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Original scientific paper

THE INFLUENCE OF RECREATIONAL ACTIVITIES ON THE FUNCTIONAL ABILITIES OF STUDENTS

Davorin Okiljević
Faculty of Physical Education and Sport, University of East Sarajevo, B & H
Darko Stojanović[1]
Faculty of Sport and Physical Education, University of Niš, Serbia
Ashrf N. Abohllala
Faculty of Sport and Physical Education, University of Niš, Serbia

Abstract: The basic aim of this research was to analyze the influence of recreational swimming content on the functional abilities of students. The research was carried out on a sample of 216 male students of the University of Niš, divided into 2 subsamples, 104 of which made up the experimental group which incorporated swimming content in their exercise and 112 who belonged to the control group which did not take part in any recreational activities. In order to evaluate the functional abilities of the students, the following tests were used: vital lung capacity, resting heart rate, absolute maximal oxygen uptake, relative maximal oxygen uptake and maximal anaerobic capacity. By applying a recreational swimming program for the duration of a semester, the experimental group achieved an increase in their functional abilities. It was noted in the increase in vital lung capacity (4.8%) and absolute (3.0%) and relative (4.3%) maximal oxygen uptake, as well as a reduction in resting heart rate (-2.2%), which justifies the implementation of these types of exercises in recreational programs for the development of these abilities. In the case of the control group, a reduction in maximal aerobic capacity was noted, as was an increase in resting heart rate.

Key words: *recreational program, swimming, functional abilities, students.*

✉ [1] darko89_nish@hotmail.com

INTRODUCTION

The human body represents a unique organized whole, comprised of a series of dimensions of a psycho-somatic status. That an entire group of factors can have a positive or negative effect on the changes to these dimensions has been indicated by several authors (Mirvić et al., 2012; Stanković et al., 2016). Numerous analyses and studies indicate that man has become dependent on the modern way of life and that very few men use physical activity, even less so than is naturally needed, which inevitably leads to a decrease in the level of functional abilities (Pantelić et al., 2006). People increasingly avoid activities which are difficult and excessively fatiguing and not suited to their individual and personal needs, and which during their performance do not help them feel better (Matavulj et al., 2014). The results of extensive research have indicated that individuals who exercise regularly and take part in properly organized and individually dosed physical activity are less prone to cardiovascular and psychosomatic illnesses (Veljović, 2009).

Experience with working with a student population suggests a solution in the form of compensation for the negative influences of the modern way of life, by applying well-organized and professionally programmed physical activities. The aforementioned activities should be a daily need, due to the adaptation of the human body to new living conditions, the influence on one's health status (Nikolić, 2003; Clisouras, 2013), the improvement in work abilities, or with the aim of active rest and recreation of younger generations. Recreational exercise includes regular physical exercise over sufficient and regular time intervals (Živković, 2005). If children and students get used to daily physical exercise and if it were to become an obligatory element in their regimen and lifestyle, they can perform it well into their old age. The positive effects of these exercises are always present, on the condition that they are in accordance with one's physical potential (Nikolić, 2003). In order to prevent the insufficient development of the anthropological dimensions of the student population, which is indicated by Đurašković (2002), it is necessary to organize programmed recreational exercise (Blagajac, 1987), so as to directly influence the effectiveness of the transformational process. Practice has indicated that every student has special traits and a special dynamic of development. Planned and programmed recreational exercise, in addition to the influence on the development and stabilization of anthropological dimensions, which has been proven by several authors (Yfanti et al., 2014; Papec et al., 2014; Nikolić & Stojanović, 2007), and its preventive and corrective effect, leads to an easier and more adequate performance of the duties of students within their study regime, which in the overall context means better preparation for the challenges which students face in their future professions in order to provide for themselves in modern society.

The basic aim of this experimental research is to analyze the efficacy of a recreational program with swimming content. Regarding the set aim, the basic hypothesis is that the experimental group would achieve a statistically significant increase in functional abilities compared to the control group.

METHOD

Participants

The population used to compile the sample for this research was defined as the population of male students, aged 19 to 26, clinically healthy and with no physical aberrations. One of the more important criteria for the selection of the sample was that the students regularly attended their courses during the 2011/2012 school year, and that they voluntarily opted to participate in the experimental group for SWIMMING (E) or the control group (CG). The experimental group (E) consisted of the students of the University of Niš, who voluntarily opted to, over regular time intervals, and in the form of recreational physical activities, only take part in swimming three times a week, following a previously determined plan and program. This group was divided into four subgroups, each of which numbered 26 students, so that these classes were actively attended by 104 students. The control group consisted of 112 students from the various faculties of the University of Niš. The participants of this group (CG) did not take part in regular and organized recreational physical activities, and so the overall number of students whose data was included in the analysis included only those who had been measured and tested at the beginning and end of the experiment, over regular time intervals. For practical reasons, most students from this group were students of the Faculty of Medicine.

Variables

To define the functional space, five tests were used, including: vital lung capacity (VLC), resting heart rate (RHR), absolute maximal oxygen uptake ($AMUO_2$), relative maximal oxygen uptake ($RMUO_2$) and the test of maximal anaerobic capacity according to Astrand (MACA). In the selection of variables we used the experience compiled in current research on the student population, where an attempt was made to take into consideration the fact that the choice should meet metric characteristics (validity, reliability and objectivity).

A description of the experiment

The experimental program consisted of swimming various distances following an interval method, which was realized from October 3, 2011, with the beginning of the new school year at the University of Niš and lasted without interruption until January 13, 2012, that is, for the course of one semester or for a total of 45 classes (the duration of one class was 60 minutes). This time was evaluated as the most suitable for influencing changes in the studied values in a qualitative sense, considering the summer break and the initial state of the participants' abilities. This period was divided into 4 cycles, the first three lasting 4 weeks each, while the fourth one lasted 3 weeks. The extent of the load during the first cycle was 600 m (3x4x50 m), during the second and third 500 m (2x5x50 m) and the fourth 400 m (2x4x50 m). The intensity increased progressively, so that during the first cycle it was 60%, during the second 70%,

during the third 80%, and during the fourth 90%, while it was controlled by measuring the pulse in the range from 120-180 b/min. Rest time between swimming distances was 2-3 min, and between series 3-5 min. The swimming exercises took place following a warm-up on dry land for a period of 15-25 min. At the beginning of the experimental program, we performed the initial measurement, and at the end, the final measurement of all the tests included in the research, with the aim of determining the variability of the results from the initial to the final state of the functional abilities of the students of both the experimental and control group. With the aim of improving the adaptability of the physiological functions and increasing them to a higher level as best as possible, occasionally during the experiment the values and dynamics of heart rate and breathing frequency were evaluated. By registering the changes during work, there was a direct influence on the further progressive increase in the intensity of the activities.

Methods of data processing

With the aim of determining the influence of the recreational exercise program, it was necessary to determine the extent of the improvement achieved by each of the groups between the initial and final measurement in the research space. With that aim in mind, we used the ANOVA – Repeated measures analysis, while the significance of the differences between two measurements was presented through the value of the F test and the coefficient of significance of the differences in the arithmetic means (p) for each variable. In order to analyze the possible inter-group differences at the final measurement of the functional abilities, by applying the ANCOVA analysis of variance we calculated the adjusted means and expressed the significance of their differences through the values of the F test and the coefficient of significance of these differences (p) for each variable. Actually, by means of this analysis we can neutralize the possible differences at the initial inter-group measurement. Changes in the percentages (%Δ) between the initial (I) and final (F) state were calculated using the following formula: $[(F - I)/I] \times 100$.The data were processed using the statistical package STATISTICA 7.0 for Windows (StatSoft, Inc., Tulsa, OK).

RESULTS

Tables 1 and 2 show the descriptive parameters of the functional abilities of the experimental and control group, where based on the values of skewness and kurtosis of the distribution curve of the results, it can be noted that they are in the zone of normal distribution, and so the reasons for applying parametric statistical methods in further analysis of the results were justified.

Table 1. *Descriptive parameters of the functional abilities of the experimental group (E).*

Test	Measu	N	Mean	Min.	Max.	Std.Dev.	Skew.	Kurt.
VLC (cm^3)	Initial	104	4328.85	3000.00	6000.00	654.44	0.37	-0.40
	Final	104	4534.62	3200.00	6300.00	628.57	0.49	-0.08
RHR (r/min)	Initial	104	81.90	60.00	100.00	8.99	0.11	-0.95
	Final	104	80.13	60.00	96.00	8.23	-0.05	-0.70
AMUO2 (l/min)	Initial	104	2.97	1.60	5.30	0.67	0.72	0.78
	Final	104	3.06	1.70	5.30	0.66	0.77	1.12
RMUO2 (ml/kg/min)	Initial	104	39.84	27.27	57.14	6.44	0.90	0.59
	Final	104	41.57	30.90	59.42	6.29	0.98	0.64
MACA (ml/kg/min)	Initial	104	42.87	26.62	61.95	7.75	0.16	-0.44
	Final	104	43.00	29.66	64.53	7.17	0.20	-0.20

Legend: N – number of participants; Mean – arithmetic mean; Min. – minimal result; Max. – maximal result; Std.Dev. – standard deviation; Skew. – skewness; Kurt. – kurtosis.

Tabela 2. *Descriptive parameters of the functional abilities of the control group (CG).*

Test	Measu	N	Mean	Min.	Max.	Std.Dev.	Skew.	Kurt.
VLC (cm^3)	Initial	112	4756.25	3300.00	6100.00	677.81	-0.13	-0.87
	Final	112	4751.79	3400.00	6100.00	683.66	-0.09	-0.98
RHR (r/min)	Initial	112	82.68	68.00	96.00	6.97	0.24	-0.77
	Final	112	84.00	72.00	96.00	5.95	0.32	-0.63
AMUO2 (l/min)	Initial	112	2.89	1.90	4.20	0.51	0.43	-0.42
	Final	112	2.95	2.10	4.20	0.47	0.42	-0.05
RMUO2 (ml/kg/min)	Initial	112	37.46	26.50	52.00	4.67	0.59	0.44
	Final	112	37.57	29.97	50.00	4.01	0.74	0.61
MACA (ml/kg/min)	Initial	112	43.94	26.80	59.50	7.46	-0.11	-0.57
	Final	112	42.80	25.90	57.00	6.80	-0.13	-0.47

Legend: N – number of participants; Mean – arithmetic mean; Min. – minimal result; Max. – maximal result; Std.Dev. – standard deviation; Skew. – skewness; Kurt. – kurtosis.

The results of the analysis of the differences between the initial and final state indicate that in the case of the experimental group (Table 3) significant improvements in all the functional abilities occurred, except for maximal anaerobic capacity (MACA), where no significant progress was made. In the case of the control group (Table 4) an improvement in the results was evident in

the absolute maximal oxygen uptake (AMUO2), and a decrease in the resting heart rate (RHR) and maximal anaerobic capacity (MACA).

Table 3. *Differences between the initial and final measurement of functional abilities of the experimental group (E).*

Test	**Mean diff.**	**%Δ**	**F** (1; 103)	**p**
VLC (cm^3)	205.77	4.8	529.52	0.000*
RHR (r/min)	-1.77	-2.2	27.52	0.000*
$AMUO_2$ (l/min)	0.09	3.0	41.98	0.000*
$RMUO_2$ (ml/kg/min)	1.73	4.3	73.18	0.000*
MACA (ml/kg/min)	0.13	0.3	0.19	0.667

Legend: Mean diff. – arithmetic mean difference; %Δ – percentage of arithmetic mean difference; F – value of the F-test for testing the significance of the arithmetic means differences; p – significance coefficient of arithmetic means differences.

Table 4. *Differences between the initial and final measurement of functional abilities of the control group (CG).*

Test	**Mean diff.**	**%Δ**	**F** (1; 111)	**p**
VLC (cm^3)	-4.46	-0.1	0.01	0.910
RHR (r/min)	1.32	1.6	10.07	0.002*
$AMUO_2$ (l/min)	0.06	2.1	8.10	0.005*
$RMUO_2$ (ml/kg/min)	0.11	0.3	0.15	0.699
MACA (ml/kg/min)	-1.14	-2.6	5.58	0.020*

Legend: Mean diff. – arithmetic mean difference; %Δ – percentage of arithmetic mean difference; F – value of the F-test for testing the significance of the arithmetic means differences; p – coefficient of significance of arithmetic means differences.

Table 5 shows the univariate differences in certain functional tests between the experimental and control group at the final measurement with a neutralization and partialization of the differences in the functional space at the initial measurement, where there is a clearly significant inter-group difference in all the tests at the significance level of 0.05 ($p<0.05$). The participants of the experimental group had improved their results, in the form of an increase in vital lung capacity (VLC), resting heart rate (RHR), relative maximal oxygen uptake ($RMU0_2$) and maximal anaerobic capacity (MACA), while in the case of absolute maximal oxygen uptake ($AMUO_2$), it was not determined that they achieved better results than the participants of the control group.

Table 5. *Differences in functional abilities between groups in final measurement.*

Test	**Adj. Mean**		**F** (1; 209)	**p**
	E	CG		
VLC (cm^3)	4715.10	4571.30	10.94	0.001*
RHR (r/min)	80.38	83.76	41.74	0.000*
$AMUO_2$ (l/min)	3.03	2.99	2.45	0.119
$RMUO_2$ (ml/kg/min)	40.57	38.58	28.50	0.000*
MACA (ml/kg/min)	43.55	42.24	5.72	0.018*

Legend: Adj. Mean – adjusted means; F – value of the F-test for testing the significance of the arithmetic means differences; p – coefficient of significance of arithmetic means differences.

DISCUSSION

In the discussion of the statistical analyses we can point out that by following a recreational swimming program, the experimental group increased their functional abilities. A more significant increase in vital capacity, absolute and relative maximal oxygen uptake and maximal anaerobic capacity, as well as a decrease in resting heart rate, was determined for the experimental group, which included swimming content in its exercise program. Thus, it was justified for this type of exercise to be applied in recreational exercise for the development of these abilities. An increase in absolute maximal oxygen uptake was achieved by the experimental group in the range from 2.97 to 3.06 l/min, which in percentage is 3%, and the relative maximal oxygen uptake from 39.84 to 41.57 ml/kg/min, or an increase of 4.3%. Resting heart rate (average values) among the students of the experimental group had a value of 80.13 beats per minute. These values are somewhat higher in comparison to the average values achieved by athletes (soccer players and handball players), while they are lower compared to men who are not involved in sport (Đurašković, 2002). This can be explained by the fact that the participants did not exercise within the limits of a submaximum and maximum work load, which could lead to the dominance of the effects of the parasympathetic (n. vagus) over the sympathetic nervous system. In addition, it is well known that programmed and properly dosed physical activity leads to bradycardia (Sačer, 2016), which could be used to account for the low heart rate frequency of our participants, compared to those who do not take part actively in physical activities. Similar results were obtained in the study by Đurašković (2002), Nikolić (2003) and Živanić (2004). The swimming program significantly influenced the increase in vital lung capacity. This increase ranged from 4328.85 cm^3 at the initial to 4534.62 cm^3 at the final measurement, which is the largest increase of 4.8%, which was confirmed in some earlier studies (Wells et al., 2005; Vaithiyanadane et al., 2012; Aydin & Koca, 2014).

CONCLUSION

Based on the analysis of the research results, we can conclude that the experimental program of recreational physical activities with swimming content gave significant results for the improvement of maximal anaerobic capacity and maximal absolute and relative oxygen uptake, the increase in vital lung capacity, as well as the decrease in the resting heart rate. Based on these results, the research could in general be used to conclude that the applied experimental swimming program had a positive effect on the improvement of the functional abilities of the male participants from the student population. The implementation of regular forms of recreational activities is mostly of importance for the preservation of health and the improvement of the function of the respiratory and cardiovascular system. This research could have varied in scientific and practical significance in terms of the application of the research results, which can relatively easily be applied in practice, since they offer insight into scientifically verified programs of regular recreational activities. The results of this research could also have a positive effect on the motivation of the participants for systematic participation in recreational activities, considering that hypokinesis is a frequent occurrence among individuals of this age. Of course, many questions have been left open which require adequate responses. One of these questions is to determine which exercises have significantly contributed to the determined differences between the experimental and control group. The second question refers to the influence of the other leisure activities of the participants, which to a great percentage can influence the positive or negative reactions of the human body, and which cannot be controlled. What is left is for a greater number of measuring instruments to be used in further similar studies, and for an increasingly larger number of factors which influence changes in the studied dimensions to be kept under control. Finally, we cannot rule out the possibility that this and other similar studies can open other questions as well, to which in the current point in time we cannot offer fully valid responses, which will in any case represent additional motivation for further professional and scientific verification of studies of this kind.

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