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Short notice

Promjene funkcionalnih sposobnosti žena pod uticajem rekreativnog plivanja

Radomir Zrnić[1], Velibor Srdić[2], Milan Nešić[3],
[1]Fakultet fizičkog vaspitanja i sporta Univerziteta u Banjoj Luci, Bosna i Hercegovina
[2]Fakultet sportskih nauka Apeiron Banjaluka, Bosna i Hercegovina
[3]Fakultet za sport i turizam, Novi Sad, Srbija

Korespondencija:
Doc. dr Radomir Zrnić,
Fakultet fizičkog vaspitanja i sporta,
Univerzitet u Banjoj Luci, Bosna i Hercegovina
sportzasvebl@blic.net

Sažetak: Istraživanje je imalo za cilj utvrditi promjene funkcionalnih sposobnosti žena pod uticajem rekreativnog plivanja. Populacija iz koje je izvučen uzorak je populacija zdravih žena, hronološke starosti od 35 do 45 godina, kod kojih dominira sedentaran način života. Procjena funkcionalne sposobnosti je testirana sa sljedećim varijablama: vitalni kapacitet, frekvencija srca u miru, radni puls, sistolni arterijski krvni pritisak, dijastolni krvni pritisak i relativna potrošnja kiseonika. Za sve rezultate izračunati su osnovni parametri deskriptivne statistike, a za utvrđivanje razlika između inicijalnog i finalnog mjerenja primjenjen je t-test. Rezultati istraživanja su pokazali da je nakon tromjesečne primjene rekreativnog plivanja došlo do statistički značajnih promjena vitalnog kapaciteteta (p = 0,000), frekvencije srca u miru (p = 0,000) i relativne potrošnje kiseonika (p = 0,000). Istraživanjem je ustanovljeno da program rekreativnog plivanja kod sedentarnih žena srednjih godina može efikasno djelovati na promjene funkcionalnih sposobnosti.
Ključne riječi: rekreacija, rekreativno plivanje, funkcionalne sposobnosti.

Uvod

Rekreativno plivanje je fizička aktivnost koja zbog svojih karakteristika može u mnogome odgovoriti potrebama savremene žene. Kao fizička aktivnost, plivanje može poboljšati zdravlje, fizičku kondiciju i kvalitet života (Saavedra i sar. 2007, Colado i sar. 2009, Fletcher i sar. 1996, Cox i sar. 2008, Nualnim i sar. 2012). Trening plivanja aktivira sve mišiće tijela, poboljšava funkcija svih sistema, kao i mišićnu i kardiovaskularnu izdržljivost (Ferretti, et all. 2014). Programi plivanja su aerobne aktivnosti koje omogućuju zdravstvene prednosti u općoj populaciji (Schmid et al. 2007). Vježbanje u vodi

Changes in Functional Abilities of Women Under the Influence of Recreational Swimming

Radomir Zrnić[1], Velibor Srdić[2], Milan Nešić[3]
[1]Faculty of physical education and sport, University of Banja Luka, Bosnia and Herzegovina
[2]Faculty of Sport Sciences Apeiron, Banja Luka, Bosnia and Herzegovina
[3]Faculty of Sport and Tourism, Novi Sad, Serbia

Correspondence:
Doc. dr Radomir Zrnić,
Faculty of physical education and sport,
University of Banja Luka, Bosnia and Herzegovina
sportzasvebl@blic.net

Abstract: The research was aimed at determining the changes in functional abilities of women under the influence of recreational swimming. The sampled population consisted of healthy women, aged 35 to 45, chronologically, with a dominant sedentary lifestyle. The assessment of functional ability was tested using the following variables: vital capacity, heart rate at rest, working heart rate, systolic blood pressure, diastolic blood pressure and relative oxygen consumption. Basic parameters of descriptive statistics were calculated for all the results, whereas the T-test was applied to determine the difference between the initial and final measurement. The results of the research showed that there were statistically significant changes of vital capacity after three months of recreational swimming (p = 0.000), heart rate at rest (p = 0.000) and relative oxygen consumption (p = 0.000). The research found that the programme of recreational swimming with sedentary middle-aged women can act effectively to change functional abilities.
Keywords: recreation, recreational swimming, functional ability.

Introduction

Recreational swimming is a physical activity that can greatly meet the needs of modern women due to its characteristics. As a physical activity, swimming can improve health, physical fitness and the quality of life (Saavedra et al. 2007, Colado et al. 2009, Fletcher et al. 1996, Cox et al. 2008, Nualnim et al. 2012). A swimming training activates all body muscles, improves the function of each system, including the muscle and cardiovascular endurance (Ferretti, et all. 2014). Swimming programmes are aerobic activities that provide health benefits to general population (Schmid et al. 2007). Exercising in water has advantages in com-

ima prednost u odnosu na druge oblike aerobnih aktivnosti za ljude koji imaju artritis, dijabetes, teškoće u razvoju, odnosno višak težine (Lin, Davey, i Cochrane, 2004). Aerobik u vodi povećava aerobni kapacitet za 24%, izdržljivost za 24%, i toleranciju vježbe za 26% Minor, Hewett, Webel, Anderson, i Kay, 1989). Programi vježbi u vodi kada je glava iznad površine vode, mogu značajno poboljšati antropometrijske mjere, sastav tijela i uticati na fiziološke promjene kod zdravih žena srednjih godina (Barbosa i sar., 2009). Povećanje kardiovaskularne izdržljivosti doprinosi većoj potrošnji kalorija, a njihova potrošnja je veća kada se povećava trajanje i intenzitet vježbe. Plivanje jača žensko srce, pomaže u regulisanju nivoa krvnog pritiska i holesterola, a smanjuje rizik od moždanog udara i bolesti srca. Plivanje štiti zglobove od pokreta visokog intenziteta, kao što je lupanje i poskakivanje, koji su zajednički za vrijeme trčanja ili drugih kopnenih aktivnosti. Plivanje je dobar izbor vježbanja za žene s osteoporozom, bolešću koja čini kosti krhke i slabima. Vježbanje u vodi omogućava tijelu 12 do 14 posto više otpora nego prilikom vježbanja na kopnu, što iziskuje puno veću potrošnju kalorija. To se dešava zbog toga što je voda skoro 800 puta gušća od vazduha, i svaki udarac, guranje, i sila je poput mini treninga otpora za cijelo tijelo, naročito oko središnjeg dijela, bokova, ruku, ramena i zadnjice. Voda u osnovi neutralizuje gravitaciju, pa je tijelo uronjeno u vodu gotovo bez težine i rizika ozljede, što se ne može isto reći za trčanje ili trening snage. Sa medicinskog, a posebno ortopedskog stanovišta, plivanje se ubraja u najpogodnije oblike tjelesnog vježbanja. Nema praktično dobnog ograničenja, plivati može dijete od rođenja, a starija osoba do kraja života. Cirkulacijski sistem je pri plivanju rasterećen, jer se cirkulacijska petlja velikog krvotoka nalazi u vodoravnom položaju, a hidrostatski pritisak na površini tijela djeluje povoljno na venski krvotok. Plivanje je naročito povoljno za gojazne osobe, koje teže nalaze odgovarajući oblik rekreativne aktivnosti, jer se u vodi ‘’gubi’’ masa tijela. Život savremene žene i njena višestruka uloga, dovodi do hroničnog zamora, smanjenja energetskog potencijala (mentalnog i fizičkog) i pojave mnogih bolesti kao što su anksioznost, kardiorespiratorni poremećaji i mentalni poremećaji. Zbog toga postoji jaka potreba za bijeg iz svakodnevnog života koristeći kretnu rekreaciju u slobodnom vremenu, a jedna od takvih aktivnosti je plivanje (Berger, 1983). Fizičke prednosti rekreativnog plivanja u cjelini su fizička kondicija, poboljšanje kardiorespiratornog i kardiopulmonalnog sistema i mišićna izdržljivost tijela. Pored toga kod žena te prednosti su u smanjenju tjelesne težine i rizik od srčanih bolesti, sma-

parison to other forms of aerobic activities for people who suffer from arthritis, diabetes, disability, i.e. excess weight (Lin, Davey and Cochrane, 2004). Water aerobics increase aerobic capacity by 24%, endurance by 24% and exercise tolerance by 26% (Minor, Hewett, Webel, Anderson and Kay, 1989). Programmes of exercising in water when you keep your head above the water surface can significantly improve anthropometric measures, body composition and influence physiological changes of healthy middle-aged women (Barbosa et al. 2009). Increasing cardiovascular endurance contributes to the increased calorie consumption due to the increased duration and intensity of training. Swimming strengthens women’s heart, helps regulate the level of blood pressure and cholesterol and reduces the risk of a stroke and heart diseases. Swimming protects the joints from high intensity movements, such as pounding and bouncing, which are common during running or other land activities. Swimming is a good choice of exercise for women with osteoporosis, a disease that makes bones fragile and weak. Exercising in water provides the body with 12 to 14 percent more resistance than exercising on land, which requires a significantly greater consumption of calories. That happens due to the fact that water is almost 800 times denser than air and each stroke, push or force is like a mini workout of resistance for the whole body, especially the central parts, hips, arms, shoulders and buttocks. Water basically neutralises gravitation, therefore the body immersed in water has almost no weight or the risk of injury, which you cannot say for running or workout of strength. From a medical, and particularly from the orthopaedic point of view, swimming is listed as one of the most convenient forms of physical exercise. Practically, there is no age limit; a child can swim from its birth, as well as elderly people until the end of their life. Circulation system is relieved in swimming, because the circulation loop of the large blood flow is in a horizontal position, whereas the hydrostatic pressure at the surface of the body acts favourably to the venous circulation. Swimming is particularly convenient for obese people, who have trouble finding appropriate forms of recreational activities, because body mass “disappears” in water. The life of a modern woman and her multiple roles lead to a chronic fatigue, decreased energy potential (mental and physical) and the occurrence of many diseases such as anxiety, cardiorespiratory disorders, mental disorders etc. Therefore, there is a strong need to escape from the everyday life using movable recreation in free time, and one such activity is swimming (Berger, 1983). Physical benefits of recreational swimming are purely consisted in physical fitness, improved cardiorespiratory and cardiopulmonary systems and muscular endurance of the body. In addition, for women these benefits

njenje negativnih psiholoških faktora i simptoma menopauze, liječenje celulita, poboljšanje cirkulacije, zaštite žena od rastuće bolesti raka. Cilj istraživanja je da se utvrdi da li postoje razlike u funkcionalnim sposobnostima sedentarnih zdravih žena srednjih godina prije i nakon polaženja programa rekreativnog plivanja.

Metod rada

Uzorak ispitanika

Populacija iz koje je izvučen namjerni uzorak za istraživanje, sačinjavale su zdrave žene sa prostora grada Banja Luka, starosti od 35 do 45 godina, kod kojih u pogledu djela životnih navika dominira sedentaran način života. Sve ispitanice (38) koje su bile obuhvaćene istraživanjem, redovno su pohađale program rekreativnog plivanja koji je realizovan na Gradskom olimpijskom bazenu u Banjoj Luci.

Uzorak varijabli

Procjena funkcionalnih sposobnosti mjerena je sa sljedećim varijablama: vitalni kapacitet (FVITKP), frekvencija srca u miru (FFSRCM), radni puls (FFSRCR), sistolni arterijski krvni pritisak (FTASI), dijastolni arterijski krvni pritisak (FTADI) i relativna potrošnja kiseonika (FRO_2max). Radni puls se mjerio odmah nakon realizacije testa hodanja UKK2km palpatorno u predjelu

include weight loss and reduced heart disease risk, decrease of negative factors and symptoms of menopause, treatment of cellulite, improved circulation, protection of women from the growing cancer risk. The aim of this research is to establish whether there are differences in functional abilities of healthy sedentary middle-aged women before and after the programme of recreational swimming.

Method of work

The sample

The population from which the sample was taken for this research can be defined as the population of healthy women from the area of the city of Banja Luka, aged 35 to 45, with a dominant sedentary lifestyle. All the examinees (38) who were included in the experiment, regularly attended the programme of recreational swimming which was implemented at the city's Olympic pool in Banja Luka.

The sample of variables

The evaluation of functional abilities was measured with the following variables: vital capacity (FVITKP), heart rate at rest (FFSRCM), working heart rate (FFSRCR), systolic arterial blood pressure (FTASI), diastolic arterial blood pressure (FTADI) and relative oxygen consumption (FRO_2max). Working heart rate was measured immediately after the completion of the test of walking UKK2km palpation

Tabela 1. *Program plivanja / Table 1. Swimming Programme*

	Vježbe / Exercises	Sedmica / Week	Opterećenje / Load	Učestalost / Rate
Zagrijavanje (10 min) / Warming up (10 min)	Istezanje / Stretching		RPE 75	
Glavne vježbe (40 min) / Main exercises (40 min)	1.Kraul - udarci nogama / Crawl – leg stroke	1- 4 sedmica / week	55-65% HRR (RPE 8-10)	
	2.Disanje u pokretu / Breathing while moving			
	3.Plutanje horizontalno / Floating horizontally			
	4.Udarci sa daskom za plivanje / Movements with swimming board			
	5. Kraul ruke / Crawl hands	5-8 sedmica / week	65-75% HRR (RPE 10-12)	
	6.Kombinacija slobodnog stila / Free style combination			
	7.Leđno udarci nogama / Leg movements in backstroke			3 puta/sedmično / times/week
	8.Kraul plivanje / Crawl swimming			
	9.Leđno ruke / Backstroke of arms			
	10.Leđna kombinacija / Backstroke combination	9-12 sedmica / week	75–85% HRR (RPE 12-14)	
	11.Leđno plivanje / Backstroke swimming			
	12.Prsno-udarci nogama / Breaststroke swimming - legs			
	13.Prsno ruke / Breaststroke -arms			
	14.Prsno plivanje / Breaststroke swimming			
	15.Prsno kombinacija / Breaststroke combination			
Hlađenje (10 min) / Cooling (10 min)	Istezanje / Stretching		RPE 75	

karotidne arterije tako što su brojani otkucaji srca u 10 sekundi pa se dobijena vrijednost množila sa šest. Sistolni i dijastolni arterijski krvni pritisak mjerio se aparatom sa manžetnom marke ‘’Teleoptik’’. Izračunavanje fitnes indeksa i određivanje relativne potrošnje kiseonika (RVO2max- mL/kg/min) realizovalo se indirektnom metodom pomoću formula koje su izvedene iz UKK2km testa hodanja (Oja i Tuxworth, 1995).

Program plivanja

Program rekreativnog plivanja je trajao tri mjeseca, tj. 12 sedmica Treninzi su se održavali tri puta sedmično u večernjim terminima, svaki trening je trajao 60 minuta. Vježbe zagrijavanja i hlađenja trajale su po 10 minuta, a glavne vježbe su trajale 40 minuta. Detaljan program plivanja prikazan je u tabeli 1.

Metode obrade podataka

Za svaku varijablu izračunati su osnovni parametri deskriptivne statistike: minimalni rezultat (Min), maksimalni rezultat (Max), aritmetička sredina (AS), standardna devijacija (SD), - asimetričnost distribucije rezultata (Skew), spljoštenost distribucije rezultata (Kurt.). Za utvrđivanje razlika između inicijalnog i finalnog mjerenja primjenjen je t-test (Malacko i Popović, 2001). Značajnost razlika utvrđena je na nivou $p<0,05$.

Rezultati

Rezultati deskriptivne analize obuhvatili su osnovne parametre identifikovanih funkcionalnih sposobnosti na inicijalnom i finalnom mjerenju (Tabela 2). U kontekstu inicijalnog mjerenja uočava se da vrijednosti centralnih i disperzionih parametara varijabli za procjenu funkcionalnih sposobnosti pokazuju normalnu raspodjelu rezultata. Uvidom u dobijene vrijednosti rezultata funkcionalnih sposobnosti na finalnom mjerenju može se konstatovati da nema značajnih odstupanja od normalne distribucije, s obzirom na to da vrijednosti koeficijenata zakrivljenosti (Skjunis) ne prelaze 1,00, izuzev kod varijable *Vitalni kapacitet (FVITKP) (-1,714),* koja značajno odstupa od normalne distribucije. Vrijednosti koeficijenta zaobljenosti (Kurtosis) kreću se ispod normalne vrijednosti distribucije 2,75, što čini distribuciju platikurtičnom ili rasplinutom, izuzev kod varijable *Vitalni kapacitet (FVITKP) (4,690),* što ukazuje na povećanu koncentraciju rezultata oko aritmetičke sredine.

measurement in the area of carotid artery by measuring heart beats in 10 seconds multiplying the resulting value by six. Systolic and diastolic arterial blood pressures were measured by a device with a ‘’Teleoptik’’ brand cuff. Calculation of fitness index and the determination of relative oxygen consumption (RVO2max- mL/kg/min) were achieved through an indirect method using formulas derived from UKK2km test of walking (Oja & Tuxworth, 1995).

Swimming programme

The programme of recreational swimming lasted three months, i.e. 12 weeks. Trainings were held three times a week in the evening, each training session lasted for 60 minutes. Warming and cooling exercises lasted about 10 minutes, whilst main exercises lasted for 40 minutes. A detailed programme of swimming is shown in Table 1 given below.

Methods of data processing

Basic parameters of descriptive statistics were calculated for each variable: minimum score (Min), maximum score (Max), arithmetic mean (AS), standard deviation (SD), - asymmetry of result distribution (Skew), flatness of result distribution (Kurt.). In order to determine the difference between the initial and final measurement, the T-test was applied (Malacko and Popović, 2001). The significance of the conclusion was determined at the level of $p<0,05$.

Results

The results of the descriptive analysis included the basic parameters of the identified functional abilities at the initial and final measurement (Table 1). In the context of the initial measurement, it can be noted that the values of central and dispersion variable parameters for the assessment of functional abilities showed normal distribution of results. After examining the values of the results obtained for functional abilities at the final measurement, it can be concluded that there are no significant deviations from the normal distribution, given that the values of the coefficient of curvature (Skjunis) do not exceed 1,00, except for the variable of *Vital capacity (FVITKP) (-1,714),* which significantly differs from the normal distribution. The values of the coefficient kurtosis (Kurtosis) are below the normal value of distribution 2,75, which makes the distribution platykurtic or fuzzy, except for the *Vital capacity* variable *(FVITKP) (4,690),* indicating an increased concentration of results around the arithmetic mean.

Tabela 2. *Deskriptivni statistički parametri funkcionalnih varijabli na inicijalnom i finalnom mjerenju /*
Table 2. *Descriptive statistical parameters of functional variables on initial and final measuring*

	Varijable	n	Min.	Max.	AS	SD	Sk.	Kt.
INITIAL	FVITKP	38	2100	3700	3040.79	320.442	-.581	.923
	FFSRCM	38	62	96	83.16	8.089	-.928	.426
	FFSRCR	38	119	186	159.34	18.594	-.625	-.317
	FTASI	38	104	164	124.66	14.880	.778	.167
	FTADI	38	60	86	74.16	6.792	.038	-.524
	FRVO2maks. ml/kg/min	38	15.9	49.3	32.532	7.9510	-.082	.120
FINAL	FVITKP	38	2200.0	4000.0	3484.211	345.2585	-1.714	4.690
	FFSRCM	38	64.0	84.0	75.789	6.2349	-.626	-.627
	FFSRCR	38	136.0	178.0	159.842	10.3598	-.340	-.477
	FTASI	38	114.0	138.0	127.053	5.4572	-.110	-.409
	FTADI	38	68.0	92.0	75.211	5.1473	.836	1.683
	FRVO2 maks. ml/kg/min	38	22.2	53.1	37.782	7.2218	-.085	.172

Legenda: n *- Broj ispitanika;* ***Min*** *- Minimum;* ***Max*** *- Maksimum;* ***AS*** *- Aritmetička sredina;* ***SD*** *– Standardna devijacija;* ***Skew*** *- Asimetričnost distribucije rezultata;* ***Kurt. -*** *Spljoštenost distribucije rezultata;* ***FVITKP –*** *Vitalni kapacitet;* ***FFSRCM*** *– Frekvencija srca u miru;* ***FFSRCR –*** *Radni puls* ***FTASI –*** *Sistolni krvni pritisak;* ***FTADI –*** *Dijastolni krvni pritisak;* ***FRVO$_2$maks. ml/kg/min –*** *Relativna potrošnja kiseonika;* ***Initaial*** *- Inicijalno,* ***Final*** *- Finalno. /*

Legend: n *– Number of respondents;* ***Min*** *- Minimum;* ***Max*** *- Maximum;* ***AS****- Arithmetic mean;****SD*** *– Standard deviation;* ***Skew*** *– Result distribution asymmetry;* ***Kurt. –*** *Result distribution flatness;* ***FVITKP –*** *Vital capacity;* ***FFSRCM –*** *Heart frequency at rest;* ***FFSRCR –*** *Working pulse;* ***FTASI –****Systolic blood pressure;* ***FTADI –*** *Diastolic heart pressure;* ***FRVO$_2$maks. –*** *Relative Oxygen Consumption;* ***Initial- Final***

Rezultatima t-testa kojim su utvrđivane promjene između inicijalnog i finalnog mjerenja (Tabela 3) bili su opservirani parametri: aritmetičke sredine razlika između inicijalnih i finalnih mjerenja (AS inicijalnog i finalnog mjerenja), standardna devijacija između inicijalnog i finalnog mjerenja (SD), Pearsonov koeficijent korelacije (r), vrijednost t-testa (t), kao i vjerovatnoća greške pri odbacivanju hipoteze (p). Na osnovu testiranih varijabli za procjenu funkcionalnih sposobnosti, vidi se da između inicijalnog i finalnog mjerenja postoji statistički značajna razlika kod varijabli *Vitalni kapacitet (FVITKP, p = 0,000), Frekvencija srca u miru (FFSRCM, p = 0,000)* i *Relativna potrošnja kiseonika (FRVO$_2$max, p = 0,000)*, u smjeru poželjnijih rezultata u finalnom mjerenju. Kod ostalih varijabli uočene razlike nisu statistički značajne. Kod sve tri navedene varijable uočene razlike su rezultati finalnog mjerenja.

The results of the T-test, which was used to determine the changes between the initial and final measurement (Table 3) consisted of the observed parameters: arithmetic mean of the initial and final measurements (AS initial and final measurements), standard deviation between the initial and final measurements (SD), Pearson coefficient of correlation (r), T-test value (t), as well as the probability of errors in the rejection of this hypothesis (p). Based on the tested variables for assessment of functional abilities, it can be seen that between the initial and final measurement there is a statistically significant difference when it comes to the variables of *Vital capacity (FVITKP, p = 0,000), Heart rate at rest (FFSRCM, p = 0,000)* and *Relative oxygen consumption (FRVO$_2$max, p = 0,000)*, while the noted differences when it comes to other variables were not statistically important. The differences noted with regards to all three given variables were a result of the final measurement.

Tabela 3. *T–test razlika između inicijalnog i finalnog mjerenja u varijablama za procjenu funkcionalnih sposobnosti /*
Table 3. *T–test between the initial and final measuring in variables for the evaluation of functional abilities*

Varijable		AS	SD	r	t	p
FVITKP	Initial	3040.789	320.442	0.845	-14.634	**0.000**
	Final	3484.211	345.258			
FFSRCM	Initial	83.158	8.089	0.702	7.843	**0.000**
	Final	75.789	6.235			
FFSRCR	Initial	159.342	18.594	0.165	-0.156	0.877
	Final	159.842	10.360			
FTASI	Initial	124.658	14.880	0.514	-1.140	0.262
	Final	127.053	5.457			
FTADI .	Initial	74.158	6.792	0.362	-0.944	0.352
	Final	75.211	5.147			
FRVO$_2$maks ml/kg/min	Initial	32.532	7.951	0.907	-9.642	**0.000**
	Final	37.782	7.222			

Legenda: M *- Aritmetička sredina;* ***SD*** *- Standardna devijacija;* ***SE*** *- Standardna greška;* ***r*** *– Pirsonov koeficijent korelacije;* ***t*** *– vrijednost Studentova t-testa;* ***p*** *- Vjerovatnoća;* ***FVITKP –*** *Vitalni kapacitet inicijalni – finalni;* ***FFSRCM –*** *Puls u mirovanju inicijalni – finalni;* ***FFSRCR*** *– Radni puls inicijalni – finalni;* ***FTASI*** *– Sistolni pritisak inicijalni – finalni;* ***FTADI*** *– Dijastolni pritisak inicijalni – finalni;* ***FRVO$_2$maks. ml/kg/min*** *– Relativna potrošnja kiseonika inicijalna – finalna /*
Legend: M – Arithmetic mean; ***SD*** *– Standard deviation;* ***SE*** *– Standard error;* ***r*** *– Pearson correlation coefficient;* ***t*** *– value of the Student's t-test;* ***p*** *- Probability;* ***FVITKP –*** *Vital capacity – initial-final;****FFSRCM –*** *Pulse at rest initial – final;* ***FFSRCR*** *– Working pulse initial-final;* ***FTASI*** *– Systolic pressure initial - final;* ***FTADI*** *– Diastolic pressure initial - final;* ***FRVO$_2$maks.*** *– Relative oxygen consumption initial – final.*

Diskusija

Rekreativno plivanje predstavlja aktivnost koja se bez rizika može upotrijebiti, kako za poboljšanje funkcionalnih sposobnosti, tako i sveukupnog zdravlja kod najšire populacije rekreativnih vežbača. Tretirane varijable su funkcionalno povezane i predstavljaju indikator sposobnosti kardiovaskularnog, respiratornog i drugih organskih sistema (Costil, 1992). Za dobre funkcionalne sposobnosti potreban je odgovarajući nivo sposobnosti, a one se mogu ostvariti redovnim i odgovarajućim fizičkim aktivnostima. Green (1989) iznosi podatak da je aerobik u vodi idealan modalitet za povoljne zdravstvene promjene. Analizirajući rezultate istraživanja (Tabela 3) vidimo da je najbolji rezultat (poboljšanje za 443,422 ml) ostvaren kod varijable Vitalni kapacitet (FVITKP, pre test 3040,789, post test 3484,211, p = 0,000). Poboljšanja ove sposobnosti se ogleda u specifičnim vježbama kada je glava u vodi prilikom horizontalnog kretanja tijela kroz vodu, te intervalne vježbe promjenljivog intenziteta. Naime, disanje izvan vode omogućuje površinsko (grudno) disanje, za razliku od aktivnosti plivanje gdje je glava u vodi i omogućuje dublje (dijafragmalno) disanje kad udah ili izdah duže traju, ili zadržavamo dah, što dodatno pospješuje rad dišnih i ostalih organa. (Khosravi i saradnici 2013) navode da trening izdržljivosti, u kombinaciji sa treningom otpora, ima veći efekat na vitalni kapacitet.

Discussion

Recreational swimming is an activity that can be used without risks in order to improve functional abilities, as well as the overall health of the broad population of recreational gymnasts. Treated variables are functionally interconnected and are an indicator of the ability of cardiovascular, respiratory and other body systems (Costil, 1992). An appropriate level of skills is necessary for good functional abilities, which can be achieved through regular and adequate physical activity. Green (1989) pointed out the data that water aerobics are an ideal modality for favourable health changes. The analysis of research results (Table 3) shows that the best results (the improvement by 443,422 ml) were achieved in the Vital capacity variable (FVITKP, pre test 3040,789, post test 3484,211, p = 0,000). Improvements of this ability are reflected in specific exercises when the head is in the water during horizontal body movement through the water, as well as in the interval exercise of a variable intensity. Namely, breathing outside the water enables surface (thorax) breathing, as opposed to swimming activities where the head is in the water allowing a deeper (diaphragmatic) breathing when an inhale or an exhale last longer, or in case of holding a breath, which further improves the functioning of respiratory and other organs. (Khosravi et al. 2013) suggest that endurance training, combined with resistance training, has

Potrošnja kiseonika, tj. njena realativna vrijednost (Tabela 3, $FRVO_2max.$ - ml/kg/min) je takođe poboljšana za 5,250 ml/kg/min (pre test 32,532, post test 37,782; p = 0,000). Plivanje je aktivnost kojom se mogu povećati aerobne sposobnosti, a potrošnja kiseonika je osnovni indikator aerobne sposobnosti. Poboljšanje ove sposobnosti, omogućio je kontinuirani rad u aerobnoj zoni, koji se intenzitetom opterećenja i dužinom dionice progresivno povećavao svaki naredni mjesec. Slično našem istraživanju, autori (Martin i saradnici, 1987) su testirali intenzivni program plivanja na kardiovaskularnu adaptaciju žena i muškaraca srednje dobi. Program je trajao 12 nedjelja, 6 puta sedmično se plivalo, a tri puta sedmično se radilo sa utezima. Svaki trening je trajao 60 minuta. Prve dvije sedmice ispitanici su plivali 30 do 45 minuta po treningu. Zadnje dvije sedmice ispitanici su u prosjeku plivali 2 km po treningu u režimu kontinuiranog i intervalnog rada. Od ukupne preplivane udaljenosti pojedinačnog treninga, oko 25% se odnosio na rad donjih ekstremiteta. Kružni trening se izvodio sa 15 pojedinačnih vježbi koje su uključivale gornje i donje ekstremitete, a svaka vježba se ponavljala 10 do 15 puta. Top of Form

Rezultati plivanja su pokazali da je nakon tretmana plivanja VO2max poboljšan za 16% (p <0,001). Povećana potrošnja kiseonika (VO2 max) je bila povezana sa manjim brojem otkucaja srca u mirovanju. Frekvencija srca je mjera kojom se može precizno kontrolisati i dozirati opterećenje u radu. Naši rezultati finalnog mjerenja pokazuju da je puls u mirovanju smanjen za 7,369 otkucaja u minuti (pre test 83,158, post test 75,789; p = 0,000). Pozitivne promjene ove sposobnosti (testa), omogućio je kontrolisani rad sa vježbama kontinuiteta i intervalnog treninga dionica plivanja u aerobnoj zoni rada. Naime, intenzitet kontinuiranog i intervalnog rekreativnog plivanja, odnosno dionice plivanja, progresivno su se povećavale iz mjeseca u mjesec. Napredak/trenutno stanje je praćeno mjerenjem pulsa poslije svake aktivnosti/dionice, čime se kontrolisao intenzitet poslije rada i isti planirao za narednu aktivnost. Naši rezultati se mogu uporediti sa rezultatima Mohr-a i saradnika (2014) koji su istraživali uticaj rekreativnog plivanja na blagu hipertenziju kod sedentarnih žena srednjih godina. Uzorak od 67 žena, podijeljenih u tri grupe (visoki i umjereni intenzitet i kontrolna) su bile pod tretmanom 15 sedmica. Grupa koja je plivala visokim intenzitetom (3 puta sedmično, 6-10 intervala u 30 minuta sa pauzom od 2 minuta između) je smanjila puls u mirovanju za 5 ± 1 min (p <0,05) i masno tkivo za 1,1 ± 0,2 kg (p <0,05). Druga grupa, koja je plivala u kontinuitetu umjerenim intenzitetom (3 x sedmično) je takođe smanjila puls u

a greater effect on vital capacities. Oxygen consumption i.e. its relative value (Table 3, $FRVO_2max.$ - ml/kg/min) is also improved by 5.250 ml/kg/min (pre test 32.532, post test 37.782; p = 0.000). Swimming is an activity which can increase aerobic capacity, whilst oxygen consumption is the main indicator of aerobic capacity. The improvement of this capacity was enabled by a continuous work in aerobic zone, which increased progressively each month by the intensity of load and the length of swimming section. Similar to our research, authors (Martin et al, 1987) tested an intensive swimming programme at cardiovascular adaptation of middle-aged women and men. The programme lasted 12 weeks, with swimming organised 6 times a week and exercises with weights were done three times a week. Each training session lasted 60 minutes. During the first two weeks, the examinees swam 30 to 45 minutes per session. The final two weeks, the examinees swam on average 2 km per session in a workout of continuous and interval regime. Out of the total distance of swimming during an individual training, around 25% focused on lower extremities. Circuit training was performed with 15 individual exercises which included upper and lower extremities, whereas each exercise was repeated 10 to 15 times. The results of swimming showed that after a swimming sessionTop of Form

the results of swimming VO2max was improved by 16% (p <0.001). The increased oxygen consumption (VO2 max) was associated with fewer heart beats at rest. Heart rate is a measure which enables a precise control and dosing of load at work. Our results of final measurement showed that the pulse at rest was reduced by 7.369 beats per minute (pre test 83.158, post test 75.789; p = 0.000). Positive changes of this ability (test) were enabled by a controlled work with exercises of continuity and interval training at swimming sections in aerobic work zone. Namely, the intensity of continuous and interval recreational swimming, i.e. swimming section, was progressively increased from one month to another. Progress/current state was monitored by measuring the pulse after each activity/section, thereby controlling the intensity after work and planning it for the following activity. Our results are comparable with the results of Mohr et al (2014) who studied the impact of recreational swimming at mild hypertension in sedentary middle-aged women. A sample of 67 women, divided into three groups (high and moderate intensity and control), were under the treatment for 15 weeks. The group which swam with high intensity (3 times a week, 6-10 intervals in 30 minutes with a 2-minute break in-between) reduced the pulse at rest by 5 ± 1 min (p <0,05) and adipose tissue by 1.1 ± 0.2 kg (p <0.05).

mirovanju za 5 ± 1 min ($p < 0,05$) i masno tkivo za 2,2 ± 0,3 kg ($p < 0,05$). U kontrolnoj grupi sve mjerene varijable su bile slične prije i poslije perioda intervencije. Autori zaključuju da visoki intenzitet sa prekidima plivanja je efikasna strategija obuke za poboljšanje kardiovaskularnog zdravlja i fizičke performanse u sedentarnih žena sa blagom hipertenzijom. Adaptacije su slične za trening visokog i umjerenog intenziteta, iako je vidljivo manje provedenog ukupnog vremena i prijeđenih kilometara u grupi visokog intenziteta. U ovom istraživanju, rekreativni program plivanja kombinovan intervalima i kontinuitetom uticao je na efikasnu adaptaciju funkcionalnih sposobnosti neaktivnih žena srednjih godina. Rezultati istraživanja omogućuju šire sagledavanje uticaja rekreativnog plivanja kao oblik zdravlja i fitnes treninga, kao i stvaranja baze podataka o funkcionalnim sposobnostima srednjovječnih žena za ovu aktivnost.

Zaključak

Analizirajući vrijednosti tretiranih varijabli, kao pokazatelje funkcionalnih sposobnosti nakon tromjesečnog rekreativnog plivanja, zaključujemo da su najbolji rezultati, statistički značajni, ostvareni u povećanju vitalnog kapaciteta, većoj relativnoj potrošnji kiseonika i manjoj frekvenciji srca u mirovanju. Tome su najviše doprinijeli zadaci intervalnog i kontinuiranog rada koji su se progresivno povećavali svaki naredni mjesec. Kod ostalih varijabli kao što je sistolni i dijastolni krvni pritisak, te radni puls, nije bilo statistički značajne promjene, te smatramo da je potreban duži trenažni vremenski period za veće promjene ovih varijabli. Naši rezultati su potvrdili dosadašnja slična istraživanja (Martin i sar. 1987; Khosravi i sar. 2013; Mohr i sar. 2014), pa se na osnovu toga za poboljšanje/pozitivne promjene funkcionalnih sposobnosti, program rekreativnog plivanja može preporučiti populaciji zdravih žena srednje dobi, kod kojih dominira sedentaran način života i rada.

Izjava autora. *Autori pridonijeli jednako.*
Konflikt interesa. *Mi izjavljujemo da nemamo konflikt interesa.*

The second group, which continuously worked with moderate intensity (3 x week) also reduced the pulse at rest by 5 ± 1 min ($p < 0.05$) and adipose tissue by 2.2 ± 0,3 kg ($p < 0.05$). In the control group, all measured variables were similar before and after the intervention period. The authors conclude that high intensity with breaks in swimming is an effective training strategy for the improvement of cardiovascular health and physical performances in sedentary women with mild hypertension. Adaptations were similar for high-intensity and moderate-intensity trainings, although evidently less overall time was spent and mileage achieved in the high-intensity group. In this research, the programme of recreational swimming, both with intervals and in continuity, influenced the effective adaptation of functional abilities of inactive middle-aged women. The results of this research provide a broader overview of the effects of recreational swimming as a form of health and fitness training, as well as a creation of a database on functional abilities of middle-aged women for this activity.

Conclusion

Analysing the values of variables treated, as an indicator of functional abilities after a three-month recreational swimming, we conclude that the best results, statistically significant, were achieved in the increase of vital capacities, greater relative oxygen consumption and lower heart rate at rest. This was mostly contributed by the tasks of interval and continuous work which were progressively increased each month. With regards to other variables, such as systolic and diastolic blood pressure, as well as the working heart rate, there were no statistically significant changes, therefore we believe that a longer training period is necessary for major changes of these variables. Our results confirmed previous similar studies (Martin et al. 1987; Khosravi et al. 2013; Mohr et al. 2014), therefore for the improvement/positive changes in functional abilities, the programme of recreational swimming can be recommended to the population of healthy middle-aged women, with a dominant sedentary work and life style.

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Literatura / References

Barbosa, T. M., Marinho, D. A., Reis, V. M., Silva, A. J., & Bragada, J. A. (2009). Physiological assessment of head-out aquatic exercises in healthy subjects: a qualitative review. *Journal of Sports Science and Medicine*, 179-189.

Berger, B. G., & Owen, D. R. (1983). Mood Alteration with Swimming-Swimmers Really Do" Feel Better". Psychosomatic medicine, 45(5), 425-433.

Colado, J. C., Triplett, N. T., Tella, V., Saucedo, P., & Abellán, J. (2009). Effects of aquatic resistance training on health and fitness in postmenopausal women. *European journal of applied physiology*, *106*(1), 113-122.

Cox, K. L., Burke, V., Beilin, L. J., Derbyshire, A. J., Grove, J. R., Blanksby, B. A., & Puddey, I. B. (2008). Short and long-term adherence to swimming and walking programs in older women—the Sedentary Women Exercise Adherence Trial (SWEAT 2). *Preventive medicine*, *46*(6), 511-517.

Costill, D., Maglischo, E., & Richardson, A. (1992). Swimming: Handbook of Sports Medicine and Science Swimming. *IOC Medical Commission Publications Advisory Committee*.

Fletcher, G. F., Balady, G., Blair, S. N., Blumenthal, J., Caspersen, C., Chaitman, B., ... & Pollock, M. L. (1996). Statement on exercise: Benefits and recommendations for physical activity programs for all Americans a statement for health professionals by the committee on exercise and cardiac rehabilitation of the council on clinical cardiology, American Heart Association. *Circulation*, *94*(4), 857-862.

Ferretti, E., De Angelis, S., Donati, G., & Torre, M. (2014). Fatal and non-fatal unintentional drownings in swimming pools in Italy: Epidemiological data derived from the public press in 2008–2012. *Microchemical journal*, *113*, 64-68.

Green, J. S. (1989). Effects of a Water Aerobics Program on the Blood Pressure, Percentage of Body Fat, Weight, and Resting Pulse Rate of Senior Citizens. *Journal of Applied Gerontology*, *8*(1), 132-138.

Khosravi, M., Tayebi, S. M., & Safari, H. (2013). Single and concurrent effects of endurance and resistance training on pulmonary function. *Iranian journal of basic medical sciences*, *16*(4), 628.

Lin, S. Y., Davey, R. C., & Cochrane, T. (2004). Community rehabilitation for older adults with osteoarthritis of the lower limb: a controlled clinical trial. *Clinical Rehabilitation*, *18*(1), 92-101.

Malacko, J., & Popović, D. (2001). Methodology of kinesiological and anthropological research. *The third edition. Leposavić: Faculty of Physical Education, University of Priština*.

Martin, W. H., Montgomery, J. A. M. E. S., Snell, P. G., Corbett, J. R., Sokolov, J. J., Buckey, J. C., ... & Blomqvist, C. G. (1987). Cardiovascular adaptations to intense swim training in sedentary middle-aged men and women. *Circulation*, *75*(2), 323-330.

Mohr, M., Nordsborg, N. B., Lindenskov, A., Steinholm, H., Nielsen, H. P., Mortensen, J., ... & Krustrup, P. (2014). High-intensity intermittent swimming improves cardiovascular health status for women with mild hypertension. *BioMed research international*, *2014*.

Mikalački, M. (2005). Sports Recreation. Novi Sad: Faculty of Physical Education. [In Serbian]

Minor, M. A., Webel, R. R., Kay, D. R., Hewett, J. E., & Anderson, S. K. (1989). Efficacy of physical conditioning exercise in patients with rheumatoid arthritis and osteoarthritis. *Arthritis & Rheumatism*, *32*(11), 1396-1405.

Nualnim, N., Parkhurst, K., Dhindsa, M., Tarumi, T., Vavrek, J., & Tanaka, H. (2012). Effects of swimming training on blood pressure and vascular function in adults> 50 years of age. *The American journal of cardiology*, *109*(7), 1005-1010.

Oja, P., & Tuxworth, B. (Eds.). (1995). *Eurofit for adults: Assessment of health-related fitness*. Council of Europe.

Saavedra, J. M., De La Cruz, E., Escalante, Y., & Rodríguez, F. A. (2007). Influence of a medium-impact aquaerobic program on health-related quality of life and fitness level in healthy adult females. *Journal of Sports Medicine and Physical Fitness*, *47*(4), 468.

Schmid, J. P., Noveanu, M., Morger, C., Gaillet, R., Capoferri, M., Anderegg, M., & Saner, H. (2007). Influence of water immersion, water gymnastics and swimming on cardiac output in patients with heart failure. *Heart*, *93*(6), 722-727.

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