SPORT AND HEALTH

SCIENTIFIC JOURNAL FIELD OF PHYSICAL EDUCATION AND SPORT

Vol. XIV, No 1 2019 ISSN 1840-152X ISSN 2637-2703

http://www.sportizdravlje.rs.ba

SPORT AND HEALTH

SCIENTIFIC JOURNAL FIELD OF PHYSICAL EDUCATION AND SPORT

Vol. XIV, No. 1, 2019. ISSN 180-152X ISSN 2637-2703

http://www.sportizdravlje.rs.ba

SPORT AND HEALTH

SCIENTIFIC JOURNAL FIELD OF PHYSICAL EDUCATION AND SPORTS

Published by
University of East Sarajevo
Faculty Physical Education and Sports

Editorial Office
Faculty Physical Education and Sports
University of East Sarajevo
Stambulcic bb, 71420 Pale, Bosnia and Herzegovina
tel/fax: 00387 (0)57 226 836
e-mail: dekanat@ffvis.ues.rs.ba

Editor in Editorial Staff: PhD Milomir Trivun, full Professor
Secretary offices: PhD Nenad Lalic, full Professor
Translation into english: PhD Jelena Grahovac (12-22)
Cover: Fog to Maglic Mountain
Cover Edited: PhD Milomir Trivun, full Professor
Copies: 300

Printed by: „KOPIKOMERC“ East Sarajevo

UDC 796.011/797(05)

S P O R T A N D H E A L T H

ISSN 1840-152X ISSN 2637-2703 Pale, 2019. vol 14, No 1: pp. 5-54 UDC 796

CONTENTS 2019/1

Orginalni scientific paper
Novica Gardaševic, Dejan Ceremidzic, Aleksandar Vujkovic
DOI: 10.7251/SIZEN0119005G
THE DIFFERENCES IN SITUATION SUCCESS BETWEEN THE ABA LEAGUE BASKETBALL PLAYERS IN SEASON 2018/19.....5

Orginalni scientific paper
Goran Grahovac, Bojan Guzina, Goran Pasic
DOI: 10.7251/SIZEN0119012G
CREATIN AS A SUPPLEMENT IN NUTRITION AND EFFECTS ON SWIMMING.....12

Orginalni scientific paper
Bojan Guzina, Miroslav Markovic
DOI: 10.7251/SIZEN0119023G
EFFECT OF EXERCISE ON THE FUNCTIONAL ABILITIES OF SECONDARY SCHOOL STUDENTS.....23

Orginalni scientific paper
Miloslav Markovic, Jelena Arnautovic, Sanja Gligoric
DOI: 10.7251/SIZEN0119032M
THE EFFECTS OF THE CONDITIONAL PREPARATION EXERCISE MODEL ON FLEXIBILITY OF YOUNG ATHLETES…….....32

Orginalni scientific paper
Ilija Stijepic
DOI: 10.7251/SIZEN0119041S
EFFECTS OF A 12-WEEK STRENGTH AND BALANCE EXERCISE PROGRAM ON FUNCTIONAL FITNESS OF OLDER MEN…….....41

Orginalni scientific paper
Milomir Trivun, Novica Gardasevic, Boris Janjic
DOI: 10.7251/SIZEN0119047T
SITUATION EFFICIENCY INDICATORS RELATIONS DEPENDING ON THE OUTCOME OF WATER POLOMATCHES.....47

Manual for Autors.....54

ORGINAL SCIENTIFIC PAPER

Novica Gardasevic[1], Dejan Ceremidzic[2], Aleksandar Vujkovic[3]
[1] Doctoral studies Student, Faculty of Physical Education and Sport, University of East Sarajevo
[2] Faculty of Physical Education and Sport, University of East Sarajevo
[3] PI High School "Stojan Cerovic" Niksic

UDK:796.323.2
DOI: 10.7251/SIZEN0119005G

THE DIFFERENCES IN SITUATION SUCCESS BETWEEN THE ABA LEAGUE BASKETBALL PLAYERS IN SEASON 2018/19

Summary:

The aim of the study was to determine whether there are statistically significant differences in the situational efficiency parameters between domestic (ex YU) and foreign (out of ex YU) basketball players, the players of the Adriatic Basketball League (ABA League) in the 2018/19 season. The study analyzed 20 parameters of situational efficiency. Using Mann–Whitney U test, it was found that there are statistically significant differences among the basketball players in 7 of the 20 analyzed variables. Players foreigners statistically significantly more lose and win the ball, hit and miss the 2- pointshot and more often block the opponent's shot. Based on the differences, it was concluded that the players foreigners are, much more in contact with the ball than the domestic players. The general conclusion is that the basketball game in the ABA League for the 2018/19 season was focused on players foreigners, which could have a certain impact on the affirmation of players from the former Yugoslavia.

Key words: *ABA league, basketball, situational success, Mann–Whitney U test, differences*

INTRODUCTION

Basketball is a collective sport game in which the goal is to score more points than opponents and thus win. Since 1891, when Dr. James Naismith has invented basketball, until today, basketball has been intensively developed and has become one of the most popular sports branches. The intense development of basketball required the need to monitor efficiency both individually and team as a whole. Monitoring implies numerical definition of situational efficiency, through standard and implemented parameters in the game. For the purpose of easier monitoring of situational efficiency, the International Basketball Federations(FIBA-Federation International Basketball Association) standardized the situational efficiency parameters that are monitored at each official match. According to Malacko& Radjo (2004), the data on the situational efficiency of the team and individual athletes are based on new requirements in every scientific and professional activity where informatics play a very important role in its overall development.

Situational efficiency in basketball, through the analysis of standard parameters of the game, is the subject of research by the scientific public (Ceremidzic D., &Ceremidzic T., 2010; Gardasevic, Ceremidzic, & Markovic, 2018; Sindik, Jukic, &Adzajlija, 2012; Subotic&Ceremidzic, 2017;Uzelac, Milanovic, &Stefan, 2016;Vareslija, 2014).

The Adriatic Basketball League (English: Adriatic basketball league – ABA) is a basketball competition founded in 2001, intended primarily for clubs from the former Yugoslavia (ex YU)

republics (Montenegro, Serbia, Bosnia and Herzegovina, Slovenia, Croatia and Northern Macedonia). Special invitations by the organizers of the league (English: Adriatic Basketball Association) to participate in the ABA League were occasionally taken by teams outside the territory of the former Yugoslav republics; Maccabi Tel Aviv (Israel), Nimbruk (Czech Republic), SolnokOlaj (Hungary), Levski Sofia (Bulgaria).The imperative of the ABA League winner, secures placement in Euro-league, while the defeated finalists and semi-finalists will be given the opportunity to participate in Euro-cup. In the basketball season of 2018/19, the Adriatic League played 12 clubs from 5 former Yugoslav republics; BuducnostVoli and Mornar Bar (Montenegro), Red Star MTS, Partizan NIS, FMP, Mega Bemax (Serbia), Zadar, Cibona, Cedevita (Croatia), Petrol Olimpija, Krka (Slovenia) and Igokea (Bosnia and Herzegovina). The former Yugoslav Republic of Northern Macedonia did not have a representative in the 2018/19 season. In previous seasons, Northern Macedonia was represented by clubs KarposSokoli and MZT Skopje Airport in the Adriatic Basketball League.

In addition to the fact that the Adriatic Basketball League is primarily aimed for affirmation of players from the territory of the former Yugoslav republics, more and more foreigners (players outside the ex YU) take part in the season. In the season 2018/19, in the regular part of the competition (22 rounds to semi-finals), about 59 players outside the ex YU area played the Adriatic League (29.80%), while there were about 139 players from the ex YU area (70.20%). Most foreign players come from the United States (USA).

According to the above, the subject of research is the standard (basic and performed) parameters of situational efficiency, basketball players of the ABA league.

The aim of the research is to determine the differences in the situational efficiency parameters between domestic (ex YU) and foreign (outside of ex YU) basketball players, the players of the Adriatic Basketball League (ABA League) in the 2018/19 season.

METHOD OF WORK

Examinee sample

The Examinee sample included 162 basketball players from 12 clubs that played Adriatic basketball league (ABA league) in the 2018/19 season. The sample included players who played on 7 or more matches of the regular part (22 rounds) of the competition, which is about 32% of the total possible performance. The Examinee sample is subdivided into 2 sub-samples:

- 121 basketball players born in the former Yugoslav republics (Montenegro, Serbia, Bosnia and Herzegovina, Slovenia, Croatia and Northern Macedonia),
- 41 basketball players born outside of the former Yugoslav republics.

Variables sample

The variables sample included 20 standard (basic and derived) parameters of the situational efficiency of basketball players, defined by the International Basketball Federation (FIBA);

1. a successful 1-point shot (ŠUT1U)),11.jump in defense (SKOKO),
2. anunsuccessful 1-point shot (ŠUT1N),12.jump in attack (SKOKN),
3. percentage of shot for 1 point (ŠUT1%), 13.assistances (ASIST),
4. a successful 2- point shot (ŠUT2U), 14.stolen balls (UKRAL),
5. an unsuccessful 2- point shot (ŠUT2N),15lost balls (IZGBL),
6. percentage of shot for 2 points(ŠUT2%),16. fouls (FAUL),
7. a successful 3-point shot (ŠUT3U), 17. blocked shot(BLOK),
8. neuspješanšut za 3 poena (ŠUT3N),18. total points (POEN),
9. an unsuccessful 3-point shot (ŠUT3%), 19.success index (INDEX),
10. total percentage of shots (UŠUT%),20. total time spent in the game (MIN).

Variables included in this research were analyzed in some of the previous studies (Gardasevic et al., 2018; Milanovic, Jukic, &Bracic, 2001;Nakic 2004, Sindik et al., 2012;Vareslija 2014). Results for all variables are taken from the official ABA League website (https://www.aba-liga.com/).

Data processing methods

Adequate mathematical-statistical methods and procedures were used for processing, data entry and analysis of results. For all application of the variable, the basic descriptive indicators are calculated; arithmetic mean, minimum and maximum values and standard deviation. The regularity of the distribution was tensed using the Kolmogorov–Smirnov test. Of the statistical procedures, Mann–Whitney U test was used to determine the differences between the subjects. Data processing is performed in the IBM software package SPSS 20.0 for Windows.

RESULTS AND DISCUSSION

Table 1.
Descriptive parameters of applied variables

Variables	N	Min	Max	Mean	St. Dev.	KS	p
ŠUT1U	162	.00	109.00	25.89	21.15	**1.95**	**0.00**
ŠUT1N	162	.00	68.00	9.95	9.66	**2.30**	**0.00**
ŠUT1%	162	.00	100.00	71.14	15.77	**1.35**	**0.05**
ŠUT2U	162	1.00	100.00	30.21	21.47	1.30	0.06
ŠUT2N	162	2.00	95.00	27.49	17.32	**1.46**	**0.02**
ŠUT2%	162	16.70	77.30	50.02	11.10	0.85	0.46
ŠUT3U	162	.00	48.00	13.54	12.28	**1.72**	**0.00**
ŠUT3N	162	.00	83.00	26.42	21.64	**1.50**	**0.02**
ŠUT3%	162	.00	100.00	29.29	17.43	**1.35**	**0.05**
UŠUT%	162	17.60	65.60	44.28	9.27	0.71	0.68
SKOKO	162	3.00	115.00	35.51	22.32	1.20	0.10
SKOKN	162	1.00	66.00	15.18	12.57	**1.65**	**0.00**
ASIST	162	1.00	126.00	27.42	25.26	**2.29**	**0.00**
UKRAL	162	1.00	44.00	10.94	7.77	**1.69**	**0.00**
IZGBL	162	.00	56.00	20.62	13.02	**1.50**	**0.02**
FAUL	162	5.00	71.00	37.32	16.03	0.80	0.54
BLOK	162	.00	39.00	4.30	6.36	**3.17**	**0.00**
POEN	162	10.00	334.00	126.95	76.76	1.11	0.17
INDEX	162	-23.00	477.00	132.58	92.83	1.04	0.22
MIN	162	45.00	726.00	309.14	153.66	1.12	0.16

Legenda: *__N__ – examinee number__Min__. – minimal result, __Max.__ – maximal result__Mean__ – arithmetic mean, __St. Dev.__ – standard error of arithmetic mean, __KS__ – Kolmogorov- Smirnov test, __p__ – significance of KS test.*

Table 1 shows the descriptive parameters of the applied variables of the situational efficiency of the basketball players of the ABA league in the 2018/19 season. Given that all the players' results who played on 7 or more games are covered, there are significant differences between minimum and maximum results in all variables. The dispersal of the results caused the violation of the normal distribution, which was concluded on the basis of statistical significance (p) for the results of the Kolmogorov Smirnov test in 11 variables. According to the violation of the distribution of the results,

the determination of the differences between the situational efficiency of the basketball player was realized using the nonparametric statistical method of Man - Whitney U test.

Table 2.
The Results of Mann-Whitney U test

Varijabla	Grupa	Mean Rank	Median	MVU	p
ŠUT1U	1	78.46	19.00	2848.50	.15
	2	90.48	22.00		
ŠUT1N	1	78.90	7.00	2795.50	.22
	2	89.18	7.00		
ŠUT1%	1	80.26	73.10	2631.00	.56
	2	85.17	74.50		
ŠUT2U	1	75.44	26.00	3214.00	**.05**
	2	**99.39**	**36.00**		
ŠUT2N	1	76.23	23.00	3118.50	**.01**
	2	**97.06**	**29.00**		
ŠUT2%	1	79.96	51.50	2666.50	.47
	2	86.04	50.80		
ŠUT3U	1	77.46	9.00	2969.00	.59
	2	93.41	14.00		
ŠUT3N	1	78.26	19.00	2873.00	.13
	2	91.07	25.00		
ŠUT3%	1	78.71	30.50	2818.00	.19
	2	89.73	34.20		
UŠUT%	1	77.91	42.90	2914.50	.09
	2	92.09	46.00		
SKOKO	1	78.15	31.00	2886.00	.11
	2	91.39	38.00		
SKOKN	1	81.77	13.00	2498.00	.90
	2	80.71	11.00		
ASIST	1	78.80	17.00	2807.00	.20
	2	89.46	27.00		
UKRAL	1	76.21	8.00	3120.50	**.01**
	2	**97.11**	**11.00**		
IZGBL	1	76.43	17.00	3094.00	**.01**
	2	**96.46**	**23.00**		
FAUL	1	79.93	37.00	2670.50	.46
	2	86.13	36.00		
BLOK	1	76.88	2.00	3040.00	**.02**
	2	**95.15**	**3.00**		
POEN	1	75.60	108.00	3195.00	**.00**
	2	**98.93**	**141.00**		
INDEX	1	75.88	112.00	3161.00	**.00**
	2	**98.10**	**161.00**		
MIN	1	78.19	268.00	2880.50	.12
	2	91.26	331.00		

Legenda: ***Group 1***–domestic players, ***Group 2*** – players foreigners, ***Mean Rank*** – arithmetic mean of rank, ***Median*** – medians, ***MVU*** – Man – Whitney U test, ***p*** –coefficient of difference significance.

Results of Man - Whitney U test in Table 2, have shown that in 7 of the 20 applied variables, there is a statistically significant difference between the ABA basketball players born on the territory of the former Yugoslav republics and the foreign basketball players in the situational efficiency parameters.

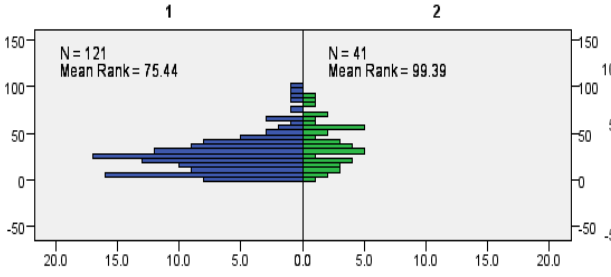
Statistically significant differences were made in variables; a successful 2-point shot, an unsuccessful 2-point shot, stolen balls, lost balls, blockade shots, total points and performance index. Basketball players foreigners had more successful 2-point shots (ŠUT2U - 36.00:26.00), they were significantly more likely to win or take the ball away (UKRAL - 11.00:8.00), they were more efficient in the block (BLOK - 3.00: 2.00). During the 22 rounds of the regular part of the competition, players foreigners scored significantly more points (POEN -141.00:108.00) and achieved a better index of success during the season (INDEX - 161.00: 112.00). Also, basketball players born outside the area of former Yugoslavia, significantly missed the 2-point shot (ŠUT2N - 29.00:23.00) and they lost the ball more often (IZGBL - 23.00:17.00). In the Table 2, apart from the arithmetic mean rank, (Mean Rank) median (Median) is presented for each variable , as a value that more realistically represents the relationship of differences between groups in variables (Pallant, 2017).

Comparing the value of the median as the central value in the distribution of results, with the average values for individual variables from other surveys, it was noted that there are certain differences. The average of a successful 2-point shot in the Croatia A-1 league (Sindik et al., 2012) for the 2006/07 season was 34.03 successful shots per player in the season, while in this research a successful 2-point shot was 26.00 shots domestic and 29.00 players foreigners in the 22 rounds of the regular part of the competition. On the basis of previous values, it would be wrong to conclude that Croatian clubs in the 2006/07 season were more efficient than ABA League clubs in the 2018/19 season. If we take into account the percentage of the 2 points shot, it is 38.88% (Croatian A-1 league), ie 51.50% domestic and 50.80% foreign players of the ABA league in the 2018/19 season. The average unsuccessful 2 points shots in the Croatian A-1 League for the 2006/07 season was 26.99 per player, which is more than the domestic players in the ABA league in the 2018/19 season (23.00), or less compared to the foreigners (29.00) from the ABA League.

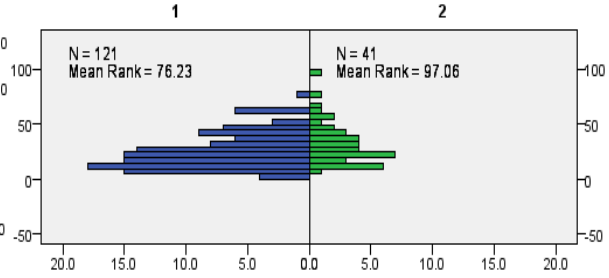
The percentage of 3- point shot was higher in both domestic (30.50%) and foreign players (34.20%) of the ABA league compared to national team players (25.75%) of the London 2012 Olympic Games (Vareslija, 2014) .By comparing the results of the same survey, players at the 2012 Olympics, on average, won 3.12 balls and lost 6.78 during the championship, while in the ABA league, home and foreign players won the ball at 8.00:11.00 and lost in ratio 17.00:23.00 per season. The number of games in the Olympic Games is significantly lower than the 22 regular season games in the ABA league, which significantly affects the differences in the above parameter.

Compared to the percentage of 3-point shots with players from Euro league for the first part of the 2016/17 season (Ceremidzic&Delic, 2016), it was concluded that the domestic (30.50%) and the foreign (34.20%) players of the ABA League had a poorer percentage of shots compared to Euroleague players where the percentage was 37.22%. Compared with NBA players for the first part of the 2016/17 season (Ceremidzic&Delic, 2016), the percentage of the shot of foreigners from the ABA League was almost identical with NBA players 34.20 - 34.40.

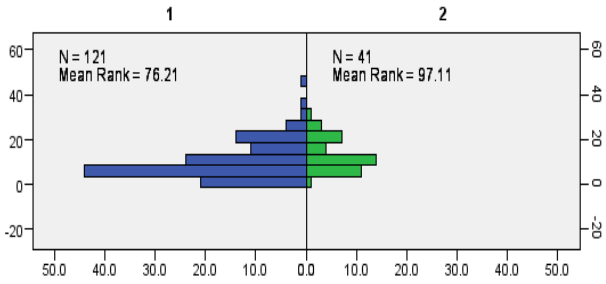
Based on the results obtained, it can be noted that the players foreigners are much more in touch with the ball and that they are much more "spending the ball" in relation to domestic players. This is indicated by the fact that they lose much more and win the ball, hit and miss the 2- point shot, and that they often block the opponent's shot. Surely,this situation suppresses the creativity and efficiency of domestic players in the ABA league and thus have a worse performance index. In support of the above is the fact is that the finalists of the ABA league in the 2018/19 season are namely the clubs where most foreigners played, ie, BC BuducnostVoli from Podgorica (Montenegro) and BC Red Star MTS from Belgrade (Serbia).



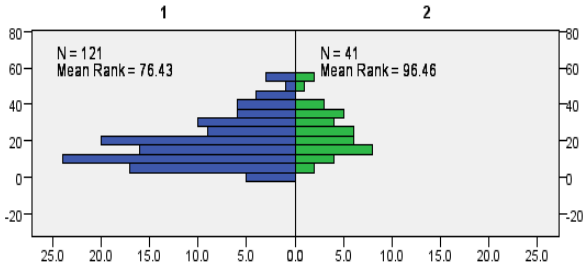
Picture 1.Frequency of the results for the variable successful 2-point shot (ŠUT2)



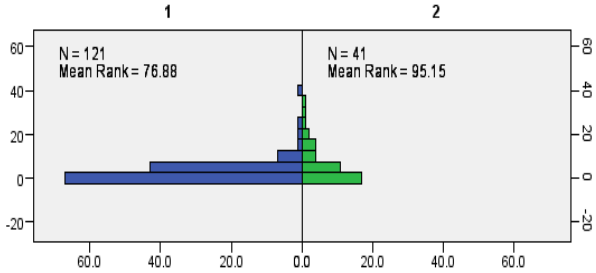
Picture 2.Frequency of the results for the variable unsuccessful 2-point shot (ŠUT2N)



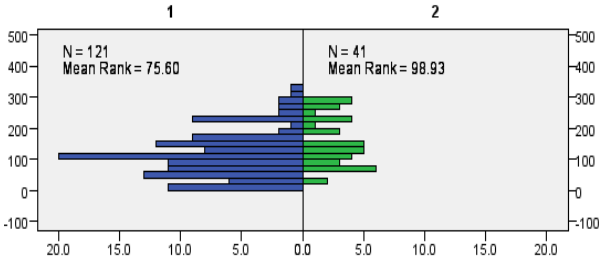
Picture 3.Frequency of the results for the variable stolen balls (UKRAL)



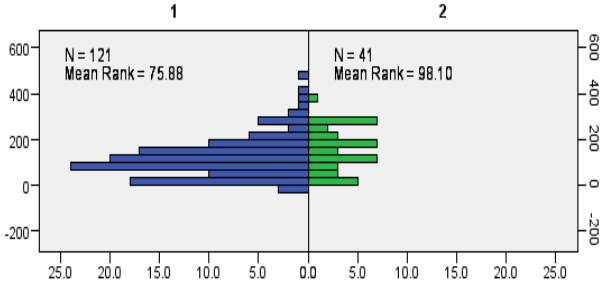
Picture *4.*Frequency of the results for the variable lost balls (IZGBL)



Picture 5. Frequency of the results for the variable blockade of the shot (BLOK)



Picture6.Frequency of the results for the variable total points (POEN)



Picture 7. Frequency of the results for the variable index of efficiency (INDEX)

CONCLUSION

Using the non-parametric statistical method, Man-Whitney U test, it has been concluded that there are statistically significant differences between 7 of the 20 applied situational efficiency variables among the sub-samples basketball players of the ABA League. It was found that basketball players born outside the territory of the former Yugoslav republics have more successful 2-point shots, more often take the ball, block the opponent's shot and score more points than players born in the former Yugoslav republics. These parameters probably also condition the fact that players foreigners have a better index of efficiency (INDEX) due to better efficiency in the above four variables (ŠUT2U, UKRAL, BLOK, POEN). The previous observation would need to be further investigated and possibly confirmed. According to the fact that the players foreigners considerably more missed the 2-point shot and more often lose the ball (ŠUT2N and IZGBL), it can generally be concluded that ABA leagues basketball players who come out of the territory of the former Yugoslavia are more often in the possession of the ball, that is, they are the bearers of the game. On the basis of the results obtained, it can be generally concluded that ABA basketball teams with more foreigners in the team have a greater chance of success. Accordingly, semi-final matches in the 2018/19 season were played by teams that rotated most of the players foreigners during the season (BC BuducnostVoli, BC Red Star MTS, Partizan NIS and Cedevita). It is certain that thanks to foreign players the ABA League has additionally gained on quality and dynamics, while on the other hand it is certain that domestic players harder get chance to prove themselves and thus stagnate.

REFERENCES

1. Ceremidzic, D.,&Ceremidzic, T. (2010). Differences in situational efficiency between NLB and NBA league teams in the regular season. *Sport and Health, V(2),* 39-43.
2. Ceremidzic, D.,&Delic, D. (2016). Differences in situational efficiency between Euro league and NBA teams in the regular season. *Sport and Health, XI(2),* 16-21.
3. Gardasevic, N., Ceremidzic, D.,& Markovic, M.(2018). Parameters of situational achievement as indicators of shots efficiency in basketball.*Sport and Health, XIII(2),* 10-15.
4. Malacko, J.,&Radjo, I. (2004). *Technology of sports and sports training*. Sarajevo: Faculty of Sport and Physical Education.
5. Milanovic, D., Jukic, I., &Bracic, M. (2001). Influence of ball-throwing variables in the basket on the results of basketball matches of the European Championships in Barcelona in 1997. U D. Milanović (Ur.) *Collection of works of the Kinesiology for the 21st Century* (pp. 286 - 289). Opatija, HR: Faculty of Physical Culture.
6. Nakic, J. (2004). *Differences in standard and implemented parameters of situational performance between men's and women's basketball teams at the senior basketball European Championships in 2003*. Master thesis, Zagreb: University, Faculty of Kinesiology.
7. Pallant. J. (2017). *SPSS Survival Guide - translation of the 6th edition*. Beograd: Mikroknjiga.
8. Sindik, J., Jukic, I.,&Adzija, M. (2012). Latent Structure of situational efficiency parameters among Croatian top basketball players. *Sport Logia, 8(2),* 127-135.
9. Subotic, LJ.,&Ceremidzic, D. (2017). Connection of situational efficiency in basketball with the participation of representing participants at the European Championship 2017. *Sport and Health, XII(2),* 62-67.
10. Uzelac, N., Milanovic, L.,& Stefan, L. (2016). The differences between the winning and defeated women's basketball teams of Group A in the indicators of situation success at the Olympics 2012 matches. V. V. Findak (ur.), *Collection of works "25. summer school of kinesiologist "*(page 298 -303). Zagreb: Croatian Kinesiological Association.
11. Vareslija, F. (2014). The impact of the system of predictors of situational efficiency of basketball players on the criterion variable of total time spent on parquet. *Sports Logos, XII(22),* 39-44.

Corespodence:
MScNovicaGardasevic
Doctoral studies Student, Faculty of Physical Education and Sport, University of East SarajevoStudenca 29, 81400 Niksic, Crna Gora;
Tel.:+38267829745;
e-mail: nowica@t-com.me

ORGINAL SCIENTIFIC PAPER

Goran Grahovac[1], Bojan Guzina[1], Goran Pašić[1]
[1]Faculty of Physical Education and Sports, University of Banja Luka

UDK: 797.2.015 : 547.495.9
DOI: 10.7251/SIZEN0119012G

CREATIN AS A SUPPLEMENT IN NUTRITION AND EFFECTS ON SWIMMING

Abstract

The subject of the study is the effect of creatine on swimming speed. In previous studies, creatine monohydrate was thought to be an effective nutritional supplement currently available related to improving exercise results. Almost 70% of these studies report a significant improvement in exercise capacity, while in the other studies, no significant improvement in results was generally observed.The test was performed on a sample of 60 swimmers, members of the Academic Swimming Club "April 22" divided into three groups and ages from 21-25. All examinees are male and in good health. Examinees belonging to this population are at the zenith of their morphological and motor development and are well motivated to advance in swimming. The subjects were divided into three groups and engaged in recreational swimming until the application of this research.All three groups of swimmers performed a specific amount of swimming, which was accompanied by the plan for the development of swimming in recreation, with the first group of swimmers taking creatine in addition to swimming, the second group of swimmers doing fitness in addition to swimming, and the third group only swimming. The measurement was carried out at the end of May and half of June 2008 at the premises of the Recreation Center SrpskeToplice (water temperature 28 degrees C).Variablessemple referred to swimming speed at 50 m freestyle technique (both measurements and time differences) were used. Descriptive statistics indicators were used. The main objective of the study is to determine whether, with creatine ingestion, with a duration of three weeks, there are significant differences in the increase in swimming speeds compared to the training of strength and swimming training models. The results of the study, analyzed by t-test, show that the difference in swimming time of 50 m freestyle technique is statistically significant.

Keywords:*creatine monohydrate, nutrition, swimming, training, t-test*

INTRODUCTION

Creatine as a dietary supplement and physical exercise

The use of creatine as a supplement in sports has been accompanied by debate and misconceptions since it became very popular in the early 1990s. There have been anecdotes and media articles that have often claimed that creatine use is harmful and unnecessary; creatine use has often been associated with the harmful effects of anabolic steroids (Metzl, Small, Levine &Gershel, 2001).Many athletes and experts in the field have stated that the use of creatine as a dietary supplement is not only beneficial to the results achieved by athletes as well as various medical conditions, but is also clinically safe (Kreider, 1998). Although creatine has recently been accepted as a safe and useful ergogenic aid, several myths have spread about creatine as a dietary supplement:

1. Any weight gained while taking this supplement is due to water retention.
2. Taking creatine as a dietary supplement causes kidney fatigue / pain.
3. Taking creatine as a dietary supplement causes cramps, dehydration, and / or alteration the status of the electrolyte.
4. The long-term effects of taking creatine as a dietary supplement are completely unknown.
5. Creatine made using newer formulas is more useful than creatine monohydrate (CM) and causes fewer side effects.
6. Taking creatine as a dietary supplement is non-ethical and / or illegal.

While these myths are refuted by scientific research, the public is still exposed to mass media that may or may not have accurate information. Due to such harmful information combined with the fact that creatine has become one of the most popular dietary supplements on the market, it is very important to research the basic literature on creatine supplementation as a supplement to the human diet. The purpose of this review is to determine the current state of creatine-related knowledge as a dietary supplement so that reasonable guidelines can be established and less grounded fears may be exercised regarding its use.

BASIC FACTS

Creatine has become one of the most studied and scientifically evaluated nutritional ergogenic aids for athletes. In addition, creatine has been evaluated as a potential therapeutic agent for various medical conditions such as Alzheimer's and Parkinson's disease. Biochemically speaking, the energy transferred to adenosine diphosphate (ADP) and to adenosine triphosphate (ATP) during and after intense exercise depends largely on the amount of phosphocreatine (PCr) stored in the muscle (Chanutin, A 1926). As PCr supplies are consumed during intense exercise, the energy remaining available is reduced due to the inability to re-synthesize ATP at the rate required to support high intensity physical exercise.As a consequence, the ability to keep the workout level under maximum strain decreases. The availability of PCr in the muscles can significantly affect the amount of energy that is generated during short periods of high intensity exercise. Moreover, it is hypothetically thought that increasing creatine content in muscle, through the intake of creatine as a dietary supplement, can increase the ability to dispose of, allowing accelerated ATP re-synthesis during and after very intense, short exercises (Chanutin, A 1926). Theoretically, taking creatine as a dietary supplement during training can lead to greater adaptation to training due to the increased quality and volume of the exercises performed.When it comes to potential medical use, creatine is closely linked to numerous metabolic processes. For this reason, the potential therapeutic role of creatine supplementation in nutrition in a wide variety of patients has been explored in medicine. Creatine is chemically known as non-protein nitrogen; a mixture containing nitrogen but not in itself a protein(Brunzel, 2003). Its synthesis is performed in the liver and pancreas from the amino acids arginine, glycine, and methionine. Approximately 95% of creatine in the body is stored in skeletal muscle. In addition, small amounts of creatine are also found in the brain and testes (Hultman, Soderlund, Timmons, Cederblad&Greenhaff, 1996).About two thirds of the creatine contained in skeletal muscle is stored as phosphocreatine (PCr), while the remaining amount of creatine is stored as free creatine. The total amount of creatine (PCr + free creatine) in skeletal muscle averages about 120 grams per person weighing 70 kg. However, the average person has the ability to store up to 160 grams of creatine in the body under certain conditions.The body breaks down about 1-2% of the total amount of creatine per day (about 1-2 grams / day) in creatinine skeletal muscle. Creatinine is then excreted in the urine. Creatine supplies can be supplemented with creatine from food or through the endogenous synthesis of creatine from glycine, arginine, and methionine. Foods that are creatine sources include meat and fish.To obtain one gram of

creatine, large quantities of fish and meat would have to be consumed. In contrast, creatine as a dietary supplement is an inexpensive and effective means of increasing the amount of creatine available without excessive intake of fat and / or protein.

The effect of supplementation on exercise and training results

The average improvement in results reported by surveys typically ranges between 10 and 15% depending on the variable of interest. For example, taking CM as a dietary supplement in the short term reports say that it improves maximal strength / stamina (5-15%), work done in sets of maximal effort muscular contractions (5-15%), single-effort sprint results (1- 5%), and work done during repetitive sprinting (5-15%). When taking CM as a dietary supplement for a long time, the overall quality of the workout seems to increase, giving a 5 to 15% greater increase in strength and results. Almost all studies indicate that "properly" taking CM increases body weight by about 1 to 2 kg in the first week of "supplementing".

The large amount of literature confirming the effectiveness of CM as a dietary supplement far exceeds the scope of this review. In short, reports indicate that after adapting to short-term CM supplementation as a dietary supplement, cyclical power, overall bench press work and jump squat increase, while also improving athletic performance in sprinting, swimming and (American) soccer (soccer). Results after adaptation to long-term CM uptake when CM combined with training include increases in creatine and PCr content in muscle, lean body mass, strength, sprint results, driving power, speed of power development, and muscle diameter (Preen, D, B Dawson , C Goodman, S Lawrence, J Beilby, S Ching 2001).

In long-term studies, it was typical that subjects taking CM received almost twice their body weight and / or fat-free mass (ie, an additional 2 to 4 pounds of muscle mass over 4 to 12 weeks of training) compared to subjects who were taking a placebo. Increased muscle mass appears to have been the result of an improved ability to perform high-intensity exercises via increased available PCr and enhanced ATP synthesis, allowing the athlete to train harder and further increase muscular hypertrophy via an increase in marked myosin heavy chain, probably due to an increase in myogenic (myogenic) regulatory factors of myogenin MRF (Willoughby, DS and JM Rosene 2003).

The huge number of research that has shown positive results from taking CM as a dietary supplement leads us to conclude that it is the most effective nutritional supplement available today to increase the ability to perform high-intensity exercises and build lean body mass.

METHOD

Subject of research

The subject of the study is the influence of creatine supplementation on swimming speed. In all likelihood, CM seems to be the most effective nutritional supplement currently available in relation to improving lean muscle mass and anaerobic capacity. To date, several hundred related studies have been performed to evaluate the effectiveness of CM as a dietary supplement to improve exercise results. Almost 70% of these studies report a significant improvement in exercise capacity, while in the other studies, no significant improvement in results was generally observed. No study has reported an ergolytic effect on results, although it has been suggested in some that weight gain, which is associated with CM taking, can be detrimental in sports such as swimming.

According to the problem and in accordance with the subject of the research, the main aim of this paper is to determine whether taking creatine supplement, lasting three weeks, has significant differences in the increase of swimming speeds compared to the power training and swimming training models.

In order to realize such a defined research goal, it is necessary to do the following tasks:

- Select an adequate sample of respondents whose characteristics will enable them to obtain valid data.
- Perform an initial measurement of swimming speed,
- Provide the experimental group with exactly the specified amount of creatine supplement for three weeks,
- Conduct training models for all three groups of three weeks of training in a defined scope of work,
- Conduct strength training on one group of subjects,
- Identify differences in swimming speed and body weight between groups of subjects after creatine supplementation (first group), strength training (second group), and the implemented swim training model (third group).

On the basis of the subject, purpose and tasks of the research, as well as on the results of previous research, it is possible to make the following hypotheses:

Hypotheses

1. H0 - no statistically significant changes in swimming speeds
2. H1 - there are statistically significant changes in swimming speeds

Sample of respondents

The test was performed on a sample of 60 swimmers members of the Academic Swimming Club "April 22" divided into three groups and ages 21-25. The examination was conducted on a voluntary basis. All examinees are male and in good health. Examinees belonging to this population are at the zenith of morphological and motor development and are well motivated to advance in swimming. Examinees engaged in recreational swimming until the application of this research.All three groups of swimmers performed a specific amount of swimming, which was accompanied by the plan for the development of swimming in recreation, with the first group of swimmers taking creatine supplementation in addition to swimming, the second group of swimmers doing fitness in addition to swimming, and the third group only swam.

Test description

The measurement was performed twice, at the end of May and half of June 2008, respectively, before and after taking creatine supplementation at the object of the Recreational Center SrpskeToplice (water temperature 28 degrees C).

Sample variables

All subjects were weighed in body weight and swimming time at 50 meters free style. After that, the first group of subjects used creatine, the third group subjects had fitness, and the second group subjects did not receive any additional therapies or training. After three weeks (21 days), all subjects were re-measured body weight and swimming time at 50 meters free style.

In addition to the variables mentioned, changes in body weight and swimming time were subsequent

Free style technique

Free Style is the fastest and most efficient swimmingtechnique in the competition. By creating continuous propulsive movements, the swimmer can move in the most uniform way through the water.

A way to take creatine

The order of magnitude of the increase in creatine content in skeletal muscle is important because studies have shown that changes in results achieved are correlated with this

increase. The schedule of taking creatine as a dietary supplement in the literature is most commonly referred to as the "supplement" schedule. It is characteristic of this schedule that CM is taken at approximately 0.3 grams / kg / day for 5 - 7 days (eg ~ 5 grams taken four times daily) and later at 3-5 grams / day. Studies have shown that taking this schedule results in an increase of 10-40% of creatine in muscle and PCr in stocks.

RESULTS WITH DISCUSSION

Statistical data processing

Regarding statistical processing, descriptive statistics indicators (arithmetic mean, median, mode) were used to represent body weights (on the first measurement, on the second measurement and differences in weight) and time on the 50 m free style (on both measurements and differences in time),extreme values, rank, quartiles, variance, standard deviation, coefficient of variation).

Qualitative data (general changes in severity/weight and time) are presented through frequency

of occurrence and percentage representation.Student's t -tests for paired samples (within one group) and for independent samples (between different groups) were used to compare the mean values of the characteristics.Aχ2 (hi square test) contingency test was used to compare the frequency of features between different groups.

Pearson's parameter correlation was used to determine the degree of correlation between the different variables for weight and time on the 50 m free style.All results, in addition to the table, are represented by graphical chart (histograms, box-plot diagrams and bar graphs).

The following were used for statistical processing, preparation and presentation of results: statistical software SPSS 16.0 for Windows; then Microsoft Office Excel 2007 and Microsoft Office Word 2007.

Table 1. Basic indicators of descriptive statistics throughout the sample

Total	time (before)	time (after)	time (difference)
Arithmetic mean	41.37	39.06	-2.31
High	57.83	53.95	5.52
Third Quartile	45.45	41.31	-0.64
Median	40.23	37.99	-1.82
First Quartile	37.02	35.53	-3.88
Low	28.28	28.84	-11.12
Rank	29.55	25.11	16.64
Mod	-	37.97	-4.06
Variance	36.77	25.10	8.69
Standard deviation	6.06	5.01	2.95
Coefficient of variation	14.66	12.83	-127.63

Table 1 shows that the average swim time per 50 m freestyle on the first measurement was 41.37 s. Half of the subjects swam 40.23 s or faster on the first measurement of the 50 m free style. The difference between the slowest (57.83 s) and the fastest examinee (28.28 s) is 29.55 s. Half of the subjects had a time of between 37.02 and 45.45 s in the 50 m free style. On the second measurement, the average time improved to 39.06 s, and at least half of the subjects had a time of 37.99 s or faster. On the second measurement, the difference between the slowest (53.95 s) and the fastest (28.84 s) was reduced to 25.11 s. 50% of the examinees had a time of between 35.53 and 41.31 s for the 50 m freestyle section. At least two subjects had a time of 37.97 s.

So, on average, examinees improved the time by 2.31 s. At least half of the examinees improved time by 1.82 s or more. The greatest progress was made by the examinees, who improved his time by 11.12 s, and the largest decrease from the first measurement was 5.52 s. 50% of examinees improved their time between 0.64 s and 3.88 s. At least two subjects improved time by exactly 4.06

Table 2. T-test (paired sample)

Total	**t**	**df**	**p**
Weight (before) - Weight (after)	-2.374	59	***0.021***
Time (before) - Time (after)	6.069	59	***0.000***

The T-test (Table 2) shows that the difference in swimming times of 50 m free style between the two measurements is extremely statistically significant.

Table 3. Pearson's correlation coefficient between the observed variables for the entire sample

Total		Time (before)	Time (after)	Time (difference)
Time (before)	r	1.000	***0.875***	***-0.569***
	p		***0.000***	***0.000***
Time (after)	r	***0.875***	1.000	-0.101
	p	***0.000***		0.444
Time (difference)	r	***-0.569***	-0.101	1.000
	p	***0.000***	0.444	

The parameter r in Table 3. represents Pearson's correlation coefficient showing the linear relationship between the variables.On the basis of the results shown in Table 4, a positive correlation is concluded, at the time of 50 m freestyle on the first and second measurements.

The time at 50 m freestyle on the first measurement is in the mean negative correlation with changes in the time between the two measurements.

So, in a very large number of cases, the subjects who swam faster on the first measurement were also faster on the second measurement.

Also, less regularity was observed that subjects who were heavier on the first measurement lost more weight between the two measurements. The correctness is that the respondents who had slower times on the first measurement improved their time after the second measurement.

Table 4. Basic indicators of descriptive statistics during the first group

Group I + Creatin	Time (before)	Time (after)	Time difference)
Arithmetic mean	40.63	39.59	-1.04
High	51.18	52.35	1.56
Third Quartile	43.45	40.99	0.59
Median	38.44	38.07	-0.86
First Quartile	36.95	36.74	-2.76
Low	35.08	32.36	-4.74

Rank	16.10	19.99	6.30
Mod	-	37.97	-
Variance	26.83	25.44	3.95
Standard deviation	5.18	5.04	1.99
Coefficient of variation	12.75	12.74	-191.88

Regarding the swimming time of the first group at 50 m free style (Table 4), we see that the average time at the first measurement was 40.63 s. Half of the examineesswam this distance in 38.44 seconds or faster. The difference between the slowest (51.18 s) and the fastest examinee (35.08 s) was 16.10 s on the first measurement. Half of the subjects in the first group recorded a time between 36.95 s and 43.45 s on the first measurement.The average swimming time of the first group was improved to 39.59 s on the second measurement, and at least 50% of the examinees had a time of 38.07 s or faster. At least two subjects had the same time - 37.97 s. The difference between the slowest (52.35 s) and the fastest (32.36 s) was increased to 19.99 s. Half of the subjects in the first group had a time between 36.74 s and 40.99 s.

So, after creatine therapy, subjects in the first group improved on average by 1.04 s, but half of the subjects improved their time by less than 0.86 s. The highest improvement was achieved by the examinee who improved his time by 4.74 s, and the highest recorded regression in the first group was 1.56 with a lower time compared to the first measurement.

Table 5. T-test (paired sample)

Group I	t	df	p
Weight (before) - Weight (after)	-5.742	19	***0.000***
Time (before) - Time (after)	2.331	19	***0.031***

The t-test (Table 5) shows that the difference in swimming time at 50 m free style in the subjects of the first group between the two statistically significant measurements.

Table 6. Pearson's correlation coefficient between the observed variables for the first group

Group I		Weight (before)	Time (before)	Weight (after)	Time (after)	Weight (difference)	Time (difference)
Weight (before)	r	1.000	***0.515***	***0.981***	***0.449***	*-0.367*	-0.205
	p		***0.020***	***0.000***	***0.047***	*0.112*	0.386
Time (before)	r	***0.515***	1.000	***0.487***	***0.925***	-0.280	-0.260
	p	***0.020***		***0.029***	***0.000***	0.232	0.269
Weight (after)	r	***0.981***	***0.487***	1.000	***0.446***	-0.180	-0.137
	p	***0.000***	***0.029***		***0.049***	0.448	0.564
Time (after)	r	***0.449***	***0.925***	***0.446***	1.000	-0.137	0.127
	p	***0.047***	***0.000***	***0.049***		0.565	0.593
Weight (difference)	r	-0.367	-0.280	-0.180	-0.137	1.000	0.382
	p	0.112	0.232	0.448	0.565		0.096
Time (difference)	r	-0.205	-0.260	-0.137	0.127	0.382	1.000
	p	0.386	0.269	0.564	0.593	0.096	

From Table 6 we can see that the weights on the first and second measurements, as well as the time on the first and second measurements, are in a very strong positive correlation.

Thus, examinees who were heavier on the first measurement were also heavier on the second measurement. Likewise, subjects who swam faster on the first measurement also swam faster on the second measurement.Also, the weight of the subjects on the first and second measurements correlated with a medium positive correlation with the time on the first and second measurements. Thus, subjects who were overweight swam more slowly at 50 m free style.

Table 7. Basic indicators of descriptive statistics during the second group

Group II	Time (before)	Time (after)	Time (difference)
Arithmetic mean	41.68	39.41	-2.27
High	57.83	53.95	5.52
Third Quartile	46.19	42.26	-0.53
Median	41.24	38.68	-1.74
First Quartile	36.69	35.62	-3.72
Low	28.28	28.84	-11.12
Rank	29.55	25.11	16.64
Mod	-	-	-
Variance	53.02	34.48	13.13
Standard deviation	7.28	5.87	3.62
Coefficient of variation	17.47	14.90	-159.75

In terms of swimming time at 50 m free style, the subjects of the second group (Table 7) averaged 41.68 s on the first measurement, and at least half of them swam this section by 41.24 s or faster. The difference between the slowest (57.83 s) and the fastest (28.28 s) was 29.55 s on the first measurement.On the second measurement, the subjects of the second group averaged 39.41 s, and at least 50% of them swam 50m for 38.68 s or faster. The difference between the fastest (28.84 s) and the slowest (53.95 s) was reduced to 25.11 s.

So, the subjects of the second group improved the time by 2.27 s on average between the two measurements, but half did not improve the time by more than 1.74 s. The time improvement average is increased by the examinees who improved their time by as much as 11.12 s. The most declining examinee spoiled his time by 5.52 s.

Table 8. T-test (paired sample)

Group II	t	df	p
Weight (before) - Weight (after)	3.199	19	***0.005***
Time (before) - Time (after)	2.799	19	***0.011***

The t-test (Table 8) shows that the difference in the time of the second group subjects between the two measurements is statistically significant.

Table 9. Pearson's correlation coefficient between the observed variables for the second group

Group II		Weight (before)	Time (before)	Weight (after)	Time (after)	Weight (difference)	Time (difference)
Weight (before)	r	1.000	-0.107	***0.995***	0.099	-0.398	0.374
	p		0.654	***0.000***	0.679	0.082	0.104
Time (before)	r	-0.107	1.000	-0.116	***0.870***	-0.050	***-0.600***
	p	0.654		0.625	***0.000***	0.833	***0.005***
Weight (after)	r	***0.995***	-0.116	1.000	0.101	-0.304	0.398
	p	***0.000***	0.625		0.672	0.193	0.082
Time (after)	r	0.099	***0.870***	0.101	1.000	-0.011	-0.127
	p	0.679	***0.000***	0.672		0.962	0.593
Weight (difference)	r	-0.398	-0.050	-0.304	-0.011	1.000	0.083
	p	0.082	0.833	0.193	0.962		0.729
Time (difference)	r	0.374	***-0.600***	0.398	-0.127	0.083	1.000
	p	0.104	***0.005***	0.082	0.593	0.729	

Table 9 shows that the weight on the first and the weight on the second measurement are in a very strong positive correlation, as well as the time on the first and second measurements. So, subjects who had more weight on the first measurement were heavier on the second measurement as well. Also, the examinees who swam 50m faster in swimming on the first measurement, generally repeated this on the second measurement.

In addition, there is a strong negative correlation between the time at the first measurement and the time difference between the two measurements, ie. subjects who swam slower on the first measurement improved their time more to the second measurement.

Table 10. Basic indicators of descriptive statistics during the third group

Group III + Fitness	Time (before)	Time (after)	Time (difference)
Arithmetic mean	41.81	38.18	-3.63
High	53.65	48.26	-0.78
Third Quartile	46.54	39.41	-1.48
Median	40.63	37.40	-3.21
First Quartile	37.32	35.45	-4.88
Low	33.46	32.50	-9.36
Rank	20.19	15.76	8.58
Mod	-	-	-3.21
Variance	33.45	16.78	6.39
Standard deviation	5.78	4.10	2.53
Coefficient of variation	13.83	10.73	-69.67

In the first measurement (Table 10), the subjects of the third group of 50 m free style swam for an average of 41.81 s, and at least half of them had a time of 40.63 s or faster. The difference between the slowest (53.65 s) and the fastest (33.46 s) was 20.19 s on the first measurement. 50% of the third group subjects had a time between 37.32 and 46.54 s.

On the second measurement, the average time of the third group subjects was improved to 38.18 s, and at least half of the subjects had a time of 37.40 s or faster. The difference between the slowest (48.26 s) and the fastest (32.50 s) was reduced to 15.76 s. Half of the subjects (medium-fast) had a time between 35.45 and 39.41 s.So, the third group of

examinees improved their average time by 3.63 s, and at least half of them improved their time by at least 3.21 s. The most advanced subjects improved time by 9.36 s, and the least advanced subjects improved time by 0.78 s. It is noted that only in this group did all examinees improve their swimming time on the second measurement.

Table 11. T-test (paired sample)

Group III	t	df	p
Weight (before) - Weight (after)	-2.101	19	***0.049***
Time (before) - Time (after)	6.419	19	***0.000***

The t-test (Table 11) shows that the difference in the time of the third group subjects between the two measurements is extremely statistically significant.

Table 12. Pearson correlation coefficient between the observed variables for the third group

Group III		Weight (before)	Time (before)	Weight (after)	Time (after)	Weight (difference)	Time (difference)
Weight (before)	r	1.000	-0.067	***0.996***	0.015	0.024	0.178
	p		0.779	***0.000***	0.948	0.919	0.452
Time (before)	r	-0.067	1.000	-0.030	***0.925***	0.419	***-0.789***
	p	0.779		0.901	***0.000***	0.066	***0.000***
Weight (after)	r	***0.996***	-0.030	1.000	0.054	0.112	0.156
	p	***0.000***	0.901		0.820	0.637	0.511
Time (after)	r	0.015	***0.925***	0.054	1.000	***0.444***	***-0.496***
	p	0.948	***0.000***	0.820		***0.050***	***0.026***
Weight (difference)	r	0.024	0.419	0.112	***0.444***	1.000	-0.238
	p	0.919	0.066	0.637	***0.050***		0.313
Time (difference)	r	0.178	***-0.789***	0.156	***-0.496***	-0.238	1.000
	p	0.452	***0.000***	0.511	***0.026***	0.313	

Table 12 shows that the subjects of the third group had very strong positive correlation on the first and second measurements, as well as the time on the first and second measurements. So, the examinees who weighed more on the first measurement, generally had more than the others on the second measurement. Likewise, examinees who were faster on the first measurement were generally faster on the second measurement as well.We note that for the examinee of this group, the difference in weight between the two measurements is in the strong positive correlation with the time on the second measurement, i.e. subjects who had better time on the second measurement, in many cases, lost less weight between the two measurements.

In the medium-strong negative correlation, the time on the second measurement and the difference in time between the two measurements, i. respondents who were slower on the second measurement in many cases improved their time on the second measurement more.

Also, in the very strong negative correlation are the time on the first measurement and the difference in measurement between the two measurements. So, examinees who were slower on the first measurement generally improved more on the time on the second measurement.

CONCLUSION

The test was performed on a sample of 60 swimmers members of the Academic Swimming Club "April 22" divided into three groups and ages 21-25. All examinees are male and in good health. Examinees belonging to this population are at the zenith of morphological and motor development and are well motivated to advance in swimming. The subjects were divided into three groups and engaged in recreational swimming until the application of this research.

All three groups of swimmers did a specific amount of swimming, which was accompanied by the plan for the development of swimming in recreation, with the first group of swimmers taking creatine in addition to swimming, the second group of swimmers doing fitness in addition to swimming, and the third group just swimming . The measurement was carried out at the end of May and half of June 2008 at the premises of the Recreation Center SrpskeToplice (water temperature 28 degrees C).A sample of variables referred to swimming speed at 50 m by the free technique (both measurements and time differences) were used. Descriptive statistics indicators were used.

The subject of the study is the effect of creatine on swimming speed. In previous studies, creatine monohydrate was thought to be an effective nutritional supplement currently available related to improving exercise results. Almost 70% of these studies report a significant improvement in exercise capacity, while in the other studies, no significant improvement in results was generally observed.The main objective of the study is to determine whether, with creatine ingestion, with a duration of three weeks, there are significant differences in the increase in swimming speeds compared to the training of strength and swimming training models. The results of the study, analyzed by t-test, show that the difference in swimming time of 50 m by the free style technique is statistically significant.

REFERENCES

1. Metzl, J.D., Small, E., Levine, S.R. & Gershel, J.C. (2001). Creatine use among young athletes. *Pediatrics*, 108, 421-425.
2. Kreider, R.B. (1998). Creatine supplementation: analysis of ergogenic value, medical safety, and concerns. *J Exerc Physiol Online*
3. Chanutin, A. (1926). The fate of creatine when administered to man**.** *J Biol Chem*, 67, 29-34.
4. Hultman, E., Bergstrom, J., Spreit, L. & Soderlund, K. (1990) Energy metabolism and fatigue.In*Biochemistry of Exercise VII*. Edited by Taylor, A., Gollnick, P.D.& Green. H. *Human Kinetics*: Champaign, IL. 73-92.
5. Harris, R.C., Soderlund, K. & Hultman, E. (1992). Elevation of creatine in resting and exercised muscle of normal subjects by creatine supplementation.*Clin Sci(Colch)*, 83, 367-74.
6. Brunzel, N.A.(2003). Renal function: Nonprotein nitrogen compounds, function tests, and renal disease.In *Clinical Chemistry*. Edited by Scardiglia, J., Brown, M., McCullough, K. and Davis, K. McGraw-Hill: New York, NY. 373-399.
7. Hultman, E., Soderlund, K., Timmons, J.A., Cederblad, G. & Greenhaff, P.L.(1996) Muscle creatine loading in men**.** *J Appl Physiol*, 81, 232-237.
8. Williams, M.H., Kreider, R. & Branch, J.D.(1999) Creatine: The power supplement. Champaign, IL: Human Kinetics Publishers. 252.
9. Preen, D., Dawson, B., Goodman, C., Lawrence, S., Beilby, J. & Ching, S.(2001). Effect of creatine loading on long-term sprint exercise performance and metabolism. *Med Sci Sports Exerc*, 33, 814-21.
10. Willoughby, D.S. and Rosene, J.M. (2003). Effects of oral creatine and resistance training on myogenic regulatory factor expression. *Med Sci Sports Exerc*, 35, 923-929.

Correspondence: Goran Grahovac Faculty of Physical Education and Sports, University of Banja Luka
e-mail:goran,grahovac@ffvis.unibl.org Translation into english: PhD. Jelena Grahovac pp. 12-22

ORGINAL SCIENTIFIC PAPER

Bojan Guzina[1], Miroslav Markovic[2]
[1] Faculty of Physical Education and Sport, University of Banja Luka
[2] Doctoral studies Student, Faculty of Physical Education and Sport, University of East Sarajevo

UDK: 796.012.1-053.5
DOI: 10.7251/SIZEN0119023G

EFFECT OF EXERCISE ON THE FUNCTIONAL ABILITIES OF SECONDARY SCHOOL STUDENTS

Summary

The aim of the research is to study the effects that exercise models have on the functional abilities of secondary students. The sample consisted of high school students in Krusevac, ages 15 and 16, enrolled in full-time physical education and the training process in additional physical education classes. A total of 112 subjects was divided into two sub-samples: The first sub-sample of 56 subjects comprised the experimental group. Here, students are enrolled in regular physical education classes and training three times a week to realize a model of motor exercises (flexibility) in the process of conditioning in additional physical education classes.The second sub-sample of 56 subjects, included in regular physical education classes only, constitutes the control group of respondents. The sample of variables consisted of: a vital lung capacity, pulse rate after load, Margaria test of anaerobic capacity.We analyzed the results of the T-test of functional ability between initial and final measurement of subjects. After analysis of the obtained results, it is concluded that there is a statistically significant difference in the pulse rate after loading (FPPOP .000) and Margaria test (FMARG .000).

Keywords: *exercise, functional abilities, students, t-test*

INTRODUCTION

Previous research
"Functional capabilities are responsible for the ability to adapt to increasing the demands of work and maintaining stability in the regulation and coordination of functions of organ systems that are very complex and complex." (Malacko, 2002; Przulj, 2006).
"In Zagreb, when a sports ambulance was operated at a systematic examination, a large number of athletes had aortic insufficiency who were engaged in persistent sports. The conclusion and the advice is that systematic training and competition that significantly strains the cardiovascular system is not recommended, but in that case it is recommended to change the type of sport, which puts less strain on the cardiovascular system" (p. 93 Medved 1966).
"The pace of development of certain organ systems, as is well known, is not constant and uniform. It certainly leads to bigger or smaller disharmonies. Thus, after the age of 13, body

weight increases by 1.4 times and height by only 1.2 times, while the heart increases by 1.9 times.It follows that growth in height occurs below the growth or development of the heart, that is, there is a period when the heart lags behind the development of the osteomuscular system. Even the heart does not develop in the same way. It first develops more in terms of cavity dilation and only later in terms of strengthening the muscle itself.It follows that growth in height occurs below the growth or development of the heart, that is, there is a period when the heart lags behind the development of the osteomuscular system. Even the heart does not develop in the same way. It first develops more in terms of cavity dilation and only later in terms of strengthening the muscle itself.At the beginning of puberty, female children lag behind boys, so their consumption of O2 / kg is 20% lower. There is a significant difference even before puberty (4-12 years), and this can be attributed to the difference in "training condition".Namely, women's children choose less dynamic games according to their nature. Hormonal changes in puberty have a greater impact (in a negative way) in girls than in boys whose physiological sizes develop further independently of puberty. In terms of pulmonary ventilation, it is seen that children are more ventilated than adults (relative to O2 received).Probably one of the causes is the large difference in respiratory rate in the effort of the youngest (65-70, and in the adult male 40), so-called "dead space" is more pronounced. Higher respiratory rate is due to the relatively lower vital capacity of young people (relative to body surface).Pulse frequency at maximum load is highest in the youngest (200-220) and decreases with age (190-200). Male and female subjects had similar values at the maximum load, but there were considerable differences if the same load was taken. For example, after work, where the subject consumes 2 liters of O2/minute, the pulse in men is 130 beats/min and in women it is 170 beats/min. (Medved1966).”

„Morphological status of athletes is a significant component that affects the functional ability of the body and conditions the predisposition of the human body for certain sports activities. Swimmers are extremely conditioned by their body morphology in which anthropometrics characteristics are very visible, perhaps more than with any other athlete. The buoyancy of swimmers depends on the anthropometric sizes, such as: height, weight, layout of center of gravity and the thrust and the vital capacity. Swimmers are divided by swimming techniques according to the ratio of muscle mass and quality of the sane, the length of limb and joint mobility. Breaststroke swimming technique, by its coordination is the most complicated technique. (Marković, V. Trivun, M. 2013).“

“The sample of 18 male subjects divided into sub-samples A and B of the finals of the 2nd International Swimming Rally held in Banja Luka from 16 to 17 April 2011, shows little statistical significance, but still worthy of attention and analysis for swimming competitors, not only at major swimming competitions (World Cups, Olympics, World Championships and other world-class competitions), but for analysis and a more complete picture of swimming (Trivun, M. 2013).”

“Swimming provides unlimited possibilities to improve poor health. Special effects are achieved in patients with a weakened muscle tone, as in the period of convalescence after certain diseases, and in conditions where there is a weakening of the function of the muscle (paresis, paralysis). Depending on the swimming technique leads to greater engagement of certain muscles. Swimming improves and lung function, increased activity intercostal muscles. Also significantly hire and other vital systems, especially cardio-vascular system. . (Trivun, M, Tošić, J., Marković, V. 2013).“

“The total sample of respondents consisted of 22 male students, the second year of enrollment in the school 20011/12 year, the Faculty of Physical Education and Sport, University of East Sarajevo. The sample of variables related to: body height (AVIT), upper arm skin folds (AKNL); abdominal skin folds (AKNT), thigh skin folds (AKNN), lower leg skin folds (AKNP), upper arm volume (AONL), thighs volume (AONK), lower leg volume (AOPK), body weight (AMAS), width of shoulders (AŠIR) width of the hips (AŠIK); knee joint diameter (ADZK), and the criterion variable was related to swimming 50 and 100 m backstroke. In addition to descriptive statistics, regression analysis was applied of the swimming results at 50 and 100 m backstroke technique with the result variables of morphological characteristics of students, as well as the correlation analysis. (Trivun, M. 2016).“

“Functional capacity and rated perceived exertion during two different models of the ascent walking are compared in this work. 28 students of Faculty of physical education (aged 21.4, ±1.27) were examined for that purpose. Streamlined treadmill managed by a diagnostic device Fitmate Med (Cosmed) was used for both walking protocols and maximal oxygen expenditure (VO2max) and maximal heart rate (HRmax) were recorded. After each protocol, the examinees expressed their rated perceived exertion (RPE). After the first measuring, when the examinees chose the walking model, there was a 12-minute training of set ascent walking model; then the second measuring followed, when the examinees practised the set walking model. Submaximal test “Chester treadmill walk test“ was applied on both measuring activities. Acquired data were analysed by kinematic method and statistic procedures. In conclusion, differences between examined walking models do exist, i. e, the set model requires larger energy expenditure amount and causes lower level of rated perceived exertion. (Vukić, Ž., Trivun, M., Jakovljević, V. 2017).“

„For establishment of differences in speed swimming craul technique on 25m, 50m and 100m between swimmers and water polo players we used T-test analise of results for independent samples. Based on T-test analise of results for independent samples we can conclude that there is statisticly big difference between swimmer and water polo players in speed during swimming all three criterion variables (BK 25M), (BK 50M),(BK 100M). (Mirvić, E., Bajrić, S., Bajrić., O., Trivun, M.2018).“

„On the basis of the obtained results it was concluded that the morphological characteristics significantly influenced the performance of situational motoric tasks in water polo, depending on the test from 39% to as much as 71%. The most significant applied variables from the morphological space of water polo players were variables; the volume of the thorax, the height of the body, the width of the hand and the foot with a positive effect, while the weight of the body and the subcutaneous fatty tissue were aggravating factors for the performance of situational motoric tasks for the 12-year-old water polo players. .(Janjić, B., Gardašević, N., Trivun, M. 2018).“

METHOD

Subject of research

The subject of research is the study of the application of exercise in the process of conditioning the athletes to functional abilities in young athletes, high school students in Krusevac, ages 15 and 16, covered by regular physical education and training in additional physical education.
Measuring instruments for functional ability assessment:
Vital Lung Capacity..... FVKPL
Post-load Pulse Frequency..... FPPOP
Margaria test of anaerobic capacity..... FMARG
Functional tests in this study were taken from functional test models (*Heim - Description of Measuring Instruments for Functional Assessment*)

1) Vital Lung Capacity (FVKP)
Instruments: Spirometer with beep
Task: The respondent in a standing posture takes a deep breath and holds it, then puts the oral extension of the spirometer in his mouth and quickly exhales all the air from his lungs. This registers the maximum expiratory flow-volume curve.
Assessment: The result is evaluated on a spirometry scale in cm3.
Note: The test is performed three times, (Medved 1966).

2) Post-load Pulse Frequency (FPPO)
Instruments: Stopwatch, metronome and 40cm high bench for climbing.
Task: It is accomplished by placing the respondent on one bench with his right foot, on two he climbs and brings his left leg to the right, on three puts his right foot on the ground, and on four he brings his left leg with his right. In order to keep pace, a metronome is used which is set at 90 beats per minute. That way, one climb and one descent are done in exactly two seconds, which equals 23 climbs per minute. The test takes 5 minutes, after which participants sit at tables prepared in advance.
Assessment: It measures the frequency of the pulse palpation and auscultation in the first 10 seconds after the termination of the test. The pulse rate thus obtained is multiplied by 6 to obtain the heart rate per minute.

3) Margaria test of anaerobic capacity
Instruments: Stopwatch with an accuracy of 1/100 sec., Space of at least 15 meters for a run-in of subjects, seven steps 17.5 cm high.
Task: After the previous run-in, the subjects climbed the stairs at the highest speed, alternating with one leg and the other with the highest speed possible.
Assessment: Measure time from the moment of touching the first step to the moment of leaving the reflective foot from the seventh step. After the results obtained, absolute anaerobic capacity is determined as the product of body mass in kg (T) and lifting power (V).

(1) Functional skills exercises

- Sprints with acceleration (gradual increase in speed from slow running through faster running to sprinting in sections of 60-100 meters)
  Sprint Training (A) repetitive maximum speed sprints with complete recovery between reps

Sprint Training (B) Two sprints between which are periods of slow running and walking

- Interval sprints (alternating change of 40 meters sprints and slow running 60 meters)
  Interval Training (A) - Intensive repetitive training periods alternating with relatively shorter breaks
  Interval Training (A) - Extensive interval training with longer periods of work and rest
- Fartlek (alternating long and slow running in nature)
  Continuous fast running (or swimming) of a long section at a fast pace
  Continuous slow running (or swimming) of a long section at a slow pace

(2) Exercise of anaerobic abilities

- Anaerobic capacity
  6 x 10 meters sprint, 3 x 40 meters sprint, 3 x 40 meters sprint, 2 x 60 meters sprint, 2 x 80 meters sprint

RESULTS WITH DISCUSSION

Data processing methods

The central and dispersion parameters of the distribution functions of anthropometric measures, motor and functional tests were calculated.

The arithmetic mean (X) were calculated for each measure and variable of the subjects, as well as the standard deviation (SD) which is a measure of the distance of the respondents' results from the arithmetic mean. To estimate the size of the range (variability), a minimum (MIN) and a maximum (MAX) result was calculated.

Table 1, Program of structure of model of motor exercises in the process of fitness preparation

WORK PROGRAM IN EXPERIMENTAL PERIOD	**NUMBER OF HOURS**
Initial diagnosis:	Before the
Anthropological features (morphological characteristics, motor and functional abilities)	implementation of the program
Functional skills exercises	5
Exercises of anaerobic abilities	4
Jumping exercises	5
High Intensity Jumping Exercises	5
Heavy ball throwing exercises	4
Exercises explosive power	7
Coordination exercises	6
Final diagnosis:	After the
Anthropological features> functional abilities	implementation of the program
Total:	36 hours

Table 2, Basic statistical parameters for evaluating the functional abilities of the experimental group at the initial measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
FVKPL	56	3880.00	3310.00	4280.00	5.11	-0.520	-0.003
FPPOP	56	161.64	151.00	170.00	8.15	0.309	0.600
FMARG	56	3.81	3.05	4.48	4.32	0.221	-0.455

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skewns (Skewn.), Kurtosis (Kurtos.)

The results presented in Table 2 in the subjects of the experimental group, in the space of tests of functional abilities, indicate that there are no statistically significant deviations of the results from the normal distribution. The test results were evaluated the functional capabilities of the experimental groups indicate that the distribution is positive.This is confirmed by the results of asymmetry of distribution (Skewn.) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below 1. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present as values below 2.75 are obtained.

Table 3, Basic statistical parameters for evaluating the functional abilities of the experimental group at the final measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
FVKPL	56	3960.00	3400.00	4290.00	15.44	0.230	1.100
FPPOP	56	154.82	150.00	166.00	12.27	0.254	0.027
FMARG	56	3.27	2.78	4.36	10.05	0.027	-0.204

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skewns (Skewn.), Kurtosis (Kurtos.)

The results presented in Table 3 in the experimental group subjects, in the space of functional ability tests, indicate that there are no statistically significant deviations of the results from the normal distribution. The test results were evaluated the functional capabilities of the experimental groups indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (Skewn.) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below 1. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present as values below 2.75 are obtained.

Table 4, Basic statistical parameters for the assessment of the functional abilities of the control group at the initial measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
FVKPL	56	3920.00	3290.00	4190.00	15.38	0.888	-1.502
FPPOP	56	163.75	153.00	171.00	10.90	0.137	-0.805
FMARG	56	3.94	3.20	4.56	10.51	0.255	0.522

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skewns (Skewn.), Kurtosis (Kurtos.)

The results presented in Table 4 in the control group subjects, in the space of the functional abilities tests of the subjects, indicate that there are no statistically significant deviations of the results from the normal distribution. The test results were evaluated the functional capabilities of the experimental groups indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (Skewn.) not exceeding 1.00, which

means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below 1. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present as values below 2.75 are obtained.

Table 5, Basic statistical parameters for the assessment of the functional abilities of the control group at thefinalmeasurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
FVKPL	56	3980.00	3340.00	4260.00	12.34	0.335	1.687
FPPOP	56	161.58	151.00	170.00	11.22	0.500	0.884
FMARG	56	3.85	3.00	4.45	11.55	0.547	-0.365

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skewns (Skewn.), Kurtosis (Kurtos.)

The results presented in Table 5 in the control group subjects, in the space of the functional abilities tests of the subjects, indicate that there are no statistically significant deviations of the results from the normal distribution. The test results were evaluated the functional capabilities of the experimental groups indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (Skewn.) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below 1. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present as values below 2.75 are obtained.

Table 6, Multivariate analysis of functional ability variance between experimental and control subjects at initial measurement

WILK'S LAMBDA TEST	**.699**
RAO's F-approximation	**1.78**
Q	**.102**

Legend: Bertlett test values (Wilks' Lambda), Rao's F approximation (Rao's F) and significance level (Q)

The analysis of Table 6, which shows the results of testing the significance of differences in the level of arithmetic means of all functional tests during the initial measurement between the samples of experimental and control group, did not find statistically significant difference, since WILK'S LAMBDA is .699, which gives Ra's F-approximation of 1.78, and a level of difference Q = .102. Therefore, no statistically significant differences were found in the applied system of functional abilities of the respondents.

Table 7, Univariate analysis of variance of the functional ability between experimental and control group of subjects at initial measurement

Tests	Mean (E)	Mean (K)	F-ratio	Q
FVKPL	3880.00	3920.00	1.44	.196
FPPOP	161.64	163.75	1.53	.159
FMARG	3.81	3.94	1.52	.122

Legend: arithmetic mean experimental group (Mean (e)), arithmetic mean control group (Mean (k)), F-test value (F-ratio) and significance level (Q)

In Table 7, a univariate analysis of the variance of functional ability tests is presented by comparing the results of the arithmetic means of the experimental and control groups at the

initial measurement. Based on the F-ratio coefficients and their significance (P-Level), it can be concluded that no statistically significant difference in the level of functional abilities was found between the experimental and control groups.

Table 8, Significance of differences of the arithmetic means of the experimental group:

Tests	Mean(i)	Mean(f)	T-value	p
FVKPL	3880.00	3960.00	1.25	**.152**
FPPOP	161.64	154.82	11.23	**.000**
FMARG	**3.81**	**3.27**	**5.12**	**.000**

Legend: arithmetic mean initially (Mean (i)), arithmetic mean final (Mean (f)), T-value (T-value) and significance level (p)

Table 8, contains the results of the T-test of functional abilities between the initial and final measurements of the experimental group. After analysis of the obtained results, it is concluded that there is a statistically significant difference in the pulse rate after loading (FPPOP .000) and in the Margaria test (FMARG .000).

Table 9, Significance of differences of arithmetic means of the control group subjects:

Tests	Mean(i)	Mean(f)	T-value	p
FVKPL	3920.00	3980.00	1.84	**.154**
FPPOP	163.75	161.58	-1.54	**.276**
FMARG	**3.94**	**3.85**	**1.45**	**.250**

Legend: arithmetic mean initially (Mean (i)), arithmetic mean final (Mean (f)), T-value (T-value) and significance level (p)

Table 9, contains the results of the T-test of functional abilities between the initial and final measurements of the control group subjects. After analysis of the obtained results, it is concluded that there is no statistically significant difference in the tests of functional abilities.

Table 10, Significance of isolated discriminant function of functional abilities of experimental group

Disc Func.	Eigenvalue	Cannonical R	Wilks' Lambda	Chi-Sqr.	df	P-Level
1	2.986	.76	.255	85.14	3	**.024**

Legend: Eugenvalue squares, Cannonical R coefficients, Bertlett test values (Wilks' Lambda), Hi square test size (Chi-Sqr), degrees of freedom (df) and significance level of the coefficient of determination (P-Level)

Table 10, One significant discriminant high intensity function (CR = 76%) was obtained, showing in which correlation the data set on the basis of which discriminant analysis of the obtained results was performed (TABLE 10.).Results of the discriminant strength of the functional ability variables are presented with the Wilks' Lambda test (.255). This indicates that the differences between the initial and final measurements of the functional abilities of the experimental group are significant (P = .024), since the size of the Hi square test has a high value (Chi-Sqr = 85.14).

CONCLUSION

The sample of respondents referred to a high school student in Krusevac, aged 15 and 16 years, covered by regular physical education classes and the training process in additional physical education classes.The total sample of 112 students was divided into two sub-samples: The first sub-sample of 56 students was enrolled in regular physical education and training three times a week to realize the model of motor exercises (flexibility) in the process of conditioning in additional physical education classes and made experimental group.The second sub-sample of 56 students, included in regular physical education classes only, constitutes the control group of respondents. The sample of variables consisted of: vital lung capacity, pulse rate after loading andMargaria testof anaerobic abilities. The aim of the research is to study the effects of exercise models on the functional abilities of high school students.

The analysis included the results of the T-test of functional ability between the initial and final measurement of the subjects. After analysis of the obtained results, it is concluded that there is a statistically significant difference in the pulse rate after loading (FPPOP .000) and Margaria test (FMARG .000).

REFERENCES

1. Janjić, B., Gardašević, N., Trivun, M.(2018). Morfološke karakteristike kao prediktori situacione uspješnosti u vaterpolu, ***Sport i Zdravlje***, Naučno-stručni časopis iz oblasti fizičkog vaspitanja i sporta. Godina XIII, broj 2, 24-31
2. Marković, V. Trivun, M. (2013). Uticaj antropometrijskih dimenzija na rezultate plivača prsne tehnike. ***Sport i Zdravlje***, Univerzitet u Istočnom Sarajevu, Fakultet fizičkog vaspitanja i sporta, Vol 8, 1 49-59
3. Mirvić, E., Bajrić, S., Bajrić., O., Trivun, M.(2018). Analiza razlika u brzini plivanja kraul tehnikom između plivača i vaterpolista (Analysis in Differences of Swimming Crawl Technique Between Swimmers and Water Polo Players) ***Sports Science And Health*** Scientifi c Journal in Sports and Medical-Rehabilitation Science B. Luka, pp- 63-71
4. Medved, R. (1966). ***Sports Medicine***. Novinsko izdavačko i štamparsko poduzeće Sportska Štampa, Zagreb, pp. 93, 142
5. Pržulj, D. (2006). Effects of conditioning on the development of motor skills of young athletes during the preparation period. Scientific and professional journal in the field of sports and physical culture ***"Sport and Health"***, 2 (5-8).
6. Trivun, M. (2013). Project result success of breast stroke finalists at 100 m 2011 international rally Ur: Bjelica, D. Journal of Sport, Physical Education and Health, ***Montenegro Sports Academy***, No ,. 37, 38, 39 / XI, Proceedings, Podgorica, (2013), 106-111
7. Trivun, M, Tošić, J., Marković, V. (2013). Terapijsko plivanje. Ur: S. Ristić, ***Biomedicinska istraživanja***, Časopis Medicinskog fakulteta u Foči, Univerzitet u Istočnom Sarajevu, Vol 4, 2 (2013), 61-66
8. Trivun, M. (2016). Relation of results in swimming with morphological characteristics of students, ***"Sport and Health"***, University of East Sarajevo, Faculty of Physical Education and Sport, Vol 11, 2, 65-71
9. Vukić, Ž., Trivun, M., Jakovljević, V. (2017). Funkcionalne sposobnosti i napori dva različita hoda uz nagib (Functional Capacity and Exertion two Different Models Walking Inclineabstract, ***Sport i Zdravlje***, Naučno-stručni časopis iz oblasti sporta i fizičke kulture. Godina XII, broj 1, 107-116, Sport And Health Vol XII 1: 107-116

Correspondence:
Bojan Guzina Faculty of Physical Education and Sports,
University of Banja Luka
e-mail:bojan,guzina@ffvis.unibl.org

ORGINAL SCIENTIFIC PAPER

Miloslav Markovic[1], Jelena Arnautovic[2], Sanja Gligoric[2]
[1] Doctoral studies Student, Faculty of Physical Education and Sport, University of East Sarajevo
[1] Masters studies Student, Faculty of Physical Education and Sport, University of East Sarajevo

UDK: 796.012.1.021.2
DOI: 10.7251/SIZEN0119032M

THE EFFECTS OF THE CONDITIONAL PREPARATION EXERCISE MODEL ON FLEXIBILITY OF YOUNG ATHLETES

Summary

The aim of the research is to study the effects of model exercises in the fitness and conditioning training of athletes on the motor abilities (flexibility) in young athletes. The sample of respondents referred to a high school student in Krusevac, aged 15 and 16 years, covered by regular physical education classes and the training process in additional physical education classes. The total sample of 112 subjects was divided into two sub-samples: The first sub-sample of 56 subjects included regular physical education classes and training three times a week to realize the model of motor exercises (flexibility) in the physical preparation process in the additional physical education classes constitutes the experimental group.The second sub-sample of 56 subjects, included in regular physical education classes only, constitutes the control group of respondents. A sample of variables consisted of: a deep bow on the bench, a split exercise and a flexibility of shoulder strap with baton. The results of the T-test of motor skills between the initial and final measurements of control group subjects were analyzed. After analysis of the obtained results, it is concluded that there is no statistically significant difference in the tests of motor skills.
The univariate analysis of the variance of motor ability tests compared the results of the arithmetic means of the experimental and control groups at the final measurement. Based on the coefficients of the F-ratio and their significance (P-Level), it can be concluded that no statistically significant difference in the level of motor abilities was found between the experimental and control groups.

Keywords: *motor skills, athletes, high school, physical education, univariate analysis*

INTRODUCION

There is a long development process between predisposition and ability development. Predispositions do not condition, but they predetermine a person's level of ability and ability. There are several theories about abilities, their origins, development factors and species. Some rely more on the significant role of inheritance factors and genes, while others attach greater importance to the social environment, however, the activity of individuals is a common feature of all theories.By some classifications, abilities manifest themselves in two forms - as general and as special abilities. These two groups have a large number of abilities

that have been studied to a greater or lesser extent. Among the most important human abilities, important for performing various activities, are motor skills. There are a number of definitions and views on motor skills.

Previous research

“Motor abilities have a significant impact on motor manifestations that are influenced by regulatory structures that provide excitation intensity in different topological regions of the body and regulatory mechanisms for structuring movement. (Malacko, 2002; Pržulj, 2006). "

"Motor skills are partly hereditary and partly acquired through the training process. There are opportunities to influence their development through specific training methods. Basic motor skills are the basis in any learning of motor tasks of a certain technique, so they can be considered to represent a basic value in the total space of human motor skills (Pržulj, 2006). "

"Motor abilities are those forms of motor activity that occur in moving structures that can be described by the same parametric system, which can be measured with the same set of measures and in which analogous physiological, biological and psychological processes, or mechanisms occur (Zatsiorski, 1975)."

Kurelić (1975), under motor skills, means that part of "the general psychophysical ability of a person, which refers to a certain level of development of the basic latent dimensions of a person, which condition the successful execution of movement, whether or not those abilities are acquired by training."

Findak (1998) states that "motor abilities are defined as latent motor structures that are responsible for an infinite number of manifest motor responses and can be measured and described."

“Biomechanical analysis of the technique of free swimming with the analysis of rational execution of the segments on which the resultant success depends. The rationality of movement depends on these important segments: stride length, frequency of repetition, number of strokes or movements, the surface area in which the swimmer operates (conditioned by anthropological dimensions) speed, continuity of movement (coordination of legs, arms and breathing). (Markovic, V., Trivun, M. 2013).”

“In order to determine the resultant success in long-distance apneo diving, depending on the water temperature in the pool and the air temperature, a comparison of the results of the basic central and dispersion parameters and the analysis of the t-test results were performed. Based on the results obtained, it can be concluded that the water temperature in the pool and the air temperature have a significant influence on the length of the lime dive by increasing the water temperature in the pool by 3 to 5º Celsius and the air temperature by 2 to 4º C contributing to better results in apnea diving (in length). (Trivun, M., Tosic, J., Pasic, G. 2015).”

“The provision of swimming competitions in terms of organization is prescribed by rules and regulations. The rules and regulations are the responsibility of the World Swimming Organization (FINA), which is responsible for national federations. Depending on the rank of the competition, the rules and regulations determine the time period for the deadline for competitors, and in this case, the swimmer. The organization of the competition at the international level include the rally with international participation swimmers.At the rally in Banja Luka, every year in May, the organizer is the Olympic Swimming Club, sponsored by the Ministry of Family, Youth and Sports of the Government of the Republic of Srpska and the City of Banja Luka. In addition to the stewards and volunteers, organization and safety of participants provided by the Ministry of Internal Affairs of the Republic of Srpska. The announcement of the meeting is 30 days from the day of the meeting. The aim is to take the example of two rallies held to present safety and stewarding during maintenance of swimming competitions. (Panic, Z., Trivun, M., Markovic, V. 2017.).”

“In a sample of 24 subjects of the student population of the school year 2009/10 of the Faculty of Physical Education and Sports of the University of East Sarajevo, enrolled in the

second year of study, male, a comparison of the results in eleven variables of morphological characteristics and one variable of swimming at 50 m by the dolphin technique.Predictor variables of morphological characteristics consisted of: body height, body weight, shoulder width, hip width, skin fold of the upper arm, skin fold of the abdomen, circumference of the upper arm, circumference of the lower leg and the diameter of the knee joint, and the criterion variable is the variable of swimming performance with the dolphin technique at 50 meters.Using regression analysis, we obtained a printout of data containing information on regression parameters, as well as statistical quantities relevant to the described test procedures with estimated parameters, in this case 11 variables of morphological characteristics and variables of swimming performance by the dolphin technique at 50 m. (Trivun, M., Budimlic, J. 2010)."

„After the implementation of the program, the results of the essential descriptive parameters show that the Group 2 respondents accomplished better results in all observed variables. The analysis of the t-test results for independent samples indicates a high level of statistical significance for all the variables used: the assessment of swimming knowledge (OPP <.000); swimming length expressed in meters (MET <.000); jumping into shallow pools feet first (SUV <.000). Results of the research indicate that the implemented swimming training program was more effective for young school-age children, thus confirming the results of earlier research regarding this issue (Kazazovic and Associates 2007); Torlakovic, A., Kebat, R., Pestek, E., Trivun, M. (2018)."

„Two samples of respondents of the male population of two generations of students at the Faculty of Physical Education and Sport, University of East Sarajevo, in enrolled in the school year 2015/2016 and school year 2018/2019 had insignificant statistical significance by analyzing t-test of the variables of the body mass index and the variables of 100 meters freestyle swimming. (Trivun, T., Torlakovic, A., Németh,Z., Mirvic, E. 2018)."

"A regression analysis was used to determine the influence of predictor variables (flexibility skills) on criterion variables (specific motor skills). The results indicated that the system of flexibility variables had a statistically significant influence at the p= .001 level, with a multiple correlation coefficient of .77 (R= .77), and multiple correlation squared of .59, explaining approximately 59% (R^2= 0.59) of the variance for the criterion variables Turn time. Based on the results, we can conclude that the predictive variable Sit and Reach (p= .005) had a statistically significant influence on the criterion variable Turn time. (Djurovic, M., Okicic, T., Madic, D., Dopsaj, M., Thanopoulos, V., Rozi, G., Pešić, M., Trivun, M. 2017.)."

METHOD

The subject of the research is the study of the effects of model exercises in the process of conditioning athletes on motor skills in young athletes, high school students in Krusevac, ages 15 and 16, covered by regular physical education and training in additional physical education classes.

Experimental program of motor exercise models in the process of conditioning

Experimental group

The experimental program of the model of programmed exercise in the process of fitness preparation of athletes was realized in the halls for physical education of high schools in Krusevac. The experiment lasted for three months, with three hours of exercise per week, totaling 36 hours of training.

The structure of classes for the implementation of the experimental program was four-part:

- preparatory part: 5 minutes of preparatory activities for exercise,

- formatting exercises: 10 minutes,
- Main part: two parts of 15 minutes of exercise with one break of five minutes between parts (35 minutes total) and
- final part: 10 minutes of stimulating recovery, calming all the organism's functions and emotions of the subjects by using means of less dynamism and low intensity (relaxing activity).

Flexibility

1. Deep bow on the bench..... MDPK
2. Split exercise..... MŠPA
3. Flexibility of shoulder strap with baton……..... MISP

Test description

Deep bow on the bench (MDPK)

Instruments: Bench 40 cm high, wooden meter 60 cm long with dividers in centimeters; the meter is attached vertically to the bench, glued with tape glue.

Task: the subject is standing on a bench with two feet provided the legs bent and feet of reach as deep as possible. The beginning of the meter is up and the end is on the floor. He is entitled to two attempts. The respondent retains the end position to read the results.

Assessment: The reach depth measured in cm is estimated; a better attempt is taken. The zero point is at the top of the meter.

Notes: Respondent must be barefoot.

Split exercise (MŠPA)

Instruments: Steel pendulum with split in cm, chalk.

Task: The subject stands barely against the wall, the foot is moved to the wall. Make a twist off the wall and step the other foot at right angles to the wall for as long as possible. The heel slides on the ground. The chalk marks the furthest position of the heel, the closest edge.

Assessment: The result is the distance of the heel from the wall, measured in cm. The task is performed 2 times, and it counts better than two attempts.

Flexibility of shoulder strap with baton (MISP)

Instruments: Round baton 150cm long and 3cm thick; at one end is a grip with a stop (ring 1 cm high), the tailor's meter is recessed into a baton and glued; the zero point starts from the delimiter.

Task: Respondent stands in a standing posture, with feet at shoulder width apart. He holds the baton in front of the body with one hand on the grip at the end of the stick and the other with it. He raises his baton in front of him, up and over his head in honest hand. One hand stands on the grip all the time and the other slides on the baton. The respondent tries to make a turn with as little distance as possible between his hands.

Assessment: The test result is measured by the distance of the hands after the completed turn, which is read in cm on a stick. It's worth the better (smaller) score of two tries.

Coordination development exercises

Acrobatics (reel forward + lifting upright, flying reel forward + lifting upright, reel backward + lifting upright, sideways, jumping on an elastic table).

Skipping (in place, with tasks, in pairs, in group).

Body position control (leap over a small groin to the toes and hold that position upright and sideways, 360º turn with rubber in your hands).

Hand Coordination (Kinetic Sensitivity): Adding props, grabbing props, hitting goals, hitting a jump shot, hitting a jump, adding a ball to one or both hands from below, above the head, back, through the legs.

Sample of respondents

The population from which the sample was derived are students of first and second year of high school in Krusevac, male, aged 15 and 16 years old. A total of 112 subjects was divided into two sub-samples:

1. A sub-sample of 56 subjects enrolled in regular physical education and training three times a week to realize a model of motor exercises in the physical preparation process in additional physical education classes forms an experimental group.
2. A sub-sample of 56 subjects, encompassed only by regular physical education classes, forms a control group of respondents.

RESULTS WITH DISCUSSION

Table 1. Basic statistical parameters for estimation of motor abilities of experimental group at initial measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
MDPK	56	39.26	28.00	47.00	15.78	-0.347	-0.041
MŠPA	56	158.45	143.00	173.00	15.25	-0.358	0.144
MISP	56	82.79	62.00	95.00	11.34	-0.954	1.655

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skewns (Skewn.), Kurtosis (Kurtos.)

Analysis of Table 1 in the subjects of the experimental group in the field of motor ability tests indicates that there are no statistically significant deviations of the results from the normal distribution. The results of tests assessing the motor skills of the respondents indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (skjunis) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below the units. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present, since values below 2.75 are obtained.

Table 2. Basic statistical parameters for the evaluation of the motor abilities of the experimental group at the final measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
MDPK	56	48.73	32.00	52.00	12.12	-0.315	-1.311
MŠPA	56	164.26	146.00	175.00	21.84	0.213	-1.241
MISP	56	76.45	58.00	92.00	15.34	0.142	1.401

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skjunis (Skewn.), Kurtosis (Kurtos.)

The results presented in Table 2 indicate that there are no statistically significant deviations from the normal distribution in the experimental group in the field of motor ability tests at the final measurement. The results of tests assessing the motor skills of the respondents indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (skjunis) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below the units. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present, since values below 2.75 are obtained.

Table 3. Basic statistical parameters for the assessment of motor abilities of the control group at the initial measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
MDPK	56	40.15	29.00	48.00	25.62	0.445	1.515
MŠPA	56	162.36	141.00	176.00	11.14	0.187	-0.448
MISP	56	79.83	59.00	92.00	10.11	0.202	-1.555

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skjunis (Skewn.), Kurtosis (Kurtos.)

Analysis of the results in Table 3 in the control group subjects in the field of motor ability tests at the initial measurement indicated that there were no statistically significant deviations from the results from the normal distribution. The results of tests assessing the motor skills of the respondents indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (skjunis) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below the units. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present, since values below 2.75 are obtained.

Table 4. Basic statistical parameters for the assessment of motor abilities of the control group at the final measurement

Variables	N	Mean	Min.	Max.	Std.dev.	Skewn.	Kurtos.
MDPK	56	46.54	37.00	51.00	11.29	0.875	-0.524
MŠPA	56	171.79	152.00	184.00	15.82	0.555	-0.152
MISP	56	74.62	51.00	86.00	25.38	0.164	0.305

Legend: arithmetic mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev.), Skjunis (Skewn.), Kurtosis (Kurtos.)

The results presented in Table 4 indicate that there are no statistically significant deviations from the normal distribution in the motor control subjects in the final measurement. The results of tests assessing the motor skills of the respondents indicate that the distribution is positive. This is confirmed by the results of asymmetry of distribution (skjunis) not exceeding 1.00, which means that the tests are not difficult (up to +1.00) or light (up to -1.00), but correspond to the research population and are below the units. The homogeneity of the results (kurtosis) indicates that good sensitivity (test discriminability) is present, since values below 2.75 are obtained.

Table 5. Univariate analysis of variance of motor ability between experimental and control subjects at initial measurement

Tests	Mean (E)	Mean (K)	F-odnos	Q
MDPK	39.26	40.15	0.25	.325
MŠPA	158.45	162.36	1.84	.196
MISP	82.79	79.83	1.86	.212

Legend: arithmetic mean of experimental group (Mean (e)), arithmetic mean of control group (Mean (k)), F-test value (F-ratio) and significance level (Q)

Table 5 shows the univariate analysis of variance in motor ability tests by comparing the results of the arithmetic means of the experimental and control groups at the initial measurement. Based on the coefficients of the F-ratio and their significance (P-Level), it can be concluded that no statistically significant difference in the level of motor abilities was found between experimental and control groups.

Table 6. Significance of differences of the arithmetic means - experimental group:

Tests	Mean(i)	Mean(f)	T-value	p
MDPK	39.26	48.73	1.43	**.258**
MŠPA	158.45	164.26	1.57	**.120**
MISP	**82.79**	**76.45**	**1.56**	**.144**

Legend: arithmetic mean initially (Mean (i)), arithmetic mean final (Mean (f)), T-value (T-value) and significance level (p)

Table 6 contains the results of the T-test of motor skills between the initial and final measurements of the experimental group. After analyzing the results obtained, it is concluded that there is a statistically significant difference in the Sargent jump (MSAR .005), distance jump (MSDM .004), triple jump (MTRS .001), foot tap (MTAP .006), arm tap (MTAP .005), running at 20 meters high start (M20V .000), running at 30 meters high at start (M30V .000) and running at 50 meters at high start (M50V .001).

Table 7. Significance of differences of the arithmetic means -control group:

Tests	Mean(i)	Mean(f)	T-value	p
MDPK	40.15	46.54	-1.52	**.108**
MŠPA	162.36	171.79	-1.27	**.205**
MISP	**79.83**	**74.62**	**-1.42**	**.244**

Legend: arithmetic mean initially (Mean (i)), arithmetic mean final (Mean (f)), T-value (T-value) and significance level (p)

Table 7, contains the results of the T-test of motor skills between the initial and final measurements of the control group subjects. After analysis of the obtained results, it is concluded that there is no statistically significant difference in the tests of motor skills.

Table 8. Factor structure of the isolated discriminant function of the experimental group

Variables	Root 1
MDPK	0.400
MŠPA	0.375
MISP	0.351

Table 8 gives the structure of the discriminant function of the participation of motor skills variables in the formation of significant discriminant functions. The group centroids shown are the arithmetic means of the results of the initial and final measurements. In order to check the efficiency of the training process for the realization of the model of motor exercises in the process of fitness preparation of athletes, 3 motor tests were measured, which are assumed to be good predictors of the studied area. The results presented indicate that the greatest contributor to the discriminant function is the Deep bow on the bench (MDPK 0.400), Split exercise (MŠPA 0.375), and Flexibility of shoulder strap with baton (MISP 0.351).

Table 9. Factor structure of the isolated discriminant function of the control group

Variables	Root 1
MDPK	0.248
MŠPA	0.236
MISP	0.225

Table 9 gives the structure of the discriminant function of the participation of motor skills variables in the formation of significant discriminant functions. The group centroids shown are the arithmetic means of the results of the initial and final measurements. In order to determine the significance of the differences between the initial and final measurements in the control group, 3 motor tests were measured, which are assumed to be good predictors of the investigated area. The present results indicate that all coefficients have lower value, and on the basis of the total contribution of all motor tests can be concluded that there was no statistically significant transformation process in the mobility area of the control group.

Table 10. Univariate analysis of variance of motor ability between experimental and control subjects at final measurement

Tests	Means (E)	Means (K)	F-odnos	Q
MDPK	48.73	46.54	1.44	.125
MŠPA	164.26	171.79	1.56	.220
MISP	76.45	74.62	1.44	.210

Legend: arithmetic mean of experimental group (Mean (e)), arithmetic mean of control group (Mean (k)), F-test value (F-ratio) and significance level (Q)

Table 10 shows the univariate analysis of variance in motor ability tests by comparing the results of the arithmetic means of the experimental and control groups at the final measurement. Based on the coefficients of the F-ratio and their significance (P-Level), it can be concluded that no statistically significant difference in the level of motor abilities (flexibility) was found between the experimental and control groups, and the reason should be sought in accelerated growth (adolescence) in a male population of 15 up to 16 years, as well as a short period of work (15 minutes in the main part of the class) to cause marked changes that would be statistically very significant.

CONCLUSION

The sample of respondents referred to a high school student in Krusevac, aged 15 and 16 years, covered by regular physical education classes and the training process in additional physical education classes. The total sample of 112 subjects was divided into two sub-samples: The first sub-sample of 56 subjects included regular physical education classes and training three times a week to realize the model of motor exercises (flexibility) in the physical preparation process in the additional physical education classes constitutes the experimental group.The second sub-sample of 56 subjects, included in regular physical education classes only, constitutes the control group of respondents. A sample of variables consisted of: a deep bow on the bench, a split exercise and a flexibility of shoulder strap with baton. The results of the T-test of motor skills between the initial and final measurements of control group subjects were analyzed. After analysis of the obtained results, it is concluded that there is no statistically significant difference in the tests of motor skills.The aim of the research is to study the effects of exercise models in the process of conditioning athletes on motor skills (flexibility) in young athletes.

The univariate analysis of the variance of motor ability tests compared the results of the arithmetic means of the experimental and control groups at the final measurement. Based on the coefficients of the F-ratio and their significance (P-Level), it can be concluded that no statistically significant difference in the level of motor abilities was found between the experimental and control groups, and the reason should be sought in the insufficient intensity of exercise (15 minutes in the main part of the class), as well as the adolescent age (15 and 16 years) of the male population, where rapid growth of long bones is emphasized.

REFERENCES

1. Djurovic, M., Okicic, T., Madic, D., Dopsaj, M., Thanopoulos, V., Rozi, G., Pesic, M., Trivun, M. (2017). The Influence of Flexibility on the Specific Motor Skills in Boy-Swimmers Aged10–12. *International Scientific Congress "Applied Sports Sciences" Editors of the Proceeding Book:* Prof. Tatiana Iancheva, DSc Assist. Prof. Stefka Djobova, PhD Assist. Prof. Milena Kuleva, PhD, 1-2 December 2017 Sofia, Bulgaria, 154-158
2. Findak, V. (1998). *Methodical organizational forms of work* (43-76). Zagreb: "Mentorex" d.o.o.
3. Kazazovic, B., D. Djedovic, A. Popo, M. Mekic (2007). Efekti transformacionih procesa u nastavi (obuci) plivanja mlađeg školskog uzrasta. Drugi međunarodni simpozi Nove Tehnologije u Sportu, Sarajevo 2007. *Zbornik radova NTS*, 324-328
4. Kurelic N., Momirovic, K., Stojanovic, M., Radojevic, Ž. i Viskic-Stalec, N. (1975). *Structure and development of morphological and motor dimensions of youth, Belgrade:* Institute for Scientific Research. Faculty of Physical Education.
5. Markovic, V. Trivun, M. (2013). The analysis of the stroke atkraul technique swimming. ***Sports and Health***, University of East Sarajevo, Faculty of Physical Education and Sports, Vol 8, 2 , 65-71
6. Panic, Ž., Trivun, M., Markoic, V. (2017). The safety and security of swimming competitions at the international meeting, the International Conference "Security Management of Sports Competitions", ***Proceedings*** / The Fourth International Conference "Security Management of Sports Competitions" in Belgrade, University "Union- Nikola Tesla", Faculty of Sport, Str. 91-95
7. Przulj, D. (2006). Effects of conditioning on the development of motor skills of young athletes during the preparation period. Scientific and professional journal in the field of sports and physical culture " ***Sport and health*** ", 2 (5-8).
8. Torlakovic, A., Kebat, R., Pestek, E., Trivun, M. (2018). Comparison of the Learning Dynamics of Swimming for Children in Different Age Categories. Komparacija dinamika učenja plivanja za djecu u različitim uzrasnim kategorijama. *International Scientific Conference Effects of Applying Physical Activity on Anthropological Status of Children, Adolescents and Adults.* December 11-12th 2018, Belgrade, University of Belgrade - Faculty of Sport and Physical Education Belgrade, Republic of Serbia, pp.55-56.
9. Trivun, M., Budimlic, J. (2010). Relations of morphological characteristics with swimming by the dolphin technique. Sport and Health, Journal of Physical Education and Sports, University of East Sarajevo, Faculty of Physical Education and Sports, Year 5, No 2 , 61-67
10. Trivun, M., Tošić, J., Pasic, G. (2015). Rezultatska uspješnost ronjenja na dah u zavisnosti od uslova sredine, ***Sportske nauke i zdravlje,*** Naučno-stručni časopis iz oblasti sportskih i medicinsko-rehabilitacionih nauka, Banja Luka, Vol 5, 1, 81-88
11. Trivun, T., Torlakovic, A., Németh,Z., Mirvić, E. (2018). Razlike rezultata studenata u bodi mas indeksu i plivanju. *International Scientific Conference Effects of Applying Physical Activity on Anthropological Status of Children, Adolescents and Adults.* December 11-12th 2018, Belgrade, University of Belgrade - Faculty of Sport and Physical Education Belgrade, Republic of Serbia, pp.149-150.
12. Zaciorski, V.M. (1975). *Physical characteristics of the athlete.* Belgrade: Alliance for Physical Culture.

Corespodence:
MsciMiloslav Markovic
Doctoral studies Student, Faculty of Physical Education and Sport,
University of East Sarajevo
Phone: 00381642015164

ORGINAL SCIENTIFIC PAPER

Ilija Stijepić[1]
[1]School of Applied Medical Sciences Prijedor, Bosnia and Herzegovina

UDK: 796.012.11
DOI: 10.7251/SIZEN0119041S

EFFECTS OF A 12-WEEK STRENGTH AND BALANCE EXERCISE PROGRAM ON FUNCTIONAL FITNESS OF OLDER MEN

Abstract

For the majority of mature adults, the maintenance of independent functioning, intact cognitive abilities, and good mental status could be the most important achievements in late life. Functional fitness is defined as the physical capacity to perform daily activities independently and without the appearance of fatigue. Functional fitness can be measured using the Senior Fitness Test – SFT. The experimental group consisted of 30 men mean age 76,9±6,27. Participants completed a 12-week strength and balance exercise program. The participants were evaluated before and after completing the exercise program for lower- and upper-body strength, aerobic endurance, lower- and upper-body flexibility, agility and dynamic balance. To determine the changes in particular parameters, paired samples T-test was used. The statistical significance was set at p<0.05. Statistically significant improvements were found in all tests.

Aging is a biological process which sooner or later affects the human organism. Aging is proces that changes the biochemical composition of the tissue and decline in functional abilities is inevitable. People who are physically inactive can lose as much as 3% to 5% of their muscle mass each decade after age 30, and the decline is even faster after age 60(Melton, Khosla, Riggs, 2000). Maximum oxygen intake- VO2 max is one of the most important factors for determining the work capacity and the ability of elderly individuals to perform independendetly everyday activities and tasks. Age related VO2 max. decline is approximately 0,75-1% per year or 10% per decade in sedentary individuals(Rogers et al. 1990; Hawkins & Wiswell, 2003). VO2 max, decline is much lower in physically active individuals, about 5% per decade (Wiswell et al. 2001; Betik & Hepple, 2008) However,

people today reach higher average life expectancy and the number of elderly people is increasing. These aging trends have an economic and social impact and present challenges to families, and health careproviders to meet the needs of aging individuals. For the majority of mature adults, the maintenance of independent functioning, intact cognitive abilities, and good mental status could be the most important achievements in late life. Functional fitness is defined as the physical capacity to perform daily activities independently and without the appearance of fatigue. Functional fitness can be measured using the Senior Fitness Test – SFT. SFT is designed to assess lower- and upper-body strength, aerobic endurance, lower- and upper-body flexibility, agility and dynamic balance (Rikli and Jones, 1999).

Most of aging-associated factors that affects the human organism can be reduced by a regular exercise (Bates et al.. 2009; Carvalho, Marques i Mota 2009; Cavani et al. 2002). Physical training provides the individual with positive influence on their own health, functional abilities and motor skills. In order to achieve positive effects of physical activity, it is necessary that the exercise programs are adjusted by the type, intensity, frequency and duration for each individual.

METHOD

The experimental group consisted of 30 men mean age 76,9±6,27. The participants were recruited on a voluntary basis after we've placed an ad poster inviting people to participate in the exercise program in the local community and in a local geriatric center. Inclusion criteria included men aged 65 or more, independent in performing daily life activities and attendance rate over 80%. Exclusion criteria included major diseases or conditions such as severe heart disease, uncontrolled hypertension, dizziness and acute phase of other diseases.

Senior Fitness Test protocol developed by Rikli and Jones (1999) was used to obtain data. Senior Fitness Test measures physical parameters associated with functional ability. Test batery is used for assessment of the functional-fitness levels of people 60 years of age and older. The physical parameters of the subjects were evaluated before and after completing the exercise program for arm-curl test (upper extremity strength), chair-stand test (lower extremity strength), 2-min step test (aerobic endurance), 8-ft up-and-go (dynamic balance and agility), back-scratch test (upper extremity flexibility), and chair sit-and-reach test (lower extremity flexibility)(Rikli and Jones, 2013).

Participants completed a 12-week exercise program consisting of two 45 minute classes per week for first 5 weeks and three 45 minute classes per week for next 7 weeks. Each class

began with 10 minute warm-up and stretching activities followed by 30 minutes of strength and balance exercises and 5 minute cool-down and stretching activities.

The intensity and complexity of exercises increased during the program with the observed progress of the participants.

The collected data were processed using the Shapir-Wilk test in order to evaluate data distribution. To determine the changes in particular parameters, paired samples T-test was used. The statistical significance was set at $p<0.05$. The procession and evaluation of data was carried out using the statistical software SPSS 16.0

RESULTS

Paired samples T-test was used to determine the changes in particular parameters of functional fitness. For each variable the mean value of the initial (initial) and final measurement, standard deviation, T-test value and level of significance was evaluated. The size of the effect for variables was calculated using Eta sqare.

Table 1. Results of Senior Fitnes Test parameters pre and posttesting for elderly men with paired T-test calculations

TEST	**Mean (SD)**		**Prosječna Razlika (Mean) (SD)**	**t (df=29)**	**p<0.05 (2-tailed)**	**Eta kvadrat**
	Inicijalno Mjerenje	Završno mjerenje				
chair-stand test	12.470 (2.837)	14.17 0(2.493)	-1,700 (1,664)	-5,596	0.000*	0.52
arm-curl test	17,930 (3,403)	18,570 (3,380)	-0,633 (1,245)	-2,786	0,009*	0.21
8-ft up-and-go	9,386 (3,236)	7,917 (2,176)	1,469(1,610)	4,998	0,000*	0.43
back-scratch test	-10.20 (6.915)	-8.90 (6.250)	-1,300 (1,705)	-4.176	0,000*	0.37
chair sit-and-reach	-5.83 (4.928)	-5.10 (4.923)	-0,733(1,437)	-2,796	0,009*	0.21
2 min. step test	100,07 (9,766)	100,87 (9,940)	-0,800(2,024)	-2,165	0,039*	0.14

Statistically significant improvements with significance set to $p<0.05$ were found in all tests. By calculating the coefficient of the significance of the difference between the initial and the

final measurement (eta square) we concluded that the greatest impact of the exercise program was achieved in the chair-stand test and 8-ft up-and-go test, while the smallest impact was achieved with a 2 minute test step which was in line with expectations given that in the training program the emphasis was not on aerobic exercises.

DISCUSSION

Targeted lower and upper extremity strengthening exercises using the participants' own body weight and dumbbells as resistance and balance exercises were proved to be effective in significantly increasing measures of functional fitness in elderly subjects. Other researchers have demonstrated that targeted lower extremity training results in improved lower body strength in elderly subjects(Schlicht et al., 2001; Yates & Dunnagan, 2001). As reported by Rogers et al., balance depends on the sensory input and organization, muscular strength, coordination of activity, level of attention, disease and medications. The decrease in at least one of these factors leads to negative balance scores. Physical activity may decrease or eliminate several of these negative factors. Decline in the ability to maintain balance is associated with a decrease in lower extremity maximal and explosive force(Izquierdo et al., 199; Pržulj, 2007). Strength training has had a positive impact on improving gait safety and stability in the elderly population (Hess and Woollacott 2005; Pijnappels et al., 2008; Orr et al., 2008). Exercise programe with elderly subjects coducted by Di brezzo et al. (2005) showed a significant improvements in the 8-ft up-and-go test, back-scratch test and chair-stand test. *Toraman, Erman, Agyar* (2004) conducted a 9 week multicomponent exercise programe.

Their research has shown statistically significant improvement in 8-ft up-and-go test, chair-stand test and arm-curl test. Brovold et al.(2013), despite an exercise protocol with a high-intensity aerobic interval, found a small effect on SFT.

CONCLUSION

After completing a 12-week exercise program, we found statistically significant improvements with significance set to $p < 0.05$ for all measured variables. Our 12- week exercise program that targets subjects strength and balance can be effective and low-cost solution to improving older adults physical ability and health. Physical activity is critical to maintaining strength, flexibility and balance in this population. In addition to improving

physical ability, the benefit of completing the exercise program is the education of the elderly on the benefits of physical activity.

REFERENCES

1. Bates, A., Donaldson, A., Lloyd, B., Castell, S., Krolik, P. and Coleman, R. (2009) 'Staying active, staying strong: pilot evaluation of a once-weekly, community-based strength training program for older adults', *Health Promotion Journal of Australia*, 20 (1), pp. 42-47.
2. Brovold, T., Skelton, D.A., Bergland, A. (2013) "Older adultsrecently discharged from the hospital: effect of aerobic intervalexercise on health-related quality of life, physical fitness, andphysical activity," *Journal of the American Geriatrics Society*, vol.61, no. 9, pp. 1580–1585.
3. Betik, A.C., Hepple, R.T. (2008). "Determinants of VO2 decline with aging: an integrated perspective ", Applied Physiology, Nutrition, and Metabolism Vol. 33, pp. 130-140,
4. Carvalho, M. J., Marques, E. and Mota, J. (2009) *'*Training and detraining effects on functional fitness after a multicomponent training in older women*'*, *Gerontology*, 55 (1), pp. 41-48.
5. Cavani, V., Mier, C. M., Musto, A. A and Tummers, N. (2002) 'Effects of 6-week resistance training program on functional fitness of older adults', *Journal of Aging and Physical Activity*, 10 (4), pp. 443-452.
6. Hawkins, S, Wiswell, R. (2003). Rate and mechanism of maximal oxygen consumption decline with aging: implications for exercise training. Sports Med., 33: 877–888.
7. Hess, J., Woollacott, M**.** (2005). Effect of high-intensity strength-training on functional measures of balance ability in balance-impaired older adults. *Journal of Manipulative and Physiological Therapeutics*, 28, 582-590.
8. Izquierdo, M., Aguado, X., Gonzalez, R., Lopez, J. L., Hakkinen, K. (1999). Maximal and explosive force production capacity and balance performance in men of different ages. *European Journal of Applied Physiology and Occupational Physiology*, 79(3), 260-267.
9. Melton, L.J., Khosla, S., Riggs, B.L. (2000). Epidemiology of sarcopenia. Mayo Clin Proc.,75 Suppl:S10–2 (discussion S12–3).
10. Orr, R., Raymond, J., Singh, F. M. (2008). Effiacacy of Progressive Resistance Training on Balance Performance in Older Adults – A Systematic Review of Randomized Controlled Trials. *Sports Medicine*, 38(4), 317-343.
11. Pijnappels, M., Reeves, N.D., Maganaris, C.N., van Dieen, J.H. (2008). Tripping witout falling; lower limb strenght, a limitation for balance recovery and a target for training in the elderly. *Journal of Electromyogy and Kinesiology*, 18(2), 188-96.
12. Pržulj, D. (2007). *Kondiciona priprema, Udžbenik.* Istočno Sarajevo: Fakultet fizičke kulture.

reverses aging in human skeletal muscle. PloS One.,2:e465.
13. Rikli, R.E., Jones, C.J. (1999). Development and validation of a functional fitness test for community residing older adults. Journal of Aging and Physical Activity 7:127–59.
14. Rikli, R. E., Jones, C.J. (2013). Senior Fitness Test Manual - 2nd Edition. Human Kinetics
15. Rogers, M.A., Hagberg, J.M., Martin, W.H., Ehsani, A.A., Holloszy, J.O. (1990). Decline in VO2max with aging in master athletes and sedentary men. J Appl Physiol.,68:2195–2199.
16. Rogers, M.E., Fernandez, J.E., & Bohlken, R.M. (2001). Training to reduce postural sway and increase functional reach in the elderly. *Journal of Occupational Rehabilitation,* **11**(4), 291-298.
17. Schlicht, J., Camaione, D.N., Owen, S.V. (2001). Effect of intense strength training on standing balance, walking speed, and sit-to-stand performance in older adults. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences,* **56**(5), M281-M286.
18. Foraman, N.F., Erman, A., Agyar, E. (2004). Effects of multicomponent training on functional fitness in older adults. *J Aging Phys Act*, 12(4), 538-53.
19. Wiswell R., Hawkins S., Jaque, V., Hyslop, D., Constatino, N., Tarpenning, K., Marcell, T., Schroeder, E. T. (2001) Relationship Between Physiological Loss, Performance Decrement, and Age in Master Athletes. *The Journals of Gerontology: Series A*, Volume 56, Issue 10,618-626
20. Yates, S.M., Dunnagan, T.A. (2001). Evaluating the effectiveness of a home-based fall risk reduction program for rural community-dwelling older adults. *Journals of Gerontology. Series A. Biological Sciences and Medical Sciences,* **56**(4), M226-M230.

Correspondence:
Ilija Stijepic
School of Applied Medical Sciences Prijedor, Bosnia and Herzegovina
E:mail:ilijamarija@gmail.com
Phone::0038765417958

ORGINAL SCIENTIFIC PAPER

Milomir Trivun[1], Novica Gardasevic[2], Boris Janjic[3]
[1] Faculty of Physical Education and Sports, University of East Sarajevo
[2] Doctoral studies student, Faculty of Physical Education and Sport, University of East Sarajevo
[3]Doctoral studies student, Faculty of Sport and Physical Education, University of Novi Sad

UDK: 797. 253. 093
DOI: 10.7251/SIZEN0119047T

SITUATION EFFICIENCY INDICATORS RELATIONS DEPENDING ON THE OUTCOME OF WATER POLO MATCHES

SUMMARY:

The aim of the research was to determine the differences in the parameters of the situational efficiency between the winning and the defeated teams in the regular part of the A1 Regional Water polo competition in the season 2018/19. The sample includes the analysis of 82 water polo matches played within 18 rounds of the regular part of the league. Differences were found in 12 variables of team situational efficiency obtained based on official statistical reports from the games played. Using Man-Whitney U test, statistically significant differences were found in 8 out of 12 analyzed variables. The teams that ended the match as the winner were more dominant in almost all variables related to the efficiency of the shot, had more efficient goalkeeper, more efficient effect in the blockade of the shot, better use of the player more, and more efficient swimmers during swimming for the ball. The statistically significant differences in variables were not found; lost balls, won balls, an estimated 5 meter shots and the total number of fouls in the match.

Keywords: *A1 Regional water polo league, differences, match statistics*

INTRODUCTION

Water polo is a collective sports game that has been included in the Summer Olympic Games program since 1900 in Paris. Water polo and football are the oldest team sports branches of the Summer Olympics. The first gold medal at the Olympic Games in 1900 was won by Great Britain (Snayder, 2008). Its roots, water polo has even 100 years before joining the summer Olympics program, with water festivals held around 1800 in English cities. The first water polo match was played in the Crystal Palace in London in 1874, while the first official water polo rules were written by William Wilson in 1876 in Aberdeen, Scotland, in the "Bon Accord Club" (Snayder, 2008).). According to the first rules, the water polo game was characterized by an uncontrolled game that included a lot of diving, sinking opponents and balls, without much attention being paid to the technique or rules of the game (Hraste, Bebic, &Rudic, 2013).

Water polo has been continuously developing to the present day, with the occasional change in the rules of the game. The latest changes to the rules occurred at the extraordinary Congress of the International Water Sports Organization (FINA), in Hangzhou, China, in 2018. The first application of the new rules was on the Europa Cup in Zagreb (5-7 April, 2019). The

new rules of the game should encourage its dynamism and attractiveness for viewers. Among other things, the new rules of the game include the following; after the corner and exclusion of the player the defending team, the time of the new attack is reduced to 20 seconds; within 6 yards from goal, any foul from the back of an attacker who holds the ball and moves towards the opponent's goal and tries to kick, the one will be punished with a five-meter shot; it is possible to achieve a goal from the free kick outside 6 meters; the corner performer can reach the goal with a straight shot from the corner or swimming from the corner and the shot; possible "flying changes" of the player to the center line of the pool; the team is entitled to two times time-out during the match; referees will be equipped with audio technology (headset and microphone) for easy communication one to another and else.

On the territory of the former Yugoslavia, a firefighter arrived thanks to students who studied in Hungary, Austria and Germany around 1907 (Rasovic, 1986). The first Yugoslavia participated with the water polo team was in the Olympic Games in 1936 in Berlin, and in 1968 it won the gold medal in Mexico for the first time.

Today, water polo is one of the most important sports branches in almost all former Yugoslav republics. Montenegro, Serbia and Croatia are the countries whose national teams occupy the very top of the world water polo. In order to preserve and affirm the water polo, in 2008, the Adriatic Water polo League was established, ie water polo competition, now called the Regional Water polo League. The regional water polo league is played by the best clubs from Montenegro, Serbia, Croatia and Slovenia. The regional water polo league is divided into A1 and A2 water polo league.

In addition to the fact that water polo is one of the most important sports branches in the countries of former Yugoslavia, scientific research dealing with water polo problems is very rare. Compared to other sporting disciplines (football, basketball, handball, martial arts), water polo researches are rather negligible. In general, the most commonly studied subjects are the basic and specific motorics of water polo players, the morphological status of water polo players, the relationships and relations of segments of the anthropological status of water polo players (Aleksandrovic, Naumovski, Radovanovic, Georgiev,&Popovski 2007; Bampouras&Marrin, 2009; Dopsaj, Madic,&Okicic, 2007; Janjic, Gardasevic,&Trivun, 2018; Melchiori, Manzi, Padua, Sardella,&Bonifazi, 2009; Tan,Polglaze,& Dawson, 2009; Tsekouras, 2005) and the like. There is much less representation of research for situational efficacy by analyzing the parameters of water polo matches statistics (Escalante, Saavedra, Mansilla, &Tella, 2011; Hrasteet al., 2013; Hraste, Jelaska,&Granic, 2016; Lupo, Tessitore, Minganti,&Capranica, 2010; Lupo, Tessitore, Minganti, King, Cortis,&Capranica, 2011; Mirvic, Rasidagic, &Bajric, 2014).

The subject of this research is the parameters of the team situational efficiency of the water polo matches of the Regional A1 League in the season 2018/19. The problem of the research is to determine whether there are statistically significant differences in the parameters of the team situational efficiency between the outcome of the winning match and the outcome of the defeating match in the regular part of the competition in the 2018/19 season.

The aim of the research is to determine the differences in the parameters of the team situational efficiency between the water polo teams that won the match and the water polo teams that were defeated in the regular part of the A1 Regional Water Polo League.

METHOD OF WORK

Sample research

A sample of 82 water polo matches of the A1 Regional Water Polo League, played in the regular part of the competition (18 rounds), was analyzed up to the Final Four in the season 2018/19. Out of the total sample of matches, which in part of 18 rounds of the regular part there were 90, games that ended with the unsolved result (5 games), official result (2 matches) and matches for which statistics were not completed (1 game) were exempted.

On the basis of the criteria the result of the match, win or defeat, from the total sample, 2 sub-sorts are defined;

- the result of the victory of 82 outcomes,
- the result defeat 82 outcomes.

A1 Regal Water polo League in the 2018/19 season played the following clubs; (PVK Jadran Customs and Primorac from Montenegro, BVK Crvena Zvezda, Partizan and VK Sabac from Serbia, HAVK Mladost, Jug CO, Jadran Split, Naval Brodosas and KLA Posk from Croatia).

Variables sample

Variables sample represent 12 parameters of team situational efficiency. The survey covers the following variables; total percentage of shots (UKŠUT%)the percentage of shots from the game (ŠIGRA%), the percentage of shots with the player more (IGVIŠ%), the percentage of the shot from 5 meters (ŠUT5M%), the percentage of the shot from the counter (ŠKONT%), the percentage of goal keeper defense ODBRG%), lost balls (IZGBL), won balls (OSVOL), blocked shots (BLOKŠ), percentage of realization of the player more (RIGRV%), swimming for the ball (PLIVL) and fouls (FAUL). Data for all variables are downloaded from the official A1 Regional Water Polo website (http://www.rwp-league.com), based on available official league statistics. The reliability of the official statistics of the Regional Water polo League was checked in the Hraste et al., (2016), where a maximum reliability coefficient of 1.00 was determined.

Data processing methods

For all data collected, the arithmetic mean (Mean) and standard deviation (SD) are calculated. Distribution normality was tested using Kolmogorov - Smirnov test (KS). For statistical purposes data processing for the purpose of determining differences, Man-Whitney U was applied (Mann-Whitney Utest), non-parametric test for two independent samples. Data processing is performed in the software packageIBM SPSS 20.0 for Windows.

RESULTS AND DISCUSSION

Table 1 presents the results from the descriptive statics domain, the arithmetic mean (Mean) and the standard deviation (SD). Also, Table 1 presents the results for Kolmogorov-Smirnov test and the level of statistical significance of the test (p). Based on Kolmogorov-Smirnov's Z values, as well as its statistical significance (p), it was concluded that the distribution of results was not normally distributed in 6 variables in group number 1 (outcome of the winning game) and in 7 variables in group number 2 (outcome of the losing game). The distortion of the distribution of results in a significant number of variables in both groups caused the application of

the non-parametric statistical method Mann-Whitney U test for determining the differences between two independent samples (Table 2).

Table 1.

Descriptive statistics of situational efficiency variables

Variables	Match Outcome Winning (Group 1) N = 82				Match outcome defeat(Group 2) N = 82			
	MEAN	**SD**	**KS-Z**	**p**	**MEAN**	**SD**	**KS-Z**	**p**
UKŠUT%	48.17	17.02	**1.38**	**.04**	33.45	18.08	**1.62**	**.01**
ŠIGRA%	39.06	19.55	**1.48**	**.02**	27.06	20.95	**2.09**	**.00**
IGVIŠ%	63.78	21.08	.82	.50	46.88	26.70	.76	.59
ŠUT5M%	73.83	43.96	**2.91**	**.00**	62.00	44.72	**1.93**	**.00**
ŠKONT%	53.18	40.75	**1.63**	**.01**	38.07	43.12	**2.37**	**.00**
ODBRG%	53.03	17.60	1.24	.08	35.56	14.30	.86	.44
IZGBL	5.63	4.47	1.09	.18	7.09	5.75	1.06	.20
OSVOL	5.87	5.28	1.21	.10	4.80	4.29	**1.44**	**.03**
BLOKŠ	2.23	1.89	**1.64**	**.00**	1.60	1.72	**1.69**	**.00**
RIGRV%	50.16	20.11	.94	.33	31.50	19.00	.78	.56
PLIVL	2.65	.97	**1.83**	**.00**	1.28	.98	**1.78**	**.00**
FAUL	9.52	3.40	.82	.50	9.92	2.60	1.04	.22

Legend: Mean** - arithmetic mean**, SD** - standard deviation**, KS - Z** - Kolmogorov Smirnov Z value**, p** - level of statistical significance, eclipse**.

Table 2 shows the results of differences in the variables in team situational efficiency based on the Mann-Whitney U test. It was found that among the winning and defeated water polo teams, there are statistically significant differences in 8 out of 12 analyzed variables of situational efficiency, expressed through the parameters of the official statistics of the water polo match.

Table 2.

Mann-Whitney's U test results

Variables	Match Outcome Winning (Group 1)			Match outcome defeat (Group 2)					
	Mean Rank	**Grouped Median**	**N**	**Mean Rank**	**Grouped Median**	**N**	**MWU test**	**Z**	**p**
UKŠUT%	**107.55**	**42.65**	**82**	**57.45**	**27.73**	**82**	**1308.00**	**-6.75**	**.00**
ŠIGRA%	**102.53**	**35.85**	**82**	**62.47**	**22.86**	**82**	**1719.50**	**-5.40**	**.00**
IGVIŠ%	**98.33**	**62.22**	**82**	**66.67**	**46.55**	**82**	**2064.00**	**-4.27**	**.00**
ŠUT5M%	44.66	90.62	43	35.63	78.94	34	616.50	-1.38	.16
ŠKONT%	**91.52**	**53.57**	**82**	**73.48**	**29.26**	**82**	**2622.00**	**-2.66**	**.00**
ODBRG%	**107.90**	**55.05**	**82**	**57.10**	**37.80**	**82**	**1279.50**	**-6.85**	**.00**
IZGBL	77.16	5.62	82	87.84	7.28	82	3800.00	1.44	.14
OSVOL	86.28	4.87	82	78.72	3.81	82	3052.00	-1.02	.30
BLOKŠ	**90.78**	**1.85**	**82**	**74.22**	**1.28**	**82**	**2683.00**	**-2.28**	**.02**
RIGRV%	**102.73**	**45.50**	**82**	**62.27**	**31.15**	**82**	**1703.00**	**-5.46**	**.00**
PLIVL	**109.62**	**2.66**	**82**	**55.38**	**1.25**	**82**	**1138.50**	**-7.54**	**.00**
FAUL	79.88	9.40	82	85.12	9.72	82	3577.00	.71	.47

***Legend:** Mean Rank Value - Grouped Median - Median grouped data (the value between the lower and upper limits of the group interval in which the median is located), **N** - the number of matches, **MWU** - the value of Mann Whitney's U test, **Z** - approximation, **p** - level of statistical significance*

By individual analysis of the difference between the winning and the defeated teams it was found that the winning team (grouped median - 42.65%) had a significantly dominant total percentage of shots in the match (UKŠUT%), compared to the losing teams (grouped median - 27.73%). Water polo teams that won in matches had a statistically significantly better percentage of shots from the game (35.85% - 22.86%), as well as the percentage of shots with the player more in the match (62.22% - 46.55%). Based on the difference (53.57% - 29.26) in the variable percentage of the shot from the contour (SKKONT%), it can be assumed that the winning teams were physically prepared. The teams that were winning, almost every second attack from the contrary ended with a goal, while the defeated teams scored goal from every third attack from the counter. Similar results were also found in the research Mirvic,et al., (2014), where it was established that the water polo representations that achieved victories at the World Championship in Shanghai 2011 achieved a significantly higher number of goals from the contrary than the losing teams. Also, the difference in the efficiency of the shots from the contour was confirmed in the research Lupo,et al.,(2010), where the difference in statistical parameters was established between the water polo team of the different ranking of the competition.

A significant role in the final outcome of the game has the goalkeeper efficiency. With the teams that won, the percentage of goalkeeper defense at the match was 55.05%, while in defeated teams this percentage was 37.80%. So, the goalkeepers contributed to the victory of their team, by defending every second opponent's shot. The performance of the goalkeeper in the defeat was every third successful defense or performance of 37.80%. A statistically significant difference in situational efficiency between the outcome of the match is the winner - defeated, is also realized in the variable block shot (1.85 - 1.28).

Also, in the variable the percentage of player's more performance (RIGRV%) was statistically significant difference in favor of the outcome of the winning match. Water polo teams that ended the match winning, nearly every second attack with the player more wassuccessful (45.50%). With the teams that ended the match with defeat, the player more realization was worse and amounted to 31.15%, or approximately every third successful attack with the player more. Similar results, compared to statistically significant differences, were also found in the research of Hraste, et al., (2016), where the difference was also established in the realization of the player more in favor of the 4 first-ranked teams compared to the other teams in the A1 Regional Water polo League (season 2013/14).

A statistically significant difference in situational efficiency was also found in the floating ball variable (PLIVL) variable. With the team that ended the game with a win, swimmers for the first ball by quarter, won the ball almost 3 times per game (2.66), while swimmers from the defeated team scored the first ball in quarter-finals on average for one-quarter per game (1.25) . Winning a ball when swimming at the start of a quarter of a water polo game puts the team in a more favorable position in terms of more attacks per quarter and the game in general. Also, the teams that often win the first ball in the quarter have faster players, more physically ready, which can be the prevailing of the match in terms of counter attack and the like. The team of American physiologists ranked the water polo as the most demanding sporting game in the physiological sense of all the sporting activities they were exploring (baseball, basketball, cross-country, football, golf, rugby, softball, swimming, tennis, volleyball and wrestling). This scoring included ratings for aerobic endurance, flexibility, anaerobic endurance, body composition, speed, strength, and more (according to Snyder, 2008). Accordingly, the differences in situational efficiency between the winning team and the defeated team, will be significantly more visible if the players

of these teams are not at the highest level of physical fitness.In variables; lost and won balls, match fouls and a 5-meter penalty shot, there was no statistically significant difference between the outcome of the match - defeat.

CONCLUSION

On the basis of the Mann-Whitney U Test, it was established that between the water polo team that won the match and the team that lost the matches in the regular part of A1 Regional Water Polo League (season 2018/19) there are statistically significant differences in 8 out of 12 analyzed variables. By analyzing the differences between the team situational efficiency variables, it can be noted that the winner of a water polo match will be the team that has better shooters efficiency, more successful performance of the player more, and a better effect of the blockade of the shot, as well as more successful goalkeeper on goal. Also, a very significant difference between the winning team and the team that lost the match, was noted in the swim speed for the ball.

The obtained results can contribute in the preparation and running of the game, or the tactical realization of the game in accordance with the knowledge of the weaknesses and advantages of some water polo teams. According to Hraste, et al.,(2015), empirical results show that statistical data are a good instrument for water polo players quality assessment.

The general conclusion of the research is that the differences in the situation efficiency are significant and big between the teams that ended the match winning it against the teams that recorded the defeat. If the water polo team wins the first quarter only once, successfully realizes every third attack with the player more, realizes successfully every third action from the counter, and has a poor overall shooter efficiency, as well as the efficiency of the goalkeeper, the outcome of the match will not be favorable.

REFERENCES

1. Aleksandrović, M., Naumovski, A., Radovanović, D., Georgiev, G., &Popovski, D. (2007). The influence of basic motor abilities and antropometric measures on the specific motor skills of talented water polo players. *Facta Universitatis, Series Physical Education and Sport, 5(1),* 65-74.
2. Bampouras, TM., &Marrin, K. (2009). Comparasion of two anaerobic water polo-specific tests with the Wingate test. *Journal Strength Conditional Resaurse, 823(1),* 336-340.
3. Dopsaj, M., Madić, D., &Okičić, T. (2007). The assessment of the acquisition of various crawl style modes in water polo players with respect to age and competitive levels. *Facta Universitatis, Series Physical Education and Sport, 5(2),* 109-120.
4. Escalante, Y., Saavedra, M. J., Mansilla, M., &Tella, V. (2011). Discriminatory power of water pologamerelated statistics at the 2008 Olympic Games. *Journal of Sports Sciences, 29(3),* 291-298.
5. Hraste, M., Bebic, M., &Rudic, R. (2013). Where is today's Water Polo Heading? An Analysis of the Stages of Development of the Game of Water Polo. Our Sea, Scientific-Professional Journal for Sea and Marine, 60 (1-2), 17-22.
6. Hraste, M., Jelaska, I., &Granic, I. (2016). Analysis of team and individual performance in water polo: Differences between the three qualitative levels of water

polo players. *Our Sea, Scientific-Professional Journal for Sea and Marine, 63(2),* 70-74.

7. Janjic, B., Gardasevic, N., &Trivun, M. (2019). Morphological characteristics as predictors of situational success in water polo. *Sport and Health, 13(2),* 24-31.
8. Lupo, C., Tessitore, A., Minganti, C., &Capranica, L. (2010). Notational analysis of elite and subelitewaterpolo matches. *Journal of Strength and Conditioning Research, 24(2),* 223-229.
9. Lupo, C., Tessitore, A., Minganti, C., King, B., Cortis, C., &Capranica L. (2011) Notational analysis of American women's collegiate water polo matches. *Journal of Strength and Conditioning Research, 25(3),* 753-757.
10. Melchiorri, G., Manzi, V., Padua, E., Sardella, F., &Bonifazi, M. (2009). Shuttle swim test for water polo players: validity and reliability. *Journal of Sports Medicine and Physical Fitness, 49(3),* 327-330.
11. Mirvic, E., Rasidagic, F., &Bajric, O. (2014). Differences between defeated and winning teams in water polo at the World Men's Championships. *Sport Science, 7(1),* 110-117.
12. Rasovic, D. (1986). *Sixty years of Hercegnovski "Adriatic".*Herceg Novi; PVK Adriatic, SIZ for Physical Culture HN, Republic SIZ Physical Culture Titograd, Commission for the History of Sport, Nor Municipality of HN, Fund for Fostering Revolutionary Traditions.
13. Snyder, P. (2008). *Waterpolo for players & teachers of aquatics*. Califomia-Fullerton: Fullerton College.
14. Tan, F., Pollaze, T., & Dawson, B. (2009). Activity profiles and physical demands of elite women's water polo match play. *Journal of Sports Sciences, 27(10),* 1095-1104.
15. Tsekouras, Y., Kavouras, S., Campagna, A., Kotsis, Y., Syntosi, S., Papazoglou, K., &Sidossis, L. (2005). The anthropometric and physiological characteristics of elite water polo players. *European Journal of Applied Physiology, 5(1),* 35-41.

Correspondence:
MScNovicaGardasevic
Doctoral studies Student, Faculty of Physical Education and Sport, University of East SarajevoStudenca 29, 81400 Niksic, Crna Gora
Tel.:+38267829745
E-mail: nowica@t-com.me

MANUAL FOR AUTHORS

Joumal ***SPORT AND HEALTH*** publishes papers from the field of physical education and sport and related bio-medical, humanistic, social and natural sciences with non published results of scientific researches and new empiric experiences. The submitted manuscript that was not prepared in conformity with the Manual for authors will immediately be returned to the author to be amended. The author is entirely liable for the content and wording of the paper. All the papers are reviewed.

CATEGORIZATION OF THE PAPERS

The Joumal publishes articles, polemics, reviews, surveys, thematic bibliographies, patents, reports and news on scientific and professionals meetings as well as similar documents vital for the field of physical education and sport.

The category of the papers is to be determined by the reviewer and the editors.
The reviewed papers are classified into the following categories:

- Original scientific paper,
- Review,
- Previous announcement,
- Paper from the scientific / professional meeting, invitation lecture and announcement,
- Scientific criticism, polemic, review
- Professional paper.

MANUSCRIPT OF THE PAPER

The manuscript of the paper includes: style of the manuscript, text, footnotes, quoted bibliography, enclosures (tables, pictures, graphs etc).

The manuscript should be written in font *Times New Roman*, size 11, with *single* spacing.

TEXT

The length of the text is limited to 10 printed pages, paper format A4, margins 2 cm. Generally text is consists of Introduction, Method, Results and Discussion, Conclusion.

Within the text the bibliography are quoted according to *APA* system (see: *Publication Manual of the American Psychological* Association; www.apastyle.org).

BIBLIOGRAPHY

The text of the paper is accompanied with the list of solely those works that are quoted in the paper. The papers are quoted according to *APA* system (see: *Publication Manual of the American Psychological Association*; www.apastyle.org). The list should begin on a separate page (after the text) under the title: Bibliography, with continuous pagination in Arabic numerals.

The papers are to be mailed to the following address:

SPORT AND HEALTH
Faculty Physical Education and Sports
Stambulčić bb
71420 Pale, BiH Bosnia

e-mail: dekanat@ ffvis.ues.rs.ba
tehnicki.sekretar@ ffvis.ues.rs.ba
milomirtrivun@gmail.com and milomir.trivun@ffvis.ues.rs.ba