApplied Physiology*, 112(2), 647-652.
6. Chiodo, S., Tessitore, A., Cortis, C., Cibelli, G., Lupo, C., Ammendolia, A., De Rosas M.,&Capranica, L. (2009). Stress-related hormonal and psychological changes to official youthTaekwondo competitions. *Scandinavian Journal of Medicine & Science in Sports, 21*(1),111–119.
7. Diamond, A., Lee, K. (2011). Interventions shown to Aid Executive Function Development in Children 4–12 Years Old. *Science,333*(6045), 959-964.
8. Foran, B. (2010). *Vrhunski kondicioni trening*. Beograd: Data status.
9. Granić, I., Krstić, T. (2006). Razlike u nekim antropometrijskim, motoričkim i funkcionalnimvarijablama između mladih košarkaša i učenika osmih razreda. U *Zborniku radova 15. Ljetne škole kineziologa Hrvatske,"Kvalitet rada u području edukacije, sporta, sportskerekreacije ikineziterapije"* (107-114). Zagreb: Hrvatski kineziološki savez.
10. Helsinška deklaracija za Biomedicinska istraživanja (1964)
11. Mišigoj-Duraković, M. (2006). *Kinantropologija - biološki aspekti tjelesnog vježbanja*. Zagreb:Kineziološki fakultet.
12. Nogueira, R.C., Weeks, B.K., & Beck, B.R. (2014). Exercise to improve pediatric bone and fat: a systematic review and meta-analysis. *Medicine and Science in Sports and Exercise, 46*(3), 610-621.
13. Ouergui, I., Haddad, M., Padulo, J., Gmada, N., Bouhlel, E., Behm, D.G**.** (2014). PhysiologicalResponses to Taekwondo Competition and Specific Training. In Haddad, M. (ed.) „*Performance Optimization in Taekwondo: From Laboratory to Field"* (pp. 2-10). Foster City: OMICS Group eBooks.

Received; May, 10. 2017
Revision received; June, 2. 2017
Accepted; July, 5. 2017
Correspondence:
Dalibor Stevic
University of East Sarajevo, Teachers' Training Faculty
Phone: +38765841176