SPORTSKE NAUKE I ZDRAVLJE

SPORTS SCIENCE AND HEALTH

Volume 11 Issue 2

Naučno-stručni časopis iz oblasti sportskih i medicinsko-rehabilitacionih nauka
Scientific Journal in Sports and Medical-Rehabilitation Science

ISSN 2232-8211 (Print)
ISSN 2232-822X (Online)

Godina 11 • Broj 2
Decembar 2021.
Republika Srpska
Bosna i Hercegovina

Volume 11 • Issue 2
December 2021
The Republic of Srpska
Bosnia and Herzegovina

UDC: 612
UDC: 613
UDC: 796

www.siz-au.com

APEIRON

SPORTSKE NAUKE I ZDRAVLJE

SPORTS SCIENCE AND HEALTH

Naučno-stručni časopis iz oblasti sportskih i medicinsko-rehabilitacionih nauka
Scientific Journal in Sports and Medical-Rehabilitation Science

Izdavač/Published by *Panevropski univerzitet "Apeiron" Banja Luka/ Pan-European University "Apeiron" Banja Luka, Bosnia and Herzegovina*

Urednik izdavača/Editor of University Publications Aleksandra Vidović, *Pan-European University "Apeiron" Banja Luka, Bosnia and Herzegovina*

Kancelarija/Office

Panevropski univerzitet "Apeiron"
Pere Krece 13, 78000 Banja Luka,
Bosna i Hercegovina
tel. +387 (0) 51 247 975,
fax +387 (0) 51 430 921
siz@siz-au.com
www.siz-au.com

Pan-European University "Apeiron"
Pere Krece 13, 78000 Banja Luka,
Bosnia and Herzegovina
tel. +387 (0) 51 247 975,
fax +387 (0) 51 430 921
siz@siz-au.com
www.siz-au.com

Sekretar i tehnička podrška/ Secretariat and Technical Support Oliver Krička, Bosnia and Herzegovina
Lektura/Text editing Tanja Aničić, Tijana Vasiljević
Dizajn/Design Sretko Bojić
Web dizajn/Web Design Alen Tatarević
Štampa/Printed by Art print, Banja Luka
Tiraž: 300 kom. /Printed in 300 copies/

Tematske oblasti/Themes:

- Predškolsko vaspitanje u funkciji razvoja djece
- Savremeno školsko fizičko vaspitanje u funkciji pravilnog rasta i razvoja djece i omladine
- Savremeno fizičko vaspitanje i zdravlje mladih
- Studentski sport kao faktor zdravog življenja
- Sport u funkciji rekreacije građana- stanovništva i zdravlja
- Sportsko- rekreativne aktivnosti kao faktor borbe protiv stresa
- Primjena sportsko-rekreativnih aktivnosti u promjeni načina života ljudi
- Moderne sportsko-rekreativne aktivnosti (fitnes, ekstremni sportovi i dr.) I zdravlje vježbača
- Korektivna gimnastika i kineziterapija u otklanjanju posturalnih poremećaja
- Sport osoba sa posebnim potrebama u funkciji osposobljavanja za život i rad
- Sport invalida kao faktor zdravlja i resocijalizacije
- Vrhunski sport i zdravlje
- Ostale aktuelne teme vezane za sportske nauke i zdravlje

- Preschool education in the function of child development
- Modern school physical education in the function of proper growth and development of children and youth
- Modern physical education and youth health
- University sports as a factor of healthy living
- Sport in the function of recreation and health of citizens
- Sports and recreational activities as anti-stress factor
- Use of sports and recreational activities in the change of people's lifestyle
- Modern sports and recreational activities (fitness, extreme sports, etc.) and health of exercisers
- Corrective exercises and kinetic therapy in the elimination of postural disorders
- Sport for people with special needs as a function of training for life and work
- Disabled sports as a factor of health and social reintegration
- Top sport and health
- Other current topics related to sports science and health

Indexed in:

ebscohost.com
doisrpska.nub.rs
erihplus.nsd.no
citefactor.org/contact
crossref.org
worldcat.org
scopus.com
road.issn.org
doaj.org
scholar.google.com
cosmosimpactfactor.com
esjindex.org

UDC 612
UDC 613
UDC 796

SPORTS SCIENCE AND HEALTH is registered with the Ministry of Science and Technology of the Republic of Srpska by serial registration code 07.030-053-85-2/11, date 08.02.2011., number 612.
SPORTS SCIENCE AND HEALTH (ISSN 2232-8211) is an international journal published two time a year.

ISSN 2232-8211 (Print)
ISSN 2232-822X (Online)

SPORTSKE NAUKE I ZDRAVLJE

SPORTS SCIENCE AND HEALTH

Vol. 11 (2021) No. 2 (121-256)

Sadržaj / Contents

Godišnja pretplata 30 EUR-a /Annual subscription is 30 EUR
Full-text available free of charge at http://www.siz-au.com

Dragi čitaoci,

Predstavljamo vam novo izdanje Časopisa ''Sportske nauke i zdravlje'', gdje možete pronaći 16 radova, autora iz Bosne i Hercegovine, Srbije, Hrvatske, Sjeverne Makedonije, Crne Gore, Italije, Poljske i Alžira. U jako izazovnom vremenu po našu struku, sa sigurnošću možemo reći da iza sebe imamo veoma uspješnu godinu.

U decembarskom broju časopisa možete pronaći radove o uticaju fizičke aktivnosti na mikrocirkulatorne promjene kod zdravih trudnica, motivaciji za rekreativno vježbanje u odnosu na spolne i dobne razlike, navikama i stavovima studenata prema sadržajima sportske rekreacije, uticaju programiranog vježbanja na pokazatelje tjelesne kompozicije rekreativnih vježbača, povezanosti kvaliteta života i lumbalnog sindroma osoba srednje životne dobi, ispitivanju pouzdanosti i valjanosti testova promjene smjera kretanja i reaktivne agilnosti pacijenata poslije operacije koljena, tjelesnom adipozitetu i povezanošću sa rizikom od visokog krvnog pritiska kod makedonske djece, efikasnosti osmonedeljnog programa crossfit vježbi na nivo fizičke aktivnosti kod alžirskih srednjoškolaca, poboljšanju sposobnosti sprinta kod muškog amaterskog fudbalskog tima Cometti metodom, skijaškoj turističkoj aktivnosti u poljskim šumama, socijalno-emocionalnoj interakciji između učenika i nastavnika tokom časa fizičkog vaspitanja, uticaju profesionalnog sporta na promjene kardiovaskularnog sistema sportista nakon završetka karijere, upoređivanju tri vrste treninga, perspektivi ženskog fudbala u gradu Zadru i Zadarskoj županiji, korelacionim aspektima strategijskog opredjeljenja internog marketinga preduzeća u oblasti zdravstvene zaštite, kao i o frekvenciji i strukturi posturalnih poremećaja donjih ekstremiteta kod djece predškolskog uzrasta.

Iskreno se nadamo da smo ovim brojem zadovoljili interesovanja i onih najzahtjevnijih čitalaca. Zahvaljujemo se svim autorima i recenzentima koji su dali svoj doprinos u poboljšanju kvaliteta Časopisa.

Ovim putem želimo svima srećnu i uspješnu Novu 2022. godinu!

„Djeca su prirodno naučnici!“
Alan Alda

UREDNIŠTVO ČASOPISA

Dear readers,

We present you a new issue of the Journal of Sports Science and Health, where you can find 16 works by authors from Bosnia and Herzegovina, Serbia, Croatia, Northern Macedonia, Montenegro, Italy, Poland and Algeria. In a very challenging time for our profession, we can say with certainty that we have a very successful year behind us.

In the December issue of the Journal you can find papers on the impact of physical activity on microcirculatory changes in healthy pregnant women, motivation for recreational exercise in relation to gender and age differences, habits and attitudes of students towards sports recreation, the impact of programmed exercise on recreational exercisers, quality of life and lumbar syndrome of middle-aged people, examination of reliability and validity of tests of change of direction and reactive agility of patients after knee surgery, physical adiposity and association with risk of high blood pressure in Macedonian children, efficiency of eight-week crossfit exercise program Algerian high school students, improving the ability to sprint in the men's amateur football team Cometti method, ski tourism activity in the Polish forests, socio-emotional interaction between students and teachers during physical education classes questioning, the impact of professional sports on changes in the cardiovascular system of athletes after the end of their careers, comparing three types of training, the perspective of women's football in the city of Zadar and his region, correlation aspects of strategic commitment of internal marketing in health care, and the frequency and structure of postural disorders in preschool children.

We sincerely hope that this issue has satisfied the interests of even the most demanding readers. Thanks to all the authors and reviewers who contributed to improving the quality of the Journal.

We wish everyone a happy and successful New Year 2022!

"Children are naturally scientists!"
Alan Alda

JOURNAL EDITORIAL

https://doi.org/10.7251/SSH2102125S
UDC: 616.12-008.331.1-053.2/.6(497.7)
Original scientific paper
Originalni naučni rad

Body Adiposity is Associated With a Risk of High Blood Pressure in Macedonian Children

Zorica Stankovska[1], Biljana Bojadzieva Stojanoska[2], Seryozha Gontarev[3], Žarko Kostovski[3]
[1]St. Kliment Ohridski Faculty of Pedagogy, Ss. Cyril and Methodius University, Skopje, Republic of North Macedonia
[2]Institute of Anatomy, Ss. Cyril and Methodius University, Skopje, Republic of North Macedonia
[3]Faculty of Physical Education, Sport, and Health, Ss. Cyril and Methodius University, Skopje, Republic of North Macedonia

Correspondence:
Žarko Kostovski, Faculty of Physical Education, Sport, and Health, Ss. Cyril and Methodius University, Skopje, Republic of North Macedonia, zarkok@ukim.edu.mk

Abstract: *The goal of this study was to determine the relationship between waist circumference (WC), body mass index (BMI), body fat percentage (BFP), waist-to-height ratio (WHtR), adiposity index (API) and high blood pressure (HBP) and to determine which anthropometric parameters can best predict HBP in Macedonian children from 6 to 10 years of age. The research was conducted on a sample of 1228 boys and girls from 6 to 10 years of age. Blood pressure was measured three times in an interval of 60 seconds, and the mean value of the three measurements was used as a result for processing. Logistic regression analysis was used to assess the associations and to calculate odds ratios. Adjusted odds ratios in the highest quartiles of WC, BMI, BFP and WHtR were statistically significant in boys (girls): hypertension – 5.19 (6.38), 3.16 (3.76), 4.39 (4.48), and 3.95 (4.84). In Macedonian children from 6 to 10 years of age, the anthropometric indices - WC and API (particularly WC) - showed stronger associations with HBP and were better at predicting HBP, compared to the other applied anthropometric indices.*

Keywords: *Blood pressure, Schoolchildren, Adiposity, Weight status.*

Introduction

Hypertension (known as high or elevated blood pressure) is one of the most common and most important problems in public health globally (WHO, 2013). High blood pressure is associated with adverse cardiovascular outcomes (Lim et al., 2012). It is considered the leading risk factor for mortality in the world, causing 7.5 million deaths annually, which is 12.8% of all deaths (WHO, 2009). The prevalence of elevated BP increased from 594 million to 1.13 billion in the period from 1975 to 2015 in people older than 18 years (Maldonado et al., 2011). The epidemiological studies have reported a high prevalence of elevated blood pressure in different age groups from childhood to adolescence in different countries (Rosner et al., 2013; 10. De Moraes et al., 2015; Maldonado et al., 2017).

The general medical examinations and meta-analyses show that the condition of BP persists from childhood to adulthood (Toschke et al., 2010). Hypertension during childhood and puberty is a powerful predictor of hypertension in adults (Liang et al., 2011). Many different, interrelated: genetic, metabolic, environmental, behavioral, psychosocial, and socioeconomic risk factors, as well as family and personal medical history, may affect hypertension in children (1Ewald & Haldeman, 2016). Early atherosclerotic lesions, left ventricular hypertrophy, increased intima-media thickness of the carotid artery, vascular changes in the retina, and cognitive impairments have been found in children with HBP (Falkner, 2010). Early identification of HBP in children can prevent the development and progression of cardiovascular diseases and their accompanying complications (Litwin, 2018).

Childhood and adolescence obesity is associated with a higher risk of cardiovascular, metabolic, and endocrine disorders (hypertension, dyslipidemia, endothelial dysfunction, chronic inflammation, metabolic syndrome, type 2 diabetes mellitus and puberty disorders) (Ebbeling,2002) renal, gastrointestinal, pulmonary, musculoskeletal, dermatological, neurological and psychosocial disorders (Güngör, 2014). Abdominal obesity in children is also related to several adverse cardiometabolic risk factors such as: hypertension metabolic syndrome, lipid abnormalities, glucose intolerance, and insulin resistance, which contribute to an increased risk for atherosclerosis development (Forkert et al., 2016). Childhood and adolescence obesity continues into adulthood (Simmonds, et al., 2016) and is associated with cardiovascular morbidity and mortality in adults (Sommer & Twig 2018).

The goal of this study was to determine the relationship between waist circumference (WC), body mass index (BMI), body fat percentage (BFP), waist-to-height ratio (WHtR), adiposity index (API) and high blood pressure (HBP) and to determine which anthropometric parameters can best predict HBP in Macedonian children from 6 to 10 years of age.

Materials and Methods

Sample of respondents

The research was conducted on a sample of 1228 children of Macedonian nationality, from 19 primary schools in the central and eastern part of the Republic of North Macedonia, 8 of which are in rural areas, and 11 in urban areas. The sample is divided into two subsamples according to gender, whereby 679 respondents are boys and 549 respondents are girls. The average age of the respondents of both genders was 8.03 ± 1.24 years.

The study included all students whose parents consented to their children's participation in the research, who were psychophysically healthy, and who regularly attended Physical and Health Education classes. The respondents were treated in accordance with the Helsinki Declaration.

The measurements were performed in the months: March, April and May 2019, in standard school conditions during the regular classes in Physical and Health Education. The measurement was performed by experts in the field of kinesiology and medicine, previously trained to perform functional tests and to take anthropometric measures.

Anthropometric measures and body composition

The measurement of anthropometric measures was carried out according to the recommendations of the IBP-International Biological Program. The height of the subjects (without shoes) was measured to the nearest 0.1 cm with a portable stadiometer. BMI was calculated as weight divided by height squared. WC was measured with a inflexible measuring tape at a level midway between the lower rib margin and the iliac crest to the nearest 0.5 cm. WHtR was calculated as the WC divided by body height

The components of the body composition are determined by bioelectrical impedance method (measuring the electrical conductivity - Bioelectrical Impedance Analysis - BIA). The measurement is realized by Body Composition Monitor, model "OMRON - BF511", and with whose help the body weight, body fat percentage, and muscle mass percentage is measured. Before starting the measurement in Body Composition Monitor were entered the parameters of gender, age and body height of the respondent. In order to ensure better accuracy of the results obtained from the assessment of body composition, before each measurement were fulfilled prerequisites recommended by ACSM.

Although the three different adiposity indicators (BMI, WC, and BFP) are all associated with some degree of measurement error, each measure provides specific information regarding body fat mass (Ledoux et al., 2011). Thus, in this study, a principal component analysis was performed with exploratory factor analysis (EFA) to obtain a construct (i.e., a factor or a latent variable) for overall adiposity based on these three anthropometric indicators, similarly to the analysis proposed by Ledoux et al. (2011). Principal component analysis using the three anthropometric indicators revealed a construct representing 87% of the shared variance, with a Cronbach's alpha of 0.91 and factor loadings of 0.94 for BMI, 0.91 for WC, and 0.95 for BFP; additionally, high communalities were observed (0.89, 0.83, and 0.90, respectively). This construct was termed the adiposity index and represents overall adiposity.

Blood pressure

The blood pressure measurement (systolic and diastolic) is realized by experts from the medicine, doctor-specialists pediatrician fields. Blood pressure measurements were performed using the oscillometric method through a calibrated Omron (Kyoto, Japan) electronic and digital device model HEM 742, with cuffs of appropriate size to fit the arms of adolescents. This device has been validated for use with adolescents (Christofaro et al. 2009). Participants were informed about the procedures and were instructed to remain at quiet rest for at least five minutes in a quiet environment and without noise, with emptied bladder, not having performed exercise 90 min before the tests or smoked or ingested food, coffee, alcoholic drinks or mate at least 30 min before data collection. The atmosphere was quiet and with no noise. Blood pressure was measured three times at intervals of 60 seconds, and the result was the median value of the three measurements. NBP was defined as BP < 90^{th} percentile; prehypertension was defined as

BP between the ≥90th percentile and the <95th percentile; and hypertension was defined as BP ≥ 95th percentile. The mean arterial pressure (MAP) was calculated using the traditional formula. The pulse pressure (PP) was calculated as SBP minus DBP. We adopted the methodological recommendations of the Update on the Task Force Report on High Blood Pressure in Children and Adolescent.

Statistical analysis

Categorical variables were tested by the chi-squared (χ^2) test, and were expressed as numbers and percentages. The Kolmogorov-Smirnov test was used to test the normality of the distribution of the continuous variables. Non-normally distributed continuous variables were compared using nonparametric tests (the Mann-Whitney U test, and the Kruskal-Wallis test). WC, BMI, BFP and WHtR values were converted to age and gender-specific z-scores. Pearson's correlation coefficients were calculated between anthropometric indices z-score and SBP, DBP, MAP, and PP. Quartiles of anthropometric indices were calculated according to the study subjects' age and gender. Logistic regression analyses were conducted separately for boys and girls to evaluate the associations between the quartiles of anthropometric parameters (WC, BMI, BFP and WHtR) and HBP. Crude and adjusted odds ratios with 95% confidence intervals (CI) were calculated.All the analyses were performed using the Statistical Package for Social Sciences software (SPSS, v. 22.0 for WINDOWS; SPSS Inc., Chicago, IL, USA), and values of $p < 0.05$ were considered statistically significant.

Results

The research was conducted on a sample of 1228 respondents, of which 679 (55.3%) were boys and 549 (44.7%) were girls from 6 to 10 years of age. The mean age of the respondents was 8.03 ± 1.24 years (Table 1).

Table 1. *Characteristics of the study participants by gender*

Variables	Boys		Girls		P*
	Mean	SD	Mean	SD	
Age (years)	8.58	1.17	8.53	1.34	0.492
Weight (kg)	132.87	9.23	132.18	10.08	0.211
Height (cm)	32.98	10.82	32.87	9.82	0.845
BMI (kg/m2)	18.00	5.84	17.51	5.77	0.145
BFP	24.39	7.78	23.68	8.08	0.136
WC (cm)	62.17	9.68	60.26	8.65	0.000
WHtR	0.47	0.06	0.46	0.05	0.000
API	-0.01	1.00	0.02	1.00	0.595
SBP (mm Hg)	104.77	18.81	101.87	19.33	0.008
DBP (mm Hg)	66.68	16.46	66.75	18.16	0.946
MAP (mm Hg)	79.38	15.52	78.46	17.35	0.325
PP (mm Hg)	38.09	16.11	35.12	14.01	0.001

**Boys versus girls. BP – blood pressure. BMI – body mass index. BFP – body fat percentage. WC – waist circumference. WHtR – waist-to-height ratio. API – adiposity index. SBP – systolic blood pressure. DBP – diastolic blood pressure. MAP – mean arterial pressure. PP – pulse pressure.*

Table 1 shows the characteristics of the sample. From the overview of the table that shows the values of: the arithmetic means, the standard deviations and the level of statistical significance, it is observable that no statistically significant differences were found between the male and female respondents in the variables: age, weight, height, BMI, BFP, API (adiposity index), DBP (diastolic blood pressure) and MAP (mean arterial pressure). The mean values of WC and WHtR are higher in boys than in girls. Boys also have higher mean values of SBP (systolic blood pressure) and PP (pulse pressure) than girls. The prevalence of prehypertension was 9.7% in boys and 6.7% in girls, while the prevalence of hypertension was 21.9% in boys and 20.6% in girls.

The comparison of the respondents with HBP (hypertension) showed statistically significant differences in the anthropometric indices in both genders separately (Table 2). The number of cases and the frequency of HBP increased with the increase of the quartiles in most anthropometric parameters in both genders (first quartile, compared to fourth quartile).

Table 2. *Characteristics of the study participants according to BP level*

Variables	Normotensive		Hypertensive		p
Boys					
Quartiles of WC:					
1st	138	30.0%	35	13.5%	0.000
2nd	122	26.5%	57	21.9%	
3rd	112	24.3%	53	20.4%	
4th	88	19.1%	115	44.2%	
Quartiles of BMI:					
1st	131	28.4%	47	18.1%	0.000
2nd	128	27.8%	38	14.7%	
3rd	111	24.1%	71	27.4%	
4th	91	19.7%	103	39.8%	
Quartiles of BFP:					
1st	136	31.4%	38	15.8%	0.000
2nd	107	24.7%	41	17.0%	
3rd	106	24.5%	59	24.5%	
4th	84	19.4%	103	42.7%	
Quartiles of WHtR:					
1st	125	27.2%	38	14.6%	0.000
2nd	134	29.1%	34	13.1%	
3rd	107	23.3%	75	28.8%	
4th	94	20.4%	113	43.5%	
Weight (kg)	132.14	9.30	134.15	9.68	0.006
Height (cm)	31.59	10.60	36.81	10.81	0.000
WC (cm)	61.05	8.89	65.38	10.25	0.000
BMI (kg/m^2)	17.58	5.74	18.95	6.28	0.003
BFP	23.54	7.70	27.39	7.67	0.000
WHtR	0.46	0.05	0.49	0.06	0.000
API	-0.12	0.97	0.48	1.03	0.000
SBP (mm Hg)	96.07	11.29	128.36	19.48	0.000
DBP (mm Hg)	60.37	8.77	86.36	23.19	0.000
MAP (mm Hg)	72.27	8.28	100.36	18.71	0.000
PP (mm Hg)	35.70	10.67	42.01	24.63	0.000
Girls					
Quartiles of WC:					
1st	115	28.9%	35	13.5%	0.000
2nd	123	30.9%	57	21.9%	
3rd	100	25.1%	53	20.4%	
4th	60	15.1%	115	44.2%	
Quartiles of BMI:					
1st	111	28.0%	47	18.1%	0.000
2nd	117	29.5%	38	14.7%	

3rd	104	26.2%	71	27.4%	
4th	65	16.4%	103	39.8%	
Quartiles of BFP:					
1st	109	29.2%	38	15.8%	0.000
2nd	99	26.5%	41	17.0%	
3rd	99	26.5%	59	24.5%	
4th	66	17.7%	103	42.7%	
Quartiles of WHtR:					
1st	113	28.4%	38	14.6%	0.000
2nd	112	28.1%	34	13.1%	
3rd	103	25.9%	75	28.8%	
4th	70	17.6%	113	43.5%	
Weight (kg)	131.53	9.58	134.15	9.68	0.001
Height (cm)	31.56	8.96	36.81	10.81	0.000
WC (cm)	58.96	7.91	65.38	10.25	0.000
BMI (kg/m^2)	17.08	5.40	18.95	6.28	0.000
BFP	22.40	7.69	27.39	7.67	0.000
WHtR	0.45	0.05	0.49	0.06	0.000
API	-0.16	0.91	0.48	1.03	0.000
SBP (mm Hg)	94.07	11.83	128.36	19.48	0.000
DBP (mm Hg)	58.99	8.46	86.36	23.19	0.000
MAP (mm Hg)	70.68	8.33	100.36	18.71	0.000
PP (mm Hg)	35.08	10.62	42.01	24.63	0.000

The chi-square (χ2) test was used for categorical variables. BMI – body mass index. BFP – body fat percentage. WC – waist circumference. WHtR – waist-to-height ratio. API – adiposity index. SBP – systolic blood pressure. DBP – diastolic blood pressure. MAP – mean arterial pressure. PP – pulse pressure.

The respondents (boys and girls separately) with hypertension showed significantly higher mean values of all analyzed variables, compared to the normotensive participants (Table 2). The mean values of all variables (SBP, DBP, MAP, and PP) increased with the increase of the quartiles of BMI, BFP, WC, and WHtR. The highest mean values of SBP, DBP, MAP and PP were found in the respondents in the highest quartiles (fourth quartile) of anthropometric indices, especially WC (these data are not presented).

The Pearson correlation coefficients between the anthropometric indexes z-scores and BP are presented in Table 3. WC z-score, BMI z-score, BFP z-score, WHtR z-score and API z-score positively and significantly correlated with BP in boys and in girls, but the strongest correlations found for BP with WC z-score, WHtR z-score and API z-score. In particular, the highest correlations were found between WC z-score and SBP and between WC z-score and MAP in boys and girls. SBP correlated significantly with DBP (for boys: $r = 0.590$, $p < 0.001$; for girls: $r = 0.723$, $p < 0.001$). Strong correlations were found between MAP and SBP (for boys: $r = 0.821$, $p < 0.001$; for girls: $r = 0.870$, $p < 0.001$) and DBP (for boys: $r = 0.945$, $p < 0.001$; for girls: $r = 0.966$, $p < 0.001$).

Correlation coefficients between BMI z-score and WC z-score ($r = 0.597$ for boys and $r = 0.617$ for girls), between BMI z-score and BFP z-score ($r = 0.854$ for boys and $r = 0.992$ for girls), between WC z-score and BFP z-score ($r = 0.784$ for boys and $r = 0.783$ for girls), between WHtR z-score and BFP z-score ($r = 0.784$ for boys and $r = 0.850$ for girls),between BMI z-score and WHtR z-score ($r = 0.603$ for boys and $r = 0.579$ for girls), and between WC z-score and WHtR z-score ($r = 0.915$ for boys and $r = 0.922$ for girls) were positive and statistically significant (all $p < 0.001$).

Table 3. *Pearson's correlation coefficients between anthropometric parameters z-scores and blood pressure*

		WC z-score	BMI z-score	BFP z-score	WHtR z-score	API z-score
SBP (mm Hg)	Boys	.368**	.241**	.288**	.328**	.325**
	Girls	.333**	.218**	.280**	.291**	.301**
DBP (mm Hg)	Boys	.359**	.179**	.304**	.327**	.343**
	Girls	.331**	.175**	.310**	.283**	.336**
MAP (mm Hg)	Boys	.395**	.218**	.325**	.357**	.367**
	Girls	.360**	.206**	.325**	.310**	.351**
PP (mm Hg)	Boys	.041	.092	.009	.028	.011
	Girls	.036	.073	-.004	.040	.857

***Correlation is significant at the level of 0.01 (2-tailed).*

In both genders, aORs increases with the increase of the quartiles of WC and BFP, while for BMI and WHtR, aORs increases after the third quartile (Table 4). Adjusted odds ratios in the highest quartiles of WC, BMI, BFP and WHtR were statistically significant in boys (girls): hypertension – 5.19 (6.38), 3.16 (3.76), 4.39 (4.48), and 3.95 (4.84). The increase of aORs in the quartiles of WC was higher than the corresponding increase of the quartiles of BMI, BFP and WHtR (except in the third quartile for WHtR in boys and girls and BFP in boys). The odds ratios were the lowest in BMI quartiles. In boys, no significant associations were found for HBP in the second quartiles of BMI, BFP and WHtR. In girls, no significant associations were found for HBP in the second quartiles of WC, BMI, BFP and WHtR.

Table 4. *Crude and adjusted odds ratios and 95% confidence intervals for HBP in quartiles of anthropometric parameters (BMI, WC, BFP and WHtR) by gender (univariate and multivariate analyses)*

	Hypertension (Boys)		Hypertension (Girl)	
Variables	**OR (95% CI)**	**aOR (95% CI)**	**OR (95% CI)**	**aOR(95% CI)**
Quartiles of WC:				
1st	1.00	1.00	1.00	1.00
2nd	1.84 (1.13-2.10)	1.85 (1.14 -3.07)	1.52 (0.93 - 2.49)	1.52 (0.93 - 2.49)
3rd	1.87 (1.14-3.06)	1.87 (1.14 - 3.01)	1.74 (1.05 - 2.88)	1.76 (1.06 - 2.92)
4th	5.15 (3.24 -8.18)	5.19 (3.27 - 8.26)	6.30 (3.8 - 10.28)	6.38 (3.90 - 10.43)
Quartiles of BMI:				
1st	1.00	1.00	1.00	1.00
2nd	0.83 (0.51 - 1.35)	0.83 (0.51 - 1.36)	0.77 (0.47 - 1.26)	0.77 (0.47 - 1.27)
3rd	1.78 (1.14 - 2.79)	1.79 (1.14 - 2.79)	1.61 (1.02 - 2.54)	1.63 (1.03 - 2.57)
4th	3.15 (2.04 - 4.88)	3.16 (2.04 - 4.89)	3.74 (2.36 - 5.94)	3.76 (2.37 - 5.96)
Quartiles of BFP:				
1st	1.00	1.00	1.00	1.00
2nd	1.37 (2.77 - 6.96)	1.37 (0.82 - 2.28)	1.19 (0.71 - 2.00)	1.19 (0.71 - 2.00)
3rd	1.99 (1.23 - 3.22)	1.99 (1.23 - 3.22)	1.71 (1.05 - 2.79)	1.71 (1.05 - 2.80)
4th	4.39 (0.82 - 2.28)	4.39 (2.76 - 6.96)	4.48 (2.77 - 7.25)	4.48 (2.77 - 7.24)
Quartiles of WHtR:				
1st	1.00	1.00	1.00	1.00
2nd	0.83 (0.49 - 1.41)	.83 (.49 - 1.41)	0.90 (0.53 - 1.54)	0.90 (0.53 - 1.53)
3rd	2.31 (1.44 - 3.68)	2.32 (1.45 - 3.70)	2.17 (1.35 - 3.47)	2.19 (1.36 - 3.51)
4th	3.95 (2.51 - 6.23)	3.96 (2.51 - 6.24)	4.80 (2.99 - 7.71)	4.84 (3.02 - 7.78)

Crude and adjusted odds ratios and 95% confidence intervals for HBP in quartiles of anthropometric parameters (BMI. WC. BFP and WHtR) by gender (univariate and multivariate analyses). OR – crude odds ratio; aOR1 – adjusted odds ratios for age; CI – confidence interval. Bold typeface indicates significance.

Discussion

In our study we found a large prevalence of prehypertension (8.4%) and hypertension (21.3%) in Macedonian children from 6 to 10 years of age, which is partly in line with the findings of other studies conducted in different populations of children and adolescents in other countries, for example, in 9–13 year-old Greek schoolchildren (prehypertension – 14.2% and hypertension – 23%) (Karatzi et. al., 2017), in Chinese schoolchildren aged 5 to 18 years (prehypertension – 15.2% and hypertension – 20.5%) (Guo et al., 2012), in Portuguese children and adolescents aged 4 to 18 years (prehypertension – 21.6% and hypertension – 12.8%) (Maldonado et al., 2011), in Spanish children aged 4 to 6 years (prehypertension – 12.3% and hypertension – 18.2%) (8), in 11–14 year-old Italian schoolchildren (prehypertension – 10.3% and hypertension – 10.1%) (Cairella et al., 2007), or in South African adolescents aged 13–17 years (prehypertension – 12.3% and hypertension – 21.3%) (Nkeh-Chungag et al., 2015). However, the differences in the times of BP visits, BP measurement methods (the auscultatory method or the oscillometric technique), sample size, age of respondents, ethnic differences, socioeconomic status, and different geographical regions that exist between surveys make it difficult to compare results. However, epidemiological data suggests that HBP is an important and common health problem in children and adolescents. Therefore, it is essential to develop and implement effective public health strategies to prevent and control prehypertension and hypertension.

Early identification, control and treatment of risk factors and a healthy lifestyle (especially in children and adolescents) may reduce the risk of cardiovascular diseases and other chronic noncommunicable diseases and may reduce the burden on public health in the future. It is also important to focus the attention on subjects with diagnosed prehypertension or hypertension – with a high risk or very high risk for cardiometabolic comorbidities. However, taking into account the recommendations and guidelines used for the evaluation and treatment of HBP in children and adolescents, it can often be underdiagnosed. For instance, in a large cohort study of pediatric population, a high frequency of undiagnosed prehypertension and hypertension was found (Hansen et al., 2007). There is evidence that both prehypertension and hypertension in children and adolescents are significant determinants of cardiovascular target organ damage (Urbina, et, al., 2011), and these adverse changes are strongly related to an increased risk of cardiovascular problems in adulthood. The meta-analysis from the analyzed studies showed that prehypertension and hypertension are related to a higher risk of: stroke, myocardial infarction and overall cardiovascular outcomes (Guo et al., 2013).

In this research the WC z-score, BMI z-score, BFP z-score, WHtR z-score and API z-score significantly correlated with SBP, DBP and MAP. However, the correlations of BMI z-score with BP were weaker than the correlations of WC z-score, BFP z-score, WHtR z-score and API z-score. The aORs for HBP in WC quartiles were higher than in BMI quartiles. The aORs were significant in the fourth and third quartile in all anthropometric indicators in both genders. Significant associations were found in the second quartiles of WC among boys.

In the research by Silva et al. which included Brazilian adolescents from 14 to 19 years of age, it was found that elevated blood pressure has been statistically significantly associated with central and general obesity only in boys, but not in girls, by comparing the fourth and first quartile of the WC (≤69 cm vs. ≥80.1 cm) and BMI (≤18.6 kg/m^2 vs. ≥23.5 kg/m^2) (aOR = 6.97 and aOR = 6.44, respectively), while the aOR for the second and third quartile was not statistically significant after the adjustment of age in the multivariate analysis. In NHANES (National Health and Nutrition Examination Survey) (1988–2008), BMI (the third vs. the first quartile, OR = 1.43; and the fourth vs. the first quartile, OR = 2.00) and WC (the fourth vs. the first quartile, OR = 2.14) were statistically significantly associated with elevated blood pressure in children and adolescents from 8 to 17 years of age, after age and gender adjustment (Rosner et al., 2013). The results of the transversal study conducted with Taiwan children aged 6 and 7 years showed that in the combined group of boys and girls, high WC was statistically significantly associated with high blood pressure (aORs were 1.78, 2.45, and 6.03 in the second, third, and fourth quartiles of WC) (Choy et al., 2011). In a research that included 7-year-old Taiwan children it was found that aORs for the elevated BP, elevated SBP, and elevated DBP were statistically significant in the second, third and fourth quartile for WHtR (Chen et al., 2012).

The results of our research suggest that the WC z-score and the API z-score show a higher association with HBP and both indices were better predictors of HBP for both boys and girls. Both WC and API can be used to assess cardiovascular risk in children in North Macedonia. There are still no specific national reference values and limit values for WC for children and adolescents in our country. The epidemiological studies have shown that children with low BMI, but high WC may have a higher risk of HBP (Zhang et al., 2016). In addition, adolescents and children with

very high WC values are classified into any BMI group. They have an increased risk of elevated BP and elevated values of: cholesterol, glucose, triglycerides, and high-density lipoproteins (Lee et al., 2016). This study confirmed the previous research where it was found that the application of several obesity indices is more effective than either measurement alone in identifying the risk of HBP (Zhang et al., 2016).

BMI, WC and WHtR are easy, fast, non-invasive, easy to measure, and can help prevent the risk of cardiovascular diseases (Millar et al., 2013). BMI cannot make the difference between a fat-free and a fat component. WC and WHtR cannot distinguish visceral from subcutaneous adipose tissue (Berker et al., 2010). The measurement of WC, unlike WHtR, does not show a difference in height because the subjects with a similar WC but different height do not have the same risk for cardiometabolic risk factors (Schneider et al., 2011). Thus, there is no international agreement or a standard for accepted waist circumference cutoff values (which vary depending on age, gender, ethnicity, and race) for defining abdominal obesity among children and adolescents. Different WC measurement methods can result in different obtained WC values (Yang & Wang, 2017). During childhood and adolescence, the intensity of growth varies as a result of different factors (gender, age, onset of puberty and other factors), WC and height may increase differently, and not simultaneously in each individual, and the WHtR ratio is different and variable during these periods of growth and development (Tybor et al., 2008). The researches so far have shown that the value of WHtR, which is equal to or greater than 0.5, indicates increased health risks in children and adults (Ashwell et al., 2005). Meanwhile, according to the past researches, the WHtR cutoff value of ≥0.5 can be used to define abdominal obesity and to predict greater cardio-metabolic risk in 6-year-old children and older, regardless of gender, age or ethnicity (Yoo, 2016). However, studies conducted in children and adolescents have shown that a WHTR limit value of less than 0.5 may predict a risk of developing high blood pressure (Kromeyer-Hauschild et al., 2013). Our study suggests that the respondents with a WHtR value below 0.5 are exposed to an increased risk for HBP, and the third and fourth quartiles of WHtR were a risk factor for hypertension in both boys and girls.

In the research by Brambilla et al., according to the analysis of the data obtained with magnetic resonance imaging, it was found that WC can be considered a good predictor of visceral adipose tissue as well as BMI of subcutaneous adipose tissue in respondents from 7 to 16 years of age (Brambilla et al., 2006). Barreira et al. analyzed the association between the anthropometric parameters and fat mass and abdominal adiposity (based on the results of the magnetic resonance imaging and dual energy X-ray absorptiometry) in respondents from 5 to 18 years of age and found that WC and WHtR were associated with the visceral adipose tissue (regardless of gender and race). However, they more strongly related with subcutaneous adipose tissue and fat mass (dependent on gender and race) (Barreira et al., 2014). The Framingham Heart Study found that the subcutaneous and visceral adipose tissue were associated with adverse metabolic risk factors, whereby the influence of the visceral adipose tissue was greater. A meta-analysis showed that BMI and WHtR are more correlated with body fat (assessed by dual-energy X-ray absorptiometry) in children. (Martin-Calvo et al., 2016)

The mechanisms of the association between obesity and hypertension can be explained by adipose tissue dysfunction characterized by decreased levels of adiponectin, hyperleptinemia, increased infiltration of macrophages, increased level of free fatty acid and elevated resistin levels, leading to activation of the sympathetic nervous system and the renin-angiotensin-aldosterone system, augmented systemic inflammation and oxidative stress, and chronic vascular inflammation, leading to hypertension (Dorresteijn et al.,2012).

The research has some limitations too. In our study, the blood pressure values were measured three times over a 1-minute period with a clinically confirmed oscillometric device. However, according to the Fourth Report (2005), with HBP (exceeding the 90th percentile), the obtained data with the oscillometric device should be repeated with auscultation, and in addition to this, in order to confirm the diagnosis of hypertension, the measurement should be repeated in at least three different days. The research did not consider biochemical parameters, socioeconomic factors, family history and dietary factors. Furthermore, in our research we included a relatively small age group of the student population - only children aged 6 to 10 years. Further research is required in order to investigate the prevalence of elevated blood pressure and to determine the factors that affect it, in both children and adolescents of all ages. The design of this study was transversal, making it impossible to determine the causal relationship.

In North Macedonia, public health strategies should be more focused on the understanding and prevention of risk factors for cardiovascular diseases. The results of our study would be useful for preparing prevention programs to improve children's health. Healthy lifestyle changes and correction of unfavorable lifestyle habits (by increasing

physical activity, maintaining a healthy weight and healthy eating habits, reducing sodium intake, increasing potassium intake in the diet, reducing smoking and alcohol consumption) are essential for preventing HBP.

Conclusion

The results of this study showed that the two anthropometric indices - WC and API (particularly WC) - were more expressly associated with hypertension, both separately and in combination. In addition, they were superior to BMI in predicting elevated BP in Macedonian children from 6 to 10 years of age.

References

Ashwell, M., & Hsieh, S. D. (2005). Six reasons why the waist-to-height ratio is a rapid and effective global indicator for health risks of obesity and how its use could simplify the international public health message on obesity. *International journal of food sciences and nutrition*, *56*(5), 303-307.

Barreira, T. V., Broyles, S. T., Gupta, A. K., & Katzmarzyk, P. T. (2014). Relationship of anthropometric indices to abdominal and total body fat in youth: sex and race differences. *Obesity*, *22*(5), 1345-1350.

Berker, D., Koparal, S., Isik, S., Pasaoglu, L., Aydin, Y., Erol, K., ... & Guler, S. (2010). Compatibility of different methods for the measurement of visceral fat in different body mass index strata. *Diagn Interv Radiol*, *16*(2), 99-105

Brambilla, P., Bedogni, G., Moreno, L. A., Goran, M. I., Gutin, B., Fox, K. R., ... & Pietrobelli, A. (2006). Crossvalidation of anthropometry against magnetic resonance imaging for the assessment of visceral and subcutaneous adipose tissue in children. *International journal of obesity*, *30*(1), 23-30.

Cairella, G., Menghetti, E., Scanu, A., Bevilacqua, N., Censi, L., Martone, D., ... & D'Addesa, D. (2007). Elevated blood pressure in adolescents from Rome, Italy. Nutritional risk factors and physical activity. *Annali di igiene: medicina preventiva e di comunita*, *19*(3), 203-214.

Chen, T. L., Choy, C. S., Chan, W. Y., Chen, C. H., & Liao, C. C. (2012). Waist-to-height ratio and elevated blood pressure among children in Taiwan. *Indian pediatrics*, *49*(6), 463-466.

Choy, C. S., Chan, W. Y., Chen, T. L., Shih, C. C., Wu, L. C., & Liao, C. C. (2011). Waist circumference and risk of elevated blood pressure in children: a cross-sectional study. *BMC Public Health*, *11*(1), 613.

Christofaro, D. G., Fernandes, R. A., Gerage, A. M., Alves, M. J., Polito, M. D., & Oliveira, A. R. (2009). Validation of the Omron HEM 742 blood pressure monitoring device in adolescents. *Arq Bras Cardiol*, *92*(1), 10-5.

De Moraes, A. C. F., Carvalho, H. B., Siani, A., Barba, G., Veidebaum, T., Tornaritis, M., ... & Mårild, S. (2015). Incidence of high blood pressure in children—Effects of physical activity and sedentary behaviors: The IDEFICS study: High blood pressure, lifestyle and children. *International journal of cardiology*, *180*, 165-170.

Dorresteijn, J. A. N., Visseren, F. L. J., & Spiering, W. (2012). Mechanisms linking obesity to hypertension. *Obesity Reviews*, *13*(1), 17-26.

Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: public-health crisis, common sense cure. *The lancet*, *360*(9331), 473-482.

Ewald, D. R., & Haldeman, L. A. (2016). Risk factors in adolescent hypertension. *Global Pediatric Health*, *3*, 2333794X15625159.

Falkner, B. (2010). Hypertension in children and adolescents: epidemiology and natural history. *Pediatric nephrology*, *25*(7), 1219-1224.

Forkert, E. C., Rendo-Urteaga, T., Nascimento-Ferreira, M. V., de Moraes, A. C. F., Moreno, L. A., & de Carvalho, H. B. (2016). Abdominal obesity and cardiometabolic risk in children and adolescents, are we aware of their relevance?. *Nutrire*, *41*(1), 15.

Güngör, N. K. (2014). Overweight and obesity in children and adolescents. *Journal of clinical research in pediatric endocrinology*, *6*(3), 129

Guo, X., Zhang, X., Guo, L., Li, Z., Zheng, L., Yu, S., ... & Li, J. (2013). Association between pre-hypertension and cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *Current Hypertension Reports*, *15*(6), 703-716.

Guo, X., Zhang, X., Li, Y., Zhou, X., Yang, H., Ma, H., ... & Sun, Y. (2012). Differences in healthy lifestyles between prehypertensive and normotensive children and adolescents in Northern China. *Pediatric cardiology*, *33*(2), 222-228.

Hansen, M. L., Gunn, P. W., & Kaelber, D. C. (2007). Underdiagnosis of hypertension in children and adolescents. *Jama*, *298*(8), 874-879.

Karatzi, K., Protogerou, A. D., Moschonis, G., Tsirimiagou, C., Androutsos, O., Chrousos, G. P., ... & Manios, Y. (2017). Prevalence of hypertension and hypertension phenotypes by age and gender among schoolchildren in Greece: The Healthy Growth Study. *Atherosclerosis*, *259*, 128-133.

Kromeyer-Hauschild, K., Neuhauser, H., Rosario, A. S., & Schienkiewitz, A. (2013). Abdominal obesity in German adolescents defined by waist-to-height ratio and its association to elevated blood pressure: the KiGGS study. *Obesity facts*, *6*(2), 165-175.

Ledoux, T., Watson, K., Baranowski, J., Tepper, B. J., & Baranowski, T. (2011). Overeating styles and adiposity among multiethnic youth. *Appetite*, *56*(1), 71-77.

Liang, Y., & Jie, M. I. (2011). Pubertal hypertension is a strong predictor for the risk of adult hypertension. *Biomedical and Environmental Sciences*, *24*(5), 459-466.

Lim, S. S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K., Adair-Rohani, H., ... & Aryee, M. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The lancet*, *380*(9859), 2224-2260.

Litwin, M. (2018). Why should we screen for arterial hypertension in children and adolescents?. *Pediatric Nephrology*, *33*(1), 83-92.

Lu, Y., Luo, B., Xie, J., Zhang, X., & Zhu, H. (2018). Prevalence of hypertension and prehypertension and its association with anthropometrics among children: a cross-sectional survey in Tianjin, China. *Journal of Human Hypertension*, *32*(11), 789-798.

Maldonado, J., Pereira, T., Fernandes, R., Santos, R., & Carvalho, M. (2011). An approach of hypertension prevalence in a sample of 5381 Portuguese children and adolescents. The AVELEIRA registry."Hypertension in Children". *Blood pressure*, *20*(3), 153-157.

Martin-Calvo, N., Moreno-Galarraga, L., & Martinez-Gonzalez, M. A. (2016). Association between body mass index, waist-to-height ratio and adiposity in children: a systematic review and meta-analysis. *Nutrients*, *8*(8), 512.

Martin-Espinosa, N., Díez-Fernández, A., Sánchez-López, M., Rivero-Merino, I., Lucas-De La Cruz, L., Solera-Martinez, M., ... & Movi-Kids group. (2017). Prevalence of high blood pressure and association with obesity in Spanish schoolchildren aged 4–6 years old. *PLoS One*, *12*(1), e0170926.

Millar, S. R., Perry, I. J., & Phillips, C. M. (2013). Surrogate measures of adiposity and cardiometabolic risk-why the uncertainty? a review of recent meta-analytic studies. *Journal Of Diabetes & Metabolism*, *4*.

Mishra, P. E., Shastri, L., Thomas, T., Duggan, C., Bosch, R., McDonald, C. M., ... & Kuriyan, R. (2015). Waist-to-height ratio as an indicator of high blood pressure in urban Indian school children. *Indian pediatrics*, *52*(9), 773-778.

Moschonis, G., Karatzi, K., Androutsos, O., Lionis, C., Chrousos, G. P., & Manios, Y. (2018). Anthropometric cut-off values identifying Greek children at risk of hypertension: the Healthy Growth Study. *Journal of human hypertension*, *32*(3), 190-196.

National High Blood Pressure Education Program. (2005). *The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents* (No. 5). US Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, National Hight Blood Pressure Education Program.

Nkeh-Chungag, B. N., Sekokotla, A. M., Sewani-Rusike, C., Namugowa, A., & Iputo, J. E. (2015). Prevalence of hypertension and pre-hypertension in 13-17 year old adolescents living in Mthatha-South Africa: A cross-sectional study. *Central European Journal of Public Health*, *23*(1), 59-64.

Rosner, B., Cook, N. R., Daniels, S., & Falkner, B. (2013). Childhood blood pressure trends and risk factors for high blood pressure: the NHANES experience 1988–2008. *Hypertension*, *62*(2), 247-254.

Schneider, H. J., Klotsche, J., Silber, S., Stalla, G. K., & Wittchen, H. U. (2011). Measuring abdominal obesity: effects of height on distribution of cardiometabolic risk factors risk using waist circumference and waist-to-height ratio. *Diabetes care*, *34*(1), e7-e7.

Simmonds, M., Llewellyn, A., Owen, C. G., & Woolacott, N. (2016). Predicting adult obesity from childhood obesity: a systematic review and meta-analysis. *Obesity reviews*, *17*(2), 95-107.

Sommer, A., & Twig, G. (2018). The impact of childhood and adolescent obesity on cardiovascular risk in adulthood: a systematic review. *Current diabetes reports*, *18*(10), 91.

Toschke, A. M., Kohl, L., Mansmann, U., & Von Kries, R. (2010). Meta-analysis of blood pressure tracking from childhood to adulthood and implications for the design of intervention trials. *Acta paediatrica*, *99*(1), 24-29.

Tybor, D. J., Lichtenstein, A. H., Dallal, G. E., & Must, A. (2008). Waist-to-height ratio is correlated with height in US children and adolescents aged 2–18 years. *International Journal of Pediatric Obesity*, *3*(3), 148-151.

Urbina, E. M., Khoury, P. R., McCoy, C., Daniels, S. R., Kimball, T. R., & Dolan, L. M. (2011). Cardiac and vascular consequences of pre-hypertension in youth. *The Journal of Clinical Hypertension*, *13*(5), 332-342.

World Health Organization. (2009). *Global health risks: mortality and burden of disease attributable to selected major risks*. World Health Organization.

World Health Organization. (2013). *A global brief on hypertension: silent killer, global public health crisis: World Health Day 2013* (No. WHO/DCO/WHD/2013.2). World Health Organization.

Yang, C., & Wang, L. (2017). Comparisons of waist circumference measurements at five different anatomical sites in Chinese children. *BioMed research international*, *2017*.

Yoo, E. G. (2016). Waist-to-height ratio as a screening tool for obesity and cardiometabolic risk. *Korean journal of pediatrics*, *59*(11), 425.

Zhang, Y. X., Zhao, J. S., & Chu, Z. H. (2016). Children and adolescents with low body mass index but large waist circumference remain high risk of elevated blood pressure. *International Journal of Cardiology*, *215*, 23-25.

Primljen: 29. novembar 2021. / Received: November 29, 2021
Prihvaćen: 09. decembar 2021. / Accepted: December 09, 2021

https://doi.org/10.7251/SSH2102135S
UDC: 658.8:316.323(100)
Original scientific paper
Originalni naučni rad

Correlation Aspects of Strategic Orientations of Internal Marketing of Primary Health Care Institutions

Vanja Sredojević, Mirjana Landika, Branislav Mihajlović
Paneuropean University "Apeiron", Banja Luka, Bosnia and Herzegovina

Correspondence:
Vanja Sredojević, Paneuropean University "Apeiron", Banja Luka, Bosnia and Herzegovina
vanja.b.sredojevic@apeiron-edu.eu

Abstract: *The business efficiency of a service company/institutions is based on recognition and appreciation of user requirements and expectations, as well as reviewing of the user perception of the of offered and provided services at the level of primary health care.*
Customer expectations in mentioned field regard not only to direct users but also it affects the large number of individuals who are in family and/or emotional relationship with the users. Services from observed domain determine the quality of life of almost all member of the community.
Verification of user perception of service quality at the level of primary health care, gives opportunity for harmonization of the working code with user requests and expectations. Examining the degree and direction of quantitative agreement of variations of observed phenomena enables the correction of procedures and additional education of employees, which achieves the adaptation of the primary health care system with user expectations and requirements..
A research approach based on the empirical examination of respondents attitudes, aims to formulate adequate internal marketing strategies on the task of aligning system solutions based on correlation analysis.
Modeled menagements solutions have the potential of scientific answer to real problem and to facilitate primary care system providers to reduce the gap between users expectations and the quality of service delivered. The above is effectively achieved by understanding and appreciating the real factors regarding a coordinated approach to users, resulting from a correlative analysis of user observations and expectations, and comparisons of user satisfaction with the form of health care.
Keywords: *customer expectations, correlation analysis, internal marketing strategies, primary care system.*

Introduction

All management solutions, whether they are potential external or internal challenges, are aimed at adapting the business system to them, by defining the most adequate strategy of external, internal and interactive marketing, with an emphasis on service activities.

As primary healthcare facilities are classified as high-level customer service business systems, the challenge for the management structure is even greater, taking into account the external impacts and changes caused by the Covid 19 among users.

The best solution for improving the service quality and harmonization of the working code with the requirements and expectations of the end user in the field of primary health care is provided by the formulation of an adequate internal marketing strategy with concrete actions aimed at systemic solutions.

The research project is based on recognizing and considering user requests and expectations, as well as reviewing the user perception of the offered and provided services at the primary health care level, and the research approach is based on empirical examination of respondents' attitudes to reduce the gap between user expectations and service quality.

The reference values for comparing the results of the research refer to the research conducted a year before the pandemic.

Previous research (Landika, Sredojević, & Stanišljević, Istraživanje i analiza, 2019) was applied to institutions (public and private) that perform primary health care activities in order to critically use adequate empirical knowledge of user perception of health care systems and processes to promote, improve, protect and revitalize the business of the systems that were the subject of research, and the focus of the researchers was to cover the market segment of

the territorial units of the former SFRY, including Bosnia and Herzegovina and the Republic of Serbia. The research hypothesis was defined in the form that responsibility for business success directly correlates with interest of customer satisfaction level.

Considering the primary requirement within health services and health care in general to provide the best possible care to each user, it makes examining the level of consumer satisfaction with the provided healthcare service an acceptable for evaluating the health service quality.

The survey questionnaire, as an instrument of the conducted research project, was applied to a randomly selected sample of population living in previously defined territorial units, and was designed to "eludicate the key factors of user satisfaction/dissatisfaction with primary health care services, and especially differences in the context of institutional framework for service provision". Only the adult population was surveyed, "assuming that user impressions do not refer exclusively to personal but also to the experiences of people relevant to the respondents or when the respondents have the role of stakeholders." The results of this research in the context of verification were tested at a significance level of 99%, and it is justified to use them with a high degree of confidence in our research project.

Estimation of the total population in the territory covered by the survey is 3,290,791 for 2020 (Wikipedia, 2021). The employment rate in the territory of Bosnia and Herzegovina is 25.29% (Wikipedija, 2021), the unemployment rate is 12.11% (Wikipedija, 2021), the pension beneficiaries rate is 12.66% (PIO/MIO, 2020), (Pension and Disability Insurance Fund), the students rate is 2.46% (KLIX, 2021), while the rest of the population (47.48%) make children under 18, and, possibly, people outside the health insurance system.

With the Covid 19 as an extremely strong external challenge which had a special impact on the health sector, from the research team standpoint it was justified to repeat all the above research steps in completely new and changed external conditions.

In order to reach even more concrete and precise results, the research team compared the respondent attitudes before and during the Covid 19; the research results were compared with the results of the previously conducted research, with the aim to identify a possible difference in the perception of the primary health care service quality.

All of the above provides a basis for the procedure correction, employee additional education and service delivery improvement, through the formulation of an adequate internal marketing strategy with the tasks of harmonizing system solutions based on correlation and comparative analysis.

Literature Review

It is important to evaluate the quality of each process, including the primary health care services, by applying adequate indicators of the healthcare institutions work quality. (Health care quality, Article 203 of the Health Care Law of the Republic of Serbia, 2020) (Kvalitet zdravstvene zaštite , član 203. Zakon o zdravstvenoj zaštiti Republike Srbije, 2020)

The quality of health care services includes the interaction of all participants in the process - healthcare workers, associates, management, patients, and service users as well.

Communication and interpersonal skills of healthcare workers are a key factor in the overall health care quality, determine the effectiveness of diagnostic and therapeutic treatment. . (VanZanten, Boulet, McKinley, DeChamping, & Jobe, 2007)

Patients expect trust, understanding, privacy and quality communication with the doctor. (Duffy, Whelan, Kelly, & Buffone, 2004)

The quality of health care services is expressed by the workers professional qualification, which ensures that they perform sensitive activity at the highest level, and by the level of education. Although frequent, patient assessments regarding the health care workers professionalism are not objective but subjective, and, as such, they are important in assessing the health care quality. "Quality medical care is the level of care at which healthcare services for individual patients and population increase the expectancy of desired health outcomes and which is in line with existing professional knowledge." (Tipurić, 2012)

Previous research shows correlations between the level of service quality and user expectations (Landika, Sredojević, & Stanišljević, Istraživanje i analiza, 2019) from which it is concluded that "Measures to improve certain aspects of health care service contribute equally to all user profiles, which means that approach to the formulation of marketing strategy is focused on the education of staff engaged in the primary health care service by contributing

to the level of user perception, regardless of user profile ... ", which contributes to attitudes about importance of the application of internal marketing as an indispensable link in the realization of optimal business results.

The health care quality belongs to the type of terms whose meaning seems close, understandable and clear, associating with a number of desirable health care features, which can include adequacy, efficiency, comprehensiveness, fairness, accessibility, satisfaction. (Šofranac & Šofranac, 2011) To date, there has been no universally accepted definition of health care quality among the scientific and professional public.

Stochastic Approach to Analysis of the Customer Satisfaction/Dissatisfaction Level With Primary Health Care Services

Empirical base of customer satisfaction metrics

For the realization of the research project and configuration of a new empirical database which would supplement the information obtained by descriptive statistical analysis in the context of quantitative valorization of consumer satisfaction/dissatisfaction level with primary health care service which would provide adequate comparative analysis of existing data, a questionnaire, as a research instrument, (https://docs.google.com/forms/d/1ugIdV3I8vClqCv4UYBxd9KIhXw7dZpsRW3s-WEC4uB4/edit) was used from a previously conducted research (Landika, Sredojević, & Stanišljević, Istraživanje i analiza, 2019).

The questionnaire contains 13 (thirteen questions), of which three questions are related to the general data of the respondents, and relate to the age, place of residence and education of the respondents. This is followed by questions related to the frequency (4-point Likert scale of frequency with offered answers from very frequently to rarely) and the form (public, private sector and combined) of using the primary health care service.

The questionnaire refers to the consumer satisfaction level with the overall service and its aspects in terms of availability, timeliness, professionalism, price and necessity, as well as the medicines price and availability in the primary health care. The answers to the questions are formulated through 5-point Likert scale of satisfaction from 5 (very satisfied) to 1 (very dissatisfied).

The conduct of the questionnaire is in line with the ethical principles and human rights in the research.

Methodological approach of expressing and analyzing consumer satisfaction/ dissatisfaction

IBM SPSS Statistics 20 software package was used for data processing and analysis; the methodological approach to analysis and processing was adequately adapted to the data type and analysis methods.

Observing the behavioral regularities, the degree and direction of the variable relationship observed in a particular decision-making problem requires an analytical approach that adapts to variables that can be considered as ranked variables. Such variables are often encountered and explain a number of research issues in everyday life. The purpose and task of correlation analysis refer to the degree and direction of quantitative connection of the variations of the analyzed phenomena, and the selection of variables that have a significant or negligible impact. Degree and direction of the phenomena and processes connection indicate an adaptive reaction in terms of individual aspects, and according to the degree and direction of the connection.

The methodological approach to comparing the respondent attitudes regarding the characteristics of a certain process or the service is realized by testing the differences within individual groups. It is justified to compare the satisfaction level with the service and its individual aspects, taking into account the form of its implementation (public or private institution in the country or abroad).

Used methodology includes the intercorrelation matrix and the Chi - square test, whose results enable the formation of the basis for decision - making in further action.

Statistical Syrvey Results and Analysis of the Consumer Satisfaction/Dissatisfaction Level With the Primary Health Care Service

Structure of empirical data collection

The survey included respondents from the territory of the Republic of Serbia and Bosnia and Herzegovina, as in the previous research project with which the results were compared. Respondents answers and attitudes are the

basis for recognizing the levels and sources of satisfaction/dissatisfaction with primary health care services, in order to create and redefine internal marketing strategies and tactics of primary health care institutions.

The conducted research project included a sample of 225 respondents, credibly completed questionnaires in the territory of the Republic of Serbia and Bosnia and Herzegovina. The survey was conducted through e-communication tools (e-mail) by which the research team rationalized both the costs and time of research activities. Respondents were included in the research by random selection, the size and structure of the respondents was harmonized with the research needs and conclusions.

The sample specifically consists of respondents aged 20-78 years, with an average age of 44 years, with a variance of 170.58, or a standard deviation of 13.06 years. The age structure of the respondents indicates the fact that the sample included all age groups relevant to examine phenomena and processes relevant to a particular research problem. Age groups that include the population under 20 and over 60 are included in the analyzed processes, mostly passively, in the sense that they are cared for by parents, children or spouses. Younger population is under parental care, although this population rarely has health problems, except in exceptional cases. In the older population, if a more serious health problem occurs, the care is taken by spouses or children, who belong to middle age group.

The structure of respondents by place of residence includes 40.2% of respondents living in the city center, 31.3% in the wider urban area, 15.6% in suburban areas and 13.3% in rural areas. Respondents are distributed according to the real situation, most population belongs to urban areas. It is true that the majority of the working age population inhabits urban areas, but they also overestimate the place of residence location, because of the picture (illusion) of social status.

The educational structure of the respondents corresponds to the real picture, with a smaller share of the population with a lower level of education (primary school only); this population uses less modern digital technologies, and often has no social status issues in terms of inclusion in the healthcare system. Respondent educational level includes 1.8% with primary education, 27.1% with secondary education, 6.2% with post-secondary education and 40.9% with higher education, while 24% of respondents with even higher educational degree (master, doctor of science or specialist of a certain profession).

The structure of respondents according to the frequency of consuming primary health care services shows that the most significant part of the surveyed population occasionally consume health services 45.8%, while often (25.3%) or very often (12.9%), and rarely or never 16% of them. The majority of respondents, 47.1%, consume health care services in private and public institutions, 38.2% in public and 14.2% in private institutions (in the country or abroad). It is reasonable to assume:

Table 1. *Structure of respondents according to the perception of service quality at the level of primary health care (Landika, Sredojević, & Mihajlović, Istraživanje i analiza, 2021)*

Service aspect / Satisfaction level (% respondents)	Overall satisfaction level	Availability	Timeliness	Professionalism	Price	Necessity	Medicines availability	Medicines price
5 (Very Satisfied)	8,4	9,3	9,3	13,8	12,0	8,0	10,0	4,4
4 (Satisfied)	46,7	41,3	38,2	49,3	31,6	32,4	38,4	19,1
3 (Enough Satisfied)	37,3	35,6	36,9	29,4	36,9	40,0	32,0	30,7
2 (Dissatisfied)	5,3	10,2	9,4	5,3	13,3	15,1	14,5	27,6
1 (Very Dissatisfied)	2,3	3,6	6,2	2,2	6,2	4,5	5,1	18,2

Respondent response is of acceptable scope and characteristics so that it is suitable for formulating conclusions in relation to the analyzed phenomena. In order to provide management structures with complete information that would maximize the agreement level between the level of service quality and the perception of customer expectations through quality strategic commitments and adequate marketing instruments, the examined phenomena were analyzed both partially and comprehensively.

Intercorrelation matrix

Based on the collected empirical data, intercorrelation matrix was designed to provide credible information to management structures in terms of the examined phenomena direction and intensity as well as the statistical testing results of its significance.

Table 2. *Intercorrelation matrix - interdependence of factors that we use to assess the quality and consumer satisfaction with primary health care service in RS / BiH. (Landika, Sredojević, & Mihajlović, Istraživanje i analiza, 2021)*

	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13
v1	1.000	-.278**	-.038	-.041	.095	.117	.160*	.108	.184**	.103	.089	.159*	-.026
v2		1.000	-.048	.139*	-.047	.003	.069	-.004	-.073	-.102	-.162*	-.064	.025
v3			1.000	.040	.147*	.166*	.182**	.083	.122	.200**	.109	.127	-.036
v4				1.000	.132*	.134*	.149*	.092	.177**	.121	-.026	.014	.004
v5					1.000	.786**	.706**	.675**	.510**	.530**	.406**	.359**	-.071
v6						1.000	.816**	.614**	.508**	.582**	.357**	.342**	-.017
v7							1.000	.582**	.471**	.518**	.302**	.312**	-.076
v8								1.000	.434**	.414**	.309**	.303**	-.047
v9									1.000	.593**	.397**	.474**	.015
v10										1.000	.377**	.467**	-.020
v11											1.000	.615**	-.032
v12												1.000	.004
v13													1.000

The test value represents the sample realization of the rank correlation coefficient r_s, and the table value is read for the values of sampling distribution of the rank correlation coefficient for a given risk of error γ and the sample size n.

In the previous table, the fields with correlation coefficients above 0.5 are shaded, which indicates statistically significant correlation between the variables to which this dependence refers. The empirical data analysis results indicate the subjective sensitivity to certain elements of the primary health care service. Correction of the observed factors in the analyzed system significantly contributes to the level of customer satisfaction.

Statistical expression and measurement of the health care impact on the achieved level of consumer satisfaction/dissatisfaction

It is justified to check how the realized level of customer satisfaction is affected by the form of primary health care, which is effectively checked by Chi - square test, which we conduct taking into account the testing procedure, which relates to: (Landika, Metodi statističke analize - primjena u oblasti zdravstvenih, sportskih i inženjerskih nauka, 2015) (Landika, Methods of statistical analysis - application in health, sports and Engineering Sciences, 2015)

- Hypotheses formulation, where in this case are: H0: the level of satisfaction with the service is the same for all institutions (public, private, domestic and foreign) and H1: the level of satisfaction with the service is not the same for all institutions (public, private, domestic and foreign);
- Determining the theoretical value of Chi - square test, which in this case is: *= 21,03*;
- Determining empirical test values of Chi - square test, which is contained in the following table and
- Comparison of tabular and test values, and making a conclusion about the test outcome.

Table 3. *Chi - test square results- determining differences in the level of satisfaction with the service in relation to the service provider (Landika, Sredojević, & Mihajlović, Istraživanje i analiza, 2021)*

Service provider \ Service aspect		Overall satisfaction level	Availability	Timeliness	Professionalism	Cijena	Necessity	Medicines availability	Medicines price
Public institution		8.4	9.3	9.3	3.8	2.0	8.0	9.2	4.1
Private institution in the country		5.3	10.2	9.3	9.3	11.6	2.4	8.4	9.1
Private institution abroad		2.2	3.6	6.9	9.4	6.9	4.4	2.0	0.7
Combined		12.4	5.6	6.2	5.3	3.3	5.1	4.5	7.6
Total:	χ^2	28.3	28.7	31.7	27.8	23.8	19.9	24.1	21.5
	Degrees of freedom number – df	12	12	12	12	12	12	12	12
	Significance level – p	0.03	0.03	0.01	0.04	0.04	0.06	0.04	0.05

The previous table shows that there are differences in terms of the form of the institution that provides the primary health care service with a high degree of reliability, 99% in the timeliness of the service provided, to at least 94% in the necessity of the primary health care service.

Discussion of Findings

Based on the empirical data, descriptive and inferential statistical analysis was performed, which gave results that were presented in tables and graphs, and in the form of values and statistical significance of correlation coefficients.

The analysis results indicate that *the form of health care* (public or private) correlates with a large number of variables, which refers to the overall level of satisfaction with the service, its availability, timeliness, staff professionalism, and the level of satisfaction with the price. In the research conducted before the pandemic, the analysis showed that there were no differences in the quality evaluation of the realized service in relation to the form of health care (private or public) regarding any aspect of service.

Research results show that the respondent age does not affect the perception of the level of health care service quality, which is not the case in the research conducted in 2019 (Landika, Sredojević, & Stanišljević, Istraživanje i analiza, 2019)(Landika, Sredojević, & Stanišljević, Research and Analysis, 2019) where the results showed a significant correlation of the variable *respondent age* with "the largest number of variables, in terms of frequency, form and perception of staff professionalism in providing primary healthcare services". *The level of overall service satisfaction* significantly correlates with the perception of service availability, timeliness and staff professionalism which correlates with service price.

In addition, it is important to emphasize that the respondents' attitudes regarding the achieved level of satisfaction with the primary healthcare service are at least average in terms of overall perception and perception of certain service aspects expressed in cumulative percentage can be shown in the following table.

Table 4. *Empirical share of respondents with an average level of satisfaction or above it (fully, mostly or partially satisfied / with the service) in certain aspects of the service (Landika, Sredojević, & Mihajlović, Istraživanje i analiza, 2021)(Landika, Sredojević, & Mihajlović, Research and Analysis, 2021)*

Aspect of service	Overall level	Service availability	Service timeliness	Staff professionalism	Service price	Necessity	Medicines availability	Medicines price
Share of respondents (%)	92.4	86.2	84.4	92.5	80.5	80.4	80.4	54.5

The only aspect that requires significant attention refers to the price of medicines used by the respondents, which is significantly higher than in the surrounding countries, which requires significant attention of the wider social system, and not employees engaged in the primary health care system. Certainly the price of medicines significantly refers to the primary health care issue.

Advanced analysis gives importance to the lack of causality within a certain number of observed variables, and it can be seen that *respondents education* and *place of residence* do not affect the perception of health care quality levels, whether observed comprehensively or segmented. Comparing the above with the previous research results, a coincidence of the analyzed results can be noticed. Research results in the context of verification have been tested at a significance level of 99%, and can be used with a high degree of confidence.

Using the Chi - square (χ^2) statistical test, it was found that the perception of the service quality at the level of primary health care depends on the form of health care, and differs significantly in the public and private sectors, as well as in the country and abroad.

Conclusion

Comparing the research results from the collected empirical data and previous research results in the context of subjective perception of sources and causes of satisfaction/dissatisfaction with services in primary care in different external circumstances, in order to create and redefine internal marketing strategies and tactics of primary health care, we came to the following conclusions; it follows from the above that the emerging epidemiological challenges have affected consumers' perception of the provided healthcare service and the level of their satisfaction, depending on the form of health care (public or private). Comparative analysis shows the connection between changed consumers' perception of the level of satisfaction with health services and the internal environment of the service provider caused by external circumstances, which can be objectively related to more patients, staff workload, staff concentration drop, lack of time for adequate empathy, lack of accommodation resources, fear, seriousness of the situation, etc. All management decisions based on derived evidence of existence/nonexistence, and the intensity and direction of quantitative variations agreement of the observed phenomena indicate a high degree of reliability.

Verification of user perception of service quality at the level of primary health care enables the harmonization of the working code with the user requests and expectations. Assessing the degree and direction of quantitative variations agreement of the observed phenomena enables the correction of procedures and additional education of employees, which achieves the adaptation of the primary health care system with user expectations and requirements. Quality combinatorics and synchronization of the mentioned elements (training, education, motivation and information) lead to motivated, competent and loyal staff oriented to the external user, which ultimately fits into the aspiration to achieve a given level of service quality that meets the consumer population expectations. Dimensioning of identified variables (training, education, motivation and information) as an integral part of the of internal marketing mix instruments, in practice, is conditioned by the specifics of each business system, emphasizing their management and organizational structure on one side and the specifics of external circumstances that management structure cannot influence on other side. The specificity of time and external circumstances in which a particular service is consumed, affects the perception of customer expectations, which requires sensibility and prompt response of management in the form of management decisions aimed at the internal market over which it has absolute control. The adaptive character of the conducted analysis gives the possibility of its implementation on numerous business processes.

References

Duffy, F. D., Whelan, G. H., Kelly, K. C., & Buffone, N. (2004). Assisting competence in communikation and interpersonal skills: Kalamazoo II. *Acad Med*, 495 - 507.

KLIX. (2021, 2 18). *klix.ba, 18.02.2021.* Preuzeto sa 18.02.2021: https://www.klix.ba/vijesti/bih/prosle-godine-smanjio-se-broj-ucenika-i-studenata-u-cijeloj-bosni-i-hercegovini/210218119 [in Bosnian]

Kvalitet zdravstvene zaštite , član 203. Zakon o zdravstvenoj zaštiti Republike Srbije. (2020, 8 14). Preuzeto sa Službeni Glasnik RS 107/05: https://www.paragraf.rs/glasila/rs/sluzbeni-glasnik-republike-srbije-107-2020.html [in Serbian]

Landika, M. (2015). *Metodi statističke analize - primjena u oblasti zdravstvenih, sportskih i inženjerskih nauka.* Banja Luka: Panevropski univerziet "Apeiron" Banja Luka. [in Serbian]

Landika, M., Sredojević, V., & Mihajlović, B. (2021). *Research and analysis.* Banja Luka: Sportske nauke i zdravlje. [in Serbian]

Landika, M., Sredojević, V., & Stanišljević, D. (2019, 11 15-16). *Stohastički aspekti marketing strategije usluga zdravstvene zaštite na teritoriji RS/BiH.* Preuzeto sa EDASOL: http://www.edasol-au.com/sites/default/files/Knjiga-apstrakata-EDASOL-2019.pdf[in Serbian]

Landika, M., Sredojević, V., & Stanišljević, D. (2019, 11 15-16). *Stohastički aspekti marketing strategije usluga zdravstvene zaštite na teritoriji RS/BiH.* Preuzeto sa EDASOL 2019: http://www.edasol-au.com/sites/default/files/Knjiga-apstrakata-EDASOL-2019.pdf[in Serbian]

PIO/MIO. (2020, 3 31). *PIO/MIO mart 2020.* Preuzeto sa 31.3.2020: http://www.fzmiopio.ba/images/statistika/strrasbos032020.pdf [in Serbian]

Šofranac, R., & Šofranac, M. (2011). *Definicija kvaliteta zdravstvene zaštite.* Neum: Zbornik-Naučno-stručni skup sa međunarodnim učešćem. "KVALITET 2011". Preuzeto January 20, 2021 sa https://quality.unze.ba/zbornici/QUALITY%202011/160-Q11-221.pdf [in Serbian]

Tipurić, D. (2012, 11 1-30). *Upravljanje kvalitetom u zdravstvu.* Preuzeto sa Zavod za javno zdravstvo, BiH: http://www.zzjzfbih.ba/wp-content/uploads/2012/11/Upravljanje-kvalitetom-u-zdravstvu-osnovna-razina.pdf [in Serbian]

VanZanten, M., Boulet, J. R., McKinley, D. W., DeChamping, A., & Jobe, A. (2007). Assesing thecomunication and interpersonal skills of graduates of interpersonal medical schools as part od the USAME. *Step 2 Clinical Skills Exam Acad Med 82*, 65 - 68.

Wikipedija. (2021, 10 21). *Wikipedija 21.10.2021.* Preuzeto sa 21.10.2021.: https://bs.wikipedia.org/wiki/Bosna_i_Hercegovina

Primljen: 02. jun 2021. / Received: Juny 02, 2021
Prihvaćen: 14. decembar 2021. / Accepted: December 14, 2021

https://doi.org/10.7251/SSH2102143H
UDC: 005.346:796.015.14-057.875
Original scientific paper
Originalni naučni rad

Efficiency Eight Weeks Program of CrossFit Exercises on the Level of Physical Fitness of Algerian High School Students

Hamzaoui Hakim, Mime Mokhtar, Benchehida Abdelkader, Cherara Lalia
Laboratory of Optimizing Research Programmes on Physical and Sports Activities, Institute of Physical Education and Sport, University of Mostaganem, Mostaganem, Algeria

Correspondence:
Benchehida Abdelkader, Laboratory of Optimizing Research Programmes on Physical and Sports Activities, Institute of Physical Education and Sport, University of Mostaganem, Mostaganem, Algeria, adel.belkadi@univ-mosta.dz

Abstract: *The aim of this study was to assess the effectiveness of a CrossFit exercises over a period of 8 weeks in a group of high school students during their physical education sessions at the school. and to mitigate the deficits in fitness caused by COVID-19 prevention measures.*
In this research included 94 students subject aged (16– 17) years were randomly allocated into an included 46 students (2nd level :12 men 11 women; 3rd level : 12 men 11 women) and 1 control group included 48 students (2nd level :13 men 11 women; 3rd level : 13 men 12 women Experimental group (EG) that performed the 8 weeks CrossFit exercises and control group (CG). Physical fitness tests were done : lifting straight legs in height (number times); running on the spot with an intensity of 70% of the maximum to severe fatigue (c); "Shuttle" run 4 × 9 m (with); 60 m run (s) and cross twine (cm).
There are a considering changes, development of the maximum dynamic force endurance, speed abilities, flexibility and mobility in the hip joints of the main groups, In the age aspect, there is mainly the improvement in results with age, both in the main and control groups (p>0,05).
The study achieved a significant improvement in the physical condition of the students, also allows to talk about the effectiveness of training, built on the basis of a motivated choice of the target CrossFit high school program.
Keywords: *physical fitness, CrossFit, high school, program.*

Introduction

To date, there is a problem of decline level of physical fitness, and as a consequence of health student youth. A number of leading experts (Harold W. Kohl, Cook, Environment, Board, & Medicine, 2013; Kaur, Singh, Arya, & Mittal, 2020; Mameshina, 2019; I. P. Masliak & Mameshina, 2018; Petrova & Bala, 2020) note that according to statistics, almost 60% high school children have health problems and low levels of physical fitness. The main reasons for this problem are the features of education in the modern school (Krivoruchko, Masliak, Bala, Skripka, & Honcharenko, 2018), the growth of educational information, the intensification of material, modernization and complication of educational programs (Varea, Riccetti, & Siracusa, 2021). All this leads to an increase in mental load and a decrease in motor activity of children (Batorova & Sørensen, 2019). Exercise is an effective means of compensating for the deficit of motor activity of the modern student (Cacioppo et al., 2021; Kolokoltsev, Iermakov, & Jagiello, 2018; Mohammed, Bachir, Eddine, & Adel, 2018; Varea et al., 2021; Voloshina et al., 2018). However, according to the results of a number of authors (Adel, Alia, & Mohammed, 2020; Andrieieva et al., 2020; Bodnar & Andres, 2016; Krivoruchko et al., 2018; Palichuk et al., 2018; Prysiazhniuk et al., 2021; Sibley, 2012), currently operating lessons are ineffective, monotonous, do not sufficiently stimulate students to physical culture and sports activities. Therefore, this problem requires the search for new interesting forms, innovative means, methods and principles of system improvement physical education, increasing the volume and diversification of types of motor activity (Adel et al., 2019; Cacioppo et al., 2021; Petrova & Bala, 2020; Pricop, A. D., Pelin, R., Florescu, O., & Mezei, M. D., 2020; Voloshina et al., 2018). A number of scientists pay considerable attention to the issue optimization of the content of physical education lessons (I. Masliak, Krivoruchko, Bala, Horchaniuk, & Korchevska, 2019; I. P. Masliak & Mameshina, 2018; Petrova, 2021; Varea et al., 2021; Voloshina et al., 2018). Numerous studies have identified the positive effects of various types of motor activities for the physical fitness of students of different ages (Belkadi et al.,

2015; Fedewa & Ahn, 2011; Mokhtar et al., 2019; Seefeldt, Malina, & Clark, 2002; Sibley & Etnier, 2003; Strong et al., 2005). Thus, Vlasova (2017) found an improvement in the level of physical fitness of junior schoolchildren under the influence of fitball-aerobics; Krivoruchko (2018) established a positive dynamics of indicators of the level of speed development under the influence cheerleading exercises for schoolchildren of 5th-6th grades;(Granacher, Muehlbauer, Doerflinger, Strohmeier, & Gollhofer, 2011; Hsieh et al., 2017; Root et al., 2019; yassin zenati, belkadi, & benbernou, 2021) found that under the influence of athletic gymnastics classes is reflected the tendency to improve the data of physical fitness in high school students. It should be noted, that the analysis of literature sources showed the absence of scientific works that would raise the question of the impact of CrossFit exercises to the level of physical fitness of high school students. Thus, the above indicates relevance and feasibility of the study. The purpose of the study is to determine the degree of change in the level of physical fitness of high school students the influence of CrossFit exercises. Connection of work with scientific programs, plans, topics.

Materials and Methods

The study was conducted on the basis of general physical education and sports program during 2020–2021. study comprised 94 subjects' students aged (16– 17) years, of which experimental groups included 46 students (2nd level :12 men 11 women; 3rd level : 12 men 11 women) and 1 control group included 48 students (2nd level :13 men 11 women; 3rd level : 13 men 12 women. All students who participated in the study were practically healthy and under the supervision of school doctor. During the study, students in the control groups were based only on the general physical education and sports program for high school students in secondary school(Beboucha, Belkadi, Benchehida, & Bengoua, 2021), and the educational process on physical education of experimental groups was designed with a variable module developed by us "CrossFit school challenge".

The CrossFit classes were held twice per week according to the school schedule. To the content of which included theoretical information, special physical training push (elements of gymnastics, athletics and weightlifting, general developmental exercises) and special training exercise (Lalia, Ali, Adel, Asli, & Othman, 2019) (specially selected CrossFit exercises: "Burpee", "Box Jump", "Farmer's Walk", "Good morning", (Bear crawl", "Floor wipers", "Burpee bench jump", etc.) (Petrova, 2021). At the end of studying the section "CrossFit" students performed a set of exercises in the same conditions, which was formed of special and technical elements of CrossFit, for a short time period and with the specified number of rounds (Granacher et al., 2011).

The age, gender and anthropometric and physiological assessments took part in evaluation of high school students. Load and level of difficulty was increased gradually taking into account the individual abilities of student's performance. Also exercises CrossFit was included in the preparatory part of the lesson of others variable modules in the system of organized breaks and were given in the form of work out exercise(Cacioppo et al., 2021; Petrova & Bala, 2020; Prysiazhniuk et al., 2021).

To determine the level of development of physical qualities, tests were used by high school students, namely, lifting straight legs in height (number times); rate running on the spot with an intensity of 70% of the maximum to severe fatigue (c),The American Heart Association generally recommends a target heart rate of(Moderate exercise intensity: 50% to about 70% of your maximum heart rate; Vigorous exercise intensity: 70% to about 85% of your maximum heart)(Fletcher et al., 2001), also Activities are considered safe and appropriate if they meet the criterion of moderate intensity, as perceived by the physician or judged by an exercise test

Shuttle" run 4 × 9 m test : The objective of this test is to assess the athlete's ability to accelerate between marked lines and to rapidly change direction.To undertake this test you will require:2 marked parallel lines 9.14m (30ft) apart,2 wooden blocks 5cm x 5cm x 10cm,Stop watch, Assistant.)(Paliczka, Nichols, & Boreham, 1987)

60 m run (s) test :The objective of this test is to monitor the development of the athlete's acceleration and pick up to full flight.To undertake this test you will require(400m – 60m marked section on the straight ,Stop watch, Assistant.) The test comprises of 3 x 60m runs from a standing start and with a full recovery between each run(Haugen, Seiler, Sandbakk, & Tønnessen, 2019),and Transverse twine (cm) (Long, 2017; Maulder, 2018; Reiman & Manske, 2009).

The research was conducted in accordance with the initiative of the research work "Improvement the process of physical education in educational institutions of various profiles "for 2020-2022 (state registration number IEPS2020/0036)(Belkadi, Benchehida, Benbernou, & Sebbane, 2019) and in accordance with the Helsinki Declaration (World Medical Association, 2013).

Statistical analysis

Statistical analysis was performed using the using SPSS software (version 22) and Significance levels were set at $p \leq 0.05$. Shapiro- Wilk test was used to evaluate normal distribution of the conformity of continuous variables. The reliability of differences in the results of the mean values in two unrelated samples was determined using Student's t-test.

Results

The study indicates the lack of significant differences between the indicators studied. In terms of age, most of the improvements have been identified. results with age, both in 2nd and 3rd level secondary school students compared with control groups. Comparing the results by gender, it was founded that reliable prevalence of these young men over the indicators of women ($p < 0.05$– 0.001), with the exception of the transverse twine test, where the opposite trend, the performance of women is better than the data men, and these changes are mostly significant ($p < 0.05$– 0.01).

After the introduction of experimental methods, a significant improvement was found in all subject's indicators, both boys and women of the main groups (Table 1), and these differences are statistically significant ($p < 0,05$– 0.001). there is an increase in results that reflect the level development of strength in men of the 2nd level, amounted to (23.7%), 3rd level (22.9%); women, respectively (54.6%) and (42.7%); time motion in men of the 2nd level is (8.3%), 3rd level (7.5%); women have (24.9% and 20.7%), respectively; agility: boys of the 2nd level is (4.1%), the 3rd level (7.8%); women have (4.2%) and (5.7%), respectively; high-speed abilities - in young men of the 2nd level is (3.7%), 3rd level (3.5%); women (9.7%) and (3.6%), respectively; flexibility young men of the 2nd level makes 10,6%, 3rd level - 11.3%; women have 23.7% and 14.6%, respectively.

Table 1. *Indicators of the level of physical fitness of students of the main groups before and after the application*

class level	Sex	Experimental group					t	p
		N	Post test		Pres test			
			Mean	SD	Mean	SD		
Lifting straight legs in the axis (number of times)								
2nd level	Men	12	15.35	1.89	17.98	2.05	4.27	<0.001
	women	11	8.23	1.54	11.36	2.97	6.69	<0.001
3rd level	Men	12	15.9	2.68	18.72	1.83	2.13	> 0.05
	women	11	9.97	0.76	13.34	1.23	8.01	<0.001
Running on place with an intensity of 70% from maximum to severe fatigue (s)								
2nd level	Men	12	117.37	3.09	125.2	1.00	4.85	<0.001
	women	11	32.14	2.38	42.9	1.21	9.04	<0.001
3rd level	Men	12	129.16	1.91	139.59	0.66	5.13	<0.001
	women	11	34.09	1.65	39.57	2.75	4.79	<0.001
" Shuttle " run								
2nd level	Men	12	9.91	0.19	9.6	0.2	3.53	<0.01
	women	11	11.76	0.74	10.03	0.25	3.91	<0.01
3rd level	Men	12	9.81	0.16	9.33	0.15	5.41	<0.001
	women	11	11.14	0.17	9.62	1.07	3.59	<0.01
60 m (s) running								
2nd level	Men	12	10.12	0.1	9.73	0.11	4.29	<0.01
	women	11	12.18	0.26	10.12	0.21	8.52	<0.001
3rd level	Men	12	10.09	0.12	8.9	0.10	3.27	<0.05
	women	11	12.3	0.26	11.07	0.97	4.31	<0.001
Transverse twine (cm)								
2nd level	Men	12	28.31	1.97	26.53	2.48	2.14	<0.05
	women	11	21.39	2.73	17.84	1.89	5.53	<0.001
3rd level	Men	12	30.47	3.37	27.9	3.14	3.29	<0.001
	women	11	21.32	2.81	16.59	2.54	4.18	<0.05

Analyzing the studied indicators in age and gender aspects obtained after application of the CrossFit exercises.it was found that high school students pre-test, mainly the trend of distinctions remained variable, compared to the post test. Investigating the performance of students in the control groups test, it was found that they are also somewhat improved, however, these changes are not significant and unreliable (p> 0.05) (table 2). Thus, the increase in results varied from 0.6% to 8.7%. It should be noted that by age and gender no revealed changes compared to the post-test. When comparing repeated data of experimental and control groups (Table 2) established a significant pre- evaluation of the results of the main groups over the control. It should be noted that significant differences in tow groups on the indicators of lifting straight legs in height 3rd level class students (p <0.05); running on the spot with intensive 70% of maximum to severe fatigue high school students of 2nd -3rd level (p <0.05; 0.001); "Shuttle" running 4 × 9 m boys of the 3rd level class(p <0.001); 60-meter run ,the 2nd level students (p <0.01) and Transverse twine girls 3rd level class (p <0.05). Determining the level of physical fitness of student's senior school age after implementation in the process physical education of the variable module "CrossFit", revealed that against the background of significant and significant improvement results, it increased by 1 point and became equal score of 4 points, indicating a "above average" level. Thus, indicators of the level of development of strength, endurance, agility and flexibility on average correspond to the estimate - 4 points ("above average"), speed abilities - 3 points ("average" level). It should be noted that in the study In the control groups, the indicators remained un- variables, ie changes on the rating scale are not observed. Thus, the results of the study indicate positive dynamics of indicators of physical fitness those students aged 16-17 of the main groups under the influence of exercises CrossFit.

Table 2. *Comparison of indicators of physical fitness of students experimental and control groups after the experiment*

Classes	Groups						
	Sex	n	Experimental	n	Control	t	p
			Mean ±SD		Mean ±SD		
Lifting straight legs in the axis (number of times)							
2nd level	Men	12	17.98±2.05	13	14.35 ± 1.65	1.57	> 0.05
	Women	11	11.36±2.97	11	8.84 ± 1.58	1.38	> 0.05
3rd level	Men	12	18.72±1.83	13	14.82 ± 1.46	2.64	<0.05
	Women	11	13.34±1.23	12	11.49 ± 1.65	2.85	<0.05
Running on place with an intensity of 70% from maximum to severe fatigue (s)							
2nd level	Men	12	123.5±1.03	13	119.94 ± 1.86	2.06	<0.05
	Women	11	43.21±1.29	11	35.25 ± 1.87	5.48	<0.001
3rd level	Men	12	138.6±0.79	13	133.24 ± 2.43	4.95	<0.001
	Women	11	40.48±2.73	12	38.71 ± 1.60	2.65	<0.05
" Shuttle " run 4 × 9							
2nd level	Men	12	9.08±0.34	13	10.05 ± 1.65	1.85	> 0.05
	Women	11	11.08±0.94	11	12.83 ± 0.98	1.36	> 0.05
3rd level	Men	12	9.07±0.64	13	9.51 ± 0.72	5.64	<0.001
	Women	11	9.76±4.48	12	11.75 ± 1.34	1.59	> 0.05
60 m (s) running							
2nd level	Men	12	8.94±0.64	13	9.48 ± 0.42	1.22	> 0.05
	Women	11	10.28±0.34	11	11.25 ± 0.75	2.84	<0.01
3rd level	Men	12	8.94±0.41	13	9.64 ± 1.35	1.28	> 0.05
	Women	11	10.06±0.86	12	12.16 ± 0.64	1.65	> 0.05
Transverse twine (cm)							
2nd level	Men	12	27.52±3.06	13	28.95 ± 3.43	0.65	> 0.05
	Women	11	16.83±1.73	11	19.55 ± 4.37	0.85	> 0.05
3rd level	Men	12	28.75±3.58	13	30.95 ± 3.59	0.76	> 0.05
	Women	11	18.95±1.94	12	22.14 ± 2.03	2.82	<0.05

Discussion

According to research, it is established that CrossFit in the process of physical education of high school student's 2nd -3rd class level could help to improve the level of physical readiness. there are a considering changes in level indicators development of the maximum dynamic force of abdominal muscles the press, found mainly a significant improvement, both Men and women of the main groups, and these differences statistically significant ($p < 0.001$). The above is confirmed by the data of (Adel et al., 2019; Mokhtar et al., 2019; Saddek et al., 2020), according to which it was found that during physical exertion, muscle hypertrophy occurs as a result of adaptive-trophic influence (Mukund & Subramaniam, 2020; Teplov, 1982), which is characterized by an increase in thickness and denser packaging of contractile elements of muscle fiber(Haun et al., 2019; Narici et al., 1996). Thus, studies (Annesi, Westcott, Faigenbaum, & Unruh, 2005; Belkadi et al., 2019; Krivoruchko et al., 2018; I. P. Masliak & Mameshina, 2018) indicate that the introduction of functional exercises in the main part of the lesson contributed to a significant improvement in strength abilities of high school students.

Analyzing the indicators of the level of endurance development, obtained after the application of the variable module "CrossFit"(Drake, Smeed, Carper, & Crawford, 2017), it was determined that the data of schoolchildren of the main groups have significantly improved and are significant differences ($p < 0.001$) (Bala & Petrova, 2019; Kozina et al., 2018). Thus, according to (Khabibullayevich, 2019; Rink, French, & Tjeerdsma, 1996), this is due to the fact that at the study age, the body's oxygen regimes become more economical during exercise, significantly increases the body's ability to work "in debt", ie increases anaerobic productivity(Jobling, Baardvik, Christiansen, & Jørgensen, 1993; Millet, Jaouen, Borrani, & Candau, 2002; Schaun, Pinto, Silva, Dolinski, & Alberton, 2018). Examining the indicators of coordination of movements obtained after the pedagogical experiment, it was found that students of high school age of the main groups, have significantly improved and are reliable. the nature of the differences ($p < 0{,}01$; 0,001). The above is not confirmed by the data of (Krivoruchko et al., 2018), according to which it is determined that in the period of 16-17 years continues to improve motor coordination to the level of adults, and differentiation of muscular effort reaches a maximum level. Thus, according to (Kozina, Ol'khovyj, & Temchenko, 2016; Sobko, Ulaeva, & Yakovenko, 2016), it was found that under the influence of physical education lessons with elements of sports orientation significantly improved the agility of high school students(Benhammou, Mourot, Mokkedes, Bengoua, & Belkadi, 2021; Faigenbaum & Mediate, 2006; Galan et al., 2017; Sobko et al., 2016; Yanci, Reina, Los Arcos, & Cámara, 2013).

Analyzing the indicators of the level of development of the frequency of movements obtained after the introduction of CrossFit exercises, a significant improvement of the data in high school students of the main groups was revealed ($p < 0.05$–0.001). Thus, scientists(Alexander & Vladislav, 2016; Belkadi, 2019; Mikolajec, Waskiewicz, Maszczyk, Bacik, & Kurek, 2012) argue that various sports have a positive effect on the development of speed abilities.

Analyzing the indicators of the level of development of mobility in the hip joints obtained after the experiment, it was determined that in high school students of the main groups,have significantly improved and have significant differences ($p < 0.05$; 0.001). According to (Базилевич & Тонконого, 2019), it is determined that at this age ossification of the skeleton are not yet completed, which provides a fairly high level mobility and significant reserves available for improvement flexibility(Segal, Hein, & Basford, 2004), especially under the influence of CrossFit exercise. The data obtained by our study are consistent with the indicators of (Chen, Fox, Ku, & Taun, 2013; Trautner et al., 2005), according to which there are positive changes in the level of development of flexibility in boys and girls of 3ed level classes, under the influence of health fitness.

Conclusion

Our conducted research shows the positive influence of the CrossFit exercises released by our study at the 2nd and 3rd level classes of secondary school students. The effectiveness of using CrossFit in secondary school is beyond doubt. This allows us to optimize and diversify the combination of physical exercises, naturally increasing interest in systematic physical education at the secondary schools; differentiated approach to the choice of exercise intensity is based on the level of initial physical fitness of the training students; motivates to improve health, maintain physical fitness, play sports and build muscles, increase activity and vitality, the ability to cope with physical fatigue. The proposed program, planned for 8 weeks of classes, was designed for young people aged 16-17. Students who recently

graduated from middle school did not have significant physical achievements. Having a low level of physical fitness of students at the beginning of the research, for 8 weeks of motivated use of the CrossFit program, we achieved a significant improvement in the physical condition of the students. Thus, the study conducted by us, allows us to talk about the effectiveness of training, built on the basis of a motivated choice of the target CrossFit program.

These results are important for physical education teachers, fitness professionals and athletes.

Prospects for further research in this area can be realized by determining the level of physical health of high school students under the influence of CrossFit exercises.

Limitations

The main limitation in this study is that only 2nd and 3rd level classes were tested. In an ideal study there would be a variety of student tested; various ages. And also for the short period of the CrossFit programme.

Another limitation could have been the number of students tested in comparison to the number of participants in the secondary high school observed. In order to obtain very widely accepted results, a large amount of data is needed, and a large number of students must be seen. While this study may not fulfil those requirements, it adds to a larger body of research that will hopefully lead in that direction.

ACKNOWLEDGMENTS

We thank the Algerian General Directorate for Scientific Research and Technological Development (DGRSDT-MESRS) for their co-operation and help in setting up the study. also, for maintaining and supporting finances and quality of research.

References

Adel, B., Abdelkader, B., Alia, C., Othman, B., Mohamed, S., & Houcin, A. (2019). The Effect of High-Intensity Exercise on Changes of Blood Concentration Components in Algerian National Judo Athletes. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, *59*(2), 148-160.

Adel, B., Alia, C., & Mohammed, Z. (2020). Algerian Judo Competition Modality and its Impacts on Upper and Lower Limbs Strength Perseverance and Limitations. *Orthopedics and Sports Medicine: Open Access Journal*, *3*, 293-299.

Alexander, B., & Vladislav, B. (2016). Factors that determine high efficiency in developing speed and strength abilities of female hurdlers. *Journal of Physical Education & Sport*, *16*.

Andrieieva, O., Yarmak, O., Palchuk, M., Hauriak, O., Dotsyuk, L., Gorashchenco, A., … Galan, I. (2020). Monitoring the morphological and functional state of students during the transition from middle to high school during the physical education process. *Journal of Physical Education and Sport*, *20*(1), 2110-2117.

Annesi, J. J., Westcott, W. L., Faigenbaum, A. D., & Unruh, J. L. (2005). Effects of a 12-week physical activity protocol delivered by YMCA after-school counselors (Youth Fit for Life) on fitness and self-efficacy changes in 5-12-year-old boys and girls. *Research Quarterly for Exercise and Sport*, *76*(4), 468-476.

Bala, T., & Petrova, A. (2019). Analysis of the attitude of high school students to innovative types of motor activity in the system of school physical education. *Slobozhanskyi herald of science and sport*, *7*(4(72)), 13-16.

Batorova, D., & Sørensen, J. (2019). METHODOLOGICAL REVIEW OF MODEL-BASED COST-EFFECTIVENESS ANALYSES OF SCHOOL-BASED INTERVENTIONS TO INCREASE PUPILS'LEVEL OF PHYSICAL ACTIVITY. *Journal of Physical Education*, *30*.

Beboucha, W., Belkadi, A., Benchehida, A., & Bengoua, A. (2021). The anthropometric and physiological characteristics of young algerian soccer players. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, *61*.

Belkadi, A. (2019). *Proceedings of IAC in Vienna 2019*. Czech Institute of Academic Education z.s.

Belkadi, A., Benchehida, A., Benbernou, O., & Sebbane, M. (2019). Competencies and training needs and its impact on determining the professional skills of Algerian elite coaches. *International Journal of Physical Education, Fitness and Sports*, *8*, 51-61.

Belkadi, A., Othman, B., Mohamed, S., M, B. H., Gleyse, J., Adel, B., … Gleyse, J. (2015). Contribution to the Identification of the Professional Skills Profile of Coaches in the Algerian Sport Judo System. *International Journal of Sports Science*, *5*, 145-150.

Benhammou, S., Mourot, L., Mokkedes, M. I., Bengoua, A., & Belkadi, A. (2021). Assessment of maximal aerobic speed in runners with different performance levels : Interest of a new intermittent running test. *Science & Sports*. https://doi.org/10.1016/j.scispo.2020.10.002

Bodnar, I. R., & Andres, A. S. (2016). Tests and standards for express-control of physical fitness and health of middle school age pupils. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *20*, 11-16.

Cacioppo, M., Bouvier, S., Bailly, R., Houx, L., Lempereur, M., Mensah-Gourmel, J., … Vagnoni, J. (2021). Emerging health challenges for children with physical disabilities and their parents during the COVID-19 pandemic : The ECHO French survey. *Annals of physical and rehabilitation medicine*, *64*, 101429.

Chen, L.-J., Fox, K. R., Ku, P.-W., & Taun, C.-Y. (2013). Fitness change and subsequent academic performance in adolescents. *Journal of School Health*, *83*, 631-638.

Drake, N., Smeed, J., Carper, M. J., & Crawford, D. A. (2017). Effects of Short-Term CrossFit™ Training : A Magnitude-Based Approach. *Journal of Exercise Physiology Online*, *20*.

Faigenbaum, A. D., & Mediate, P. (2006). Effects of medicine ball training on fitness performance of high school physical education students. *Physical Educator*, *63*, 160.

Fedewa, A. L., & Ahn, S. (2011). The effects of physical activity and physical fitness on children's achievement and cognitive outcomes : A meta-analysis. *Research quarterly for exercise and sport*, *82*, 521-535.

Fletcher, G. F., Balady, G. J., Amsterdam, E. A., Chaitman, B., Eckel, R., Fleg, J., … Bazzarre, T. (2001). Exercise Standards for Testing and Training. *Circulation*, *104*, 1694-1740.

Galan, Y., Nakonechnyi, I., Moseichuk, Y., Vaskan, I., Palichuk, Y., & Yarmak, O. (2017). *The analysis of physical fitness of students of 13-14 years in the process of physical education*.

Granacher, U., Muehlbauer, T., Doerflinger, B., Strohmeier, R., & Gollhofer, A. (2011). Promoting strength and balance in adolescents during physical education : Effects of a short-term resistance training. *The Journal of Strength & Conditioning Research*, *25*, 940-949.

Harold W. Kohl, I. I. I., Cook, H. D., Environment, C. on P. A. and P. E. in the S., Board, F. and N., & Medicine, I. of. (2013). Physical Activity and Physical Education : Relationship to Growth, Development, and Health. In *Educating the Student Body : Taking Physical Activity and Physical Education to School*. National Academies Press (US).

Haugen, T., Seiler, S., Sandbakk, Ø., & Tønnessen, E. (2019). The Training and Development of Elite Sprint Performance : An Integration of Scientific and Best Practice Literature. *Sports Medicine - Open*, *5*, 44.

Haun, C. T., Vann, C. G., Roberts, B. M., Vigotsky, A. D., Schoenfeld, B. J., & Roberts, M. D. (2019). A critical evaluation of the biological construct skeletal muscle hypertrophy : Size matters but so does the measurement. *Frontiers in physiology*, *10*, 247.

Hsieh, S.-S., Lin, C.-C., Chang, Y.-K., Huang, C.-J., Hung, T.-M., & City, T. (2017). Effects of childhood gymnastics program on spatial working memory. *Medicine and science in sports and exercise*, *49*, 2537-2547.

Jobling, M., Baardvik, B. M., Christiansen, J. S., & Jørgensen, E. H. (1993). The effects of prolonged exercise training on growth performance and production parameters in fish. *Aquaculture International*, *1*, 95-111.

Kaur, H., Singh, T., Arya, Y. K., & Mittal, S. (2020). Physical Fitness and Exercise During the COVID-19 Pandemic : A Qualitative Enquiry. *Frontiers in Psychology*, *0*. https://doi.org/10.3389/fpsyg.2020.590172

Khabibullayevich, B. H. (2019). THEORETICAL FOUNDATIONS OF A HEALTHY LIFESTYLE, PHYSICAL EDUCATION AND PHYSICAL ACTIVITY OF PUPILS. *European Journal of Research and Reflection in Educational Sciences Vol*, *7*.

Kolokoltsev, M. M., Iermakov, S. S., & Jagiello, M. (2018). Comparative analysis of the functional characteristics and motor qualities of students of different generations and body types. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *22*, 287-295.

Kozina, Z. L., Goloborodko, Y. A., Boichuk, Y. D., Sobko, I. M., Repko, O. O., Bazilyuk, T. A., … Tararak, N. G. (2018). *The influence of a special technique for developing coordination abilities on the level of technical preparedness and development of psycho-physiological functions of young volleyball players 14-16 years of age*.

Kozina, Z. L., Ol'khovyj, O. M., & Temchenko, V. A. (2016). Influence of information technologies on technical fitness of students in sport-oriented physical education. *Physical education of students*, *20*, 21-28.

Krivoruchko, N. V., Masliak, I. P., Bala, T. M., Skripka, I. N., & Honcharenko, V. I. (2018). The influence of cheerleading exercises on the demonstration of strength and endurance of 15-17-year-olds girls. *Physical education of students*, *22*, 127-133.

Lalia, C., Ali, A. R., Adel, B., Asli, H., & Othman, B. (2019). Effects of caloric restriction on anthropometrical and specific performance in highly-trained university judo athletes. *Physical education of students*, *23*, 30-36.

Long, M. (2017). *The Effects of a Six Week Lumbopelvic Control and Balance Training Program in High School Basketball Players*. West Virginia University.

Mameshina, M. (2019). Differentiation of the content of classes on physical education, taking into account indicators of physical health and physical preparedness of students in grades 7–9. *Slobozhanskyi herald of science and sport*, *7*, 26-31.

Masliak, I., Krivoruchko, N., Bala, T., Horchaniuk, Y., & Korchevska, O. (2019). *Efficiency of using cheerleading for flexibility development at female students of teacher training college*.

Masliak, I. P., & Mameshina, M. A. (2018). Physical health of schoolchildren aged 14-15 years old under the influence of differentiated education. *Pedagogics, psychology, medical-biological problems of physical training and sports*.

Maulder, P. S. (2018). *Relationship between maturation, strength, movement competency and motor skill performance in adolescent males*.

Mikolajec, K., Waskiewicz, Z., Maszczyk, A., Bacik, B., & Kurek, P. (2012). Effects of stretching and strength exercises on speed and power abilities in male basketball players. *Isokinetics and Exercise Science*, *20*, 61-69.

Millet, G. P., Jaouen, B., Borrani, F., & Candau, R. (2002). Effects of concurrent endurance and strength training on running economy and VO2 kinetics. *Medicine & Science in Sports & Exercise*, *34*, 1351-1359.

Mohammed, B., Bachir, K., Eddine, S. N., & Adel, B. (2018). Study of LDH adaptations associated with the development of Speed endurance in basketball players U19. *International Journal of Applied Exercise Physiology*, *7*, 35-43.

Mokhtar, M., Adel, B., Wahib, B., Hocine, A., Othman, B., & Mohamed, S. (2019). The effects of tow protocol cold water immersion on the post match recovery and physical performance in well-trained handball players. *Pedagogics, psychology, medical-biological problems of physical training and sports*, *23*, 288-295.

Mukund, K., & Subramaniam, S. (2020). Skeletal muscle : A review of molecular structure and function, in health and disease. *Wiley Interdisciplinary Reviews. Systems Biology and Medicine*, *12*, e1462.

Narici, M. V., Hoppeler, H., Kayser, B., Landoni, L., Claassen, H., Gavardi, C., … Cerretelli, P. (1996). Human quadriceps cross-sectional area, torque and neural activation during 6 months strength training. *Acta physiologica scandinavica*, *157*, 175-186.

Palichuk, Y., Dotsyuk, L., Kyselytsia, O., Moseychuk, Y., Martyniv, O., Yarmak, O., & Galan, Y. (2018). *The influence of means of orienteering on the psychophysiological state of girls aged 15-16-years*.

Paliczka, V. J., Nichols, A. K., & Boreham, C. A. (1987). A multi-stage shuttle run as a predictor of running performance and maximal oxygen uptake in adults. *British Journal of Sports Medicine*, *21*, 163-165.

Petrova, A. (2021). IMPACT OF CROSSFIT EXERCISES ON THE LEVEL OF PHYSICAL PREPAREDNESS OF HIGH SCHOOL-AGE PUPILS. *Slobozhanskyi herald of science and sport*, *9*(2), 109-121.

Petrova, A., & Bala, T. (2020). THE CARDIORESPIRATORY SYSTEM STATE OF THE 10TH-11TH GRADE BOYS AFTER THE INTRO-

DUCTION OF THE VARIABLE MODULE "CROSSFIT". *Slobozhanskyi herald of science and sport*, *8*(3), 20-33.

Pricop, A. D., Pelin, R., Florescu, O., & Mezei, M. D. (2020). Diversification of sports activities in technical higher education by improving sports facilities. *Physical Education, Sport & Kinetotherapy Journal*, *59*(3), 202-215.

Prysiazhniuk, S., Pryimakov, O., Iermakov, S., Oleniev, D., Eider, J., & Mazurok, N. (2021). Influence of weekly physical exercises on indicators of biological age of student's youth. *Physical education of students*, *25*, 58-66.

Reiman, M. P., & Manske, R. C. (2009). *Functional testing in human performance*. Human kinetics.

Rink, J. E., French, K. E., & Tjeerdsma, B. L. (1996). Foundations for the learning and instruction of sport and games. *Journal of teaching in Physical Education*, *15*, 399-417.

Root, H., Marshall, A. N., Thatcher, A., Valier, A. R. S., Valovich McLeod, T. C., & Bay, R. C. (2019). Sport specialization and fitness and functional task performance among youth competitive gymnasts. *Journal of athletic training*, *54*, 1095-1104.

Saddek, B., Coquart, J. B. J., Mourot, L., Adel, B., Idriss, M. M., Ali, B., & Djamel, M. (2020). Comparison of Two Tests to Determine the Maximal Aerobic Speed. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, *60*, 241-251.

Schaun, G. Z., Pinto, S. S., Silva, M. R., Dolinski, D. B., & Alberton, C. L. (2018). Whole-body high-intensity interval training induce similar cardiorespiratory adaptations compared with traditional high-intensity interval training and moderate-intensity continuous training in healthy men. *The Journal of Strength & Conditioning Research*, *32*, 2730-2742.

Seefeldt, V., Malina, R. M., & Clark, M. A. (2002). Factors affecting levels of physical activity in adults. *Sports medicine*, *32*, 143-168.

Segal, N. A., Hein, J., & Basford, J. R. (2004). The effects of Pilates training on flexibility and body composition : An observational study. *Archives of physical medicine and rehabilitation*, *85*, 1977-1981.

Sibley, B. A. (2012). Using sport education to implement a CrossFit unit. *Journal of Physical Education, Recreation & Dance*, *83*, 42-48.

Sibley, B. A., & Etnier, J. L. (2003). The relationship between physical activity and cognition in children : A meta-analysis. *Pediatric exercise science*, *15*, 243-256.

Sobko, I. N., Ulaeva, L. A., & Yakovenko, Y. A. (2016). Factorial structure of physical rehabilitation group students' complex fitness. *Physical education of students*, 32-37.

Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gutin, B., … Pivarnik, J. M. (2005). Evidence based physical activity for school-age youth. *The Journal of pediatrics*, *146*, 732-737.

Teplov, S. I. (1982). [Mechanisms of the adaptive and trophic effects of the sympathetic nervous system on brain vessels and tissue]. *Fiziologicheskii zhurnal SSSR imeni I. M. Sechenova*, *68*, 275-283.

Trautner, H. M., Ruble, D. N., Cyphers, L., Kirsten, B., Behrendt, R., & Hartmann, P. (2005). Rigidity and flexibility of gender stereotypes in childhood : Developmental or differential? *Infant and Child Development: An International Journal of Research and Practice*, *14*, 365-381.

Varea, V., Riccetti, A., & Siracusa, M. (2021). The Powerpuff Girls : Making it as early career academics in physical education. *Journal of Gender Studies*, 1-12.

Vlasova, S. (2017). Innovations in the physical education of schoolchildren. *Фізичне виховання, спорт і культура здоров'я у сучасному суспільстві*, 51-56.

Voloshina, L. N., Kondakov, V. L., Tretyakov, A. A., Kopeikina, E. N., Cretu, M., & Potop, V. (2018). Modern strategies for regulating the motor activity of preschool and school age children in the educational space. *Pedagogics, psychology, medical-biological problems of physical training and sports*.

World Medical Association. (2013). World Medical Association Declaration of Helsinki : Ethical principles for medical research involving human subjects. *Jama*, *310*(20), 2191-2194.

Yanci, J., Reina, R., Los Arcos, A., & Cámara, J. (2013). Effects of different contextual interference training programs on straight sprinting and agility performance of primary school students. *Journal of sports science & medicine*, *12*, 601.

Yacine, Z., Othmane, B., Adel, B., Mohamed, S., Aabdelkader, B., & Lalia, C. Functional Movement Screening as a Predictor of Injury in Highly Trained Female's Martial Arts Athletes. *Polish Hyperbaric Research*, *71*(2), 67-74.

Базилевич, Н., & Тонконого, О. (2019). The effect of fitball aerobics on the level of physical fitness and functional state of female students of pedagogical universities. *Вісник Прикарпатського університету. [In Russian]. Серія: Фізична культура*, 3-8.

Primljen: 28. septembar 2021. / Received: September 28, 2021
Prihvaćen: 15. novembar 2021. / Accepted: November 14, 2021

https://doi.org/10.7251/SSH2102151B
Original scientific paper

UDC: 572.51:616.718-007.2-053.4
Originalni naučni rad

Frequency and Structure of Lower Limbs Disorders in Preschool Children

Frekvencija i struktura poremećaja donjih ekstremiteta kod djece predškolskog uzrasta

Senad Bajrić, Velibor Srdić, Osmo Bajrić

Pan-European University Apeiron, Banja Luka, Bosnia and Herzegovina

Correspondence:
Senad Bajrić
Pan-European University Apeiron, Banja Luka, Bosnia and Herzegovina
senad.o.bajric@apeiron-edu.eu

Panevropski Univerzitet "Apeiron", Banja Luka, Bosna i Hercegovina

Korespondencija:
Senad Bajrić
Panevropski Univerzitet "Apeiron", Banja Luka, Bosna i Hercegovina
senad.o.bajric@apeiron-edu.eu

Abstract: *The research was conducted on a sample of 266 respondents of preschool age, aged 4-6 years of both sexes in Preschool Institution "Zvjezdica" Banja Luka. Out of the total number of respondents, the male population consisted of 137 respondents, while female population consisted of 129 respondents. Disorders of the knee joint, X - legs, O - legs and hyperextension of the legs were used to assess the presence of lower extremity deformities.*

The main goal of the research was to determine the actual state of frequency and structure of lower extremity deformities in preschool subjects in relation to gender and age. The frequencies and structure of deformities of the lower extremities are shown in tabular relation to the sex and age of the subjects.

The results of the research indicate a slightly higher frequency of lower extremity deformities in boys compared to girls, and the highest frequency of presence was found in subjects of both sexes aged 4 years, and slightly lower in subjects aged 5 years. It is surprising that the presence of deformities was not determined in subjects of both sexes aged 6 years.

However, these results also oblige us to be careful and constantly and continuously monitor the postural status of children in order to timely identify physical disorders and take adequate activities in preventive and corrective work.

The obtained results should initiate activities in order to timely diagnose, control and undertake effective programs of corrective exercise in preschool children.

Key words: *"X" legs, "O" legs, hyperextension, age, sex.*

Sažetak: *Istraživanje je provedeno na uzorku od 266 ispitanika predškolskog uzrasta, uzrasne dobi 4 – 6 godina oba pola Predškolske ustanove „Zvjezdica" iz Banja Luke. Od ukupnog broja ispitanika mušku populaciju činilo je 137 ispitanika, a žensku populaciju činilo je 129 ispitanika. Za procjenu prisustva deformiteta donjih ekstremiteta uzeti su poremećaji u zglobu koljena, X - noge, O - noge i hiperekstenzija nogu.*

Osnovni cilj istraživanja bio je da se utvrdi stvarno stanje frekvencije i strukture deformiteta donjih ekstremiteta kod ispitanika predškolskog uzrasta u odnosu na pol i uzrasnu dob. Frekvencije i struktura deformiteta donjih ekstremiteta prikazani su tabelarno u odnosu na pol i uzrasnu dob ispitanika.

Rezultati istraživanja ukazuju na nešto veću frekvenciju prisutnosti deformiteta donjih ekstremiteta kod dječaka u odnosu na djevojčice, a najveća frekvencija prisutnosti utvrđena je kod ispitanika oba pola uzrasta 4 godine, a nešto manja kod ispitanika uzrasta 5 godina. Iznenađuje podatak da kod ispitanika oba pola uzrasta 6 godina nije utvrđena prisutnost deformacija.

Međutim, i ovi rezultati nas obavezuju da moramo biti obazrivi i vršiti stalno i kontinuirano praćenje posturalnog statusa djece u cilju pravovremenog prepoznavanja tjelesnih poremećaja i preduzimanju adekvatnih aktivnosti na preventivnom i korektivnom radu.

Dobijeni rezultati treba da pokrenu aktivnosti u cilju pravovremenog dijagnosticiranja, kontrole i preduzimanja efikasnih programa korektivnog vježbanja kod djece predškolskog uzrasta.

Ključne riječi: *„X" noge, „O" noge, hiperekstenzija, uzrasna dob, pol.*

Introduction

Posture is the basic precondition for good health, proper growth and human development in general, which is why it is very important that the education of posture begins at

Uvod

Držanje tijela je osnovni preduslov dobrog zdravlja, pravilnog rasta i uopšte razvitka čovjeka, zbog čega je vrlo bitno da vaspitanje držanja tijela počne u što ranijem

the earliest possible age. Experience to date shows that the characteristics of the environment affect the way of life, and thus the posture of the body, which is later reflected in the life cycle of each individual. The fact is that in the physical education of children there are a number of shortcomings that need to be addressed. If we are looking for the causes of poor posture in the preschool population, then we should certainly look for them first in the family, and then in preschool institutions, because the correct approach and understanding of the importance of physical activity by parents and educators is a prevention for school children and youth. Based on numerous studies by authors in the field of postural disorders and physical deformities in the school population in primary schools (Bogdanović, Z., Koničanin, A., 2009; Bajrić et al. 2011; 2012; Nikšić, 2015; Čolakhodžić et al. 2017), it can be argued with certainty that the number of children with impaired physical status is constantly increasing every year. The professor of physical education has a significant role in detection of deformities in right time, the implementation of corrective treatment, as well as the process of educating proper posture (Bogdanović, 2007).

According to Kosinac (2008; 2011), proper posture creates favorable conditions for the activity of the locomotor system. The muscles that maintain body balance are in normal tone (tension). Their tone is even, which ensures that the muscles are ready to move. However, uneven tone and weakness of certain muscle regions, primarily the muscles of the back, chest and abdomen are the primary causes of disorders in the proper posture of children. Also, weakness of the pelvic girdle muscles and lower extremities can lead to secondary disorders in the upper parts of the body.

The subject of this research is to determine the actual state of the presence of postural disorders of the lower extremities ("X" legs, "O" legs and hyperextension of the legs) in preschool children and their relationship with gender.

Methods

Sample of respondents

The data for this paper are part of the scientific research project "Monitoring the physical and motor development of preschool and young school children in Banja Luka", which was implemented at the Faculty of Sports Sciences of the Pan-European University "Apeiron" in Banja Luka.

The analysis was conducted on a sample of 266 respondents - children of preschool aged 4-6 years ("Zvjezdica", Banja Luka), of which 137 boys and 127 girls. The Volanski method was used to assess the postural status of

uzrasnom dobu. Dosadašnja iskustva govore da karakteristike sredine utiču na način života, pa tako i na držanje tijela, koje se kasnije odražava na životni ciklus svakog pojedinca. Činjenica je da u tjelesnom odgoju djece postoji čitav niz nedostataka koje je potrebno otkloniti. Ako bi tražili uzroke lošeg držanja tijela kod predškolske populacije onda ih zasigurno treba tražiti prvo u porodici, a zatim u predškolskim ustanovama, jer pravilan pristup i shvatanje značaja tjelesne aktivnosti uopšte od strane roditelja i vaspitača, predstavlja preventivu za školsku djecu i omladinu. Na osnovu brojnih istraživanja autora u prostoru posturalnih poremećaja i tjelesnih deformiteta kod školske populacije u osnovnim školama (Bogdanović, Z., Koničanin, A., 2009; Bajrić i sar. 2011; 2012; Nikšić, 2015; Čolakhodžić i sar. 2017), sa sigurnošću se može tvrditi da se broj djece sa narušenim tjelesnim statusom svake godine stalno povećava. Profesor fizičkog vaspitanja ima značajnu ulogu u pravovremenom otkrivanju deformiteta, sprovođenju korektivnog tretmana, kao i procesu vaspitanja pravilnog držanja tijela (Bogdanović, 2007).

Prema Kosincu, (2008; 2011),pravilno držanje tijela stvara povoljne uslove za aktivnost lokomotornog aparata. Mišići koji održavaju ravnotežu tijela nalaze se u normalnom tonusu (napetosti). Njihov tonus je ravnomjeran, a to obezbjeđuje spremnost mišića za kretanje. Međutim, neravnomjernost tonusa i slabost pojedinih mišićnih regija, u prvom redu mišića leđa, grudnog koša i trbuha primarni su uzroci nastanka poremećaja u pravilnom držanju tijela kod djece. Isto tako, slabost mišića karličnog pojasa i donjih ekstremiteta može dovesti do sekundarnih poremećaja u gornjim dijelovima tijela.

Predmet ovog istraživanja jeste utvrđivanje stvarnog stanja prisustva posturalnih poremećaja donjih ekstremiteta („X" noge, „O" noge i hiperekstenzija nogu) kod djece predškolskog uzrasta i njihova povezanost sa pripadnošću polu.

Metod Rada

Uzorak ispitanika

*Podaci za ovaj rad su dio naučnoistraživačkog projekta „*Monitoring fizičkog i motoričkog razvoja djece predškolskog i djece mlađeg školskog uzrasta u gradu Banja Luka*", koji je realizovan na Fakultetu sportskih nauka Panevropskog univerziteta „Apeiron" u Banja Luci. Analiza je sprovedena na uzorku od 266 ispitanika-djece predškolskog uzrasta 4-6 godina (PU „Zvjezdica", Banja Luka), od toga 137 dječaka i 127 djevojčica. Za procjenu posturalnog statusa donjih ekstremiteta kod djece*

the lower extremities in preschool children. According to Volanski, there are three grades: 0, 1, 2.

A score of 0 implies normal postural status (absence of disorder).

Grade 1 implies a smaller deviation from the normal postural status, which essentially implies the functional stage of the disorder where the relaxation of the muscular part of the locomotor system has occurred.

Grade 2 implies a significant deviation from the normal status that corresponds to the structural changes of the locomotor system and falls within the competence of health institutions.

The sample of respondents included 266 respondents from kindergarten "Zvjezdica" from Banja Luka, of which 139 were boys and 127 were girls. The selection of the sample of respondents was conditioned by organizational, economic and personnel possibilities for conducting measurements. All respondents regularly attend physical education classes.

Sample variables

A sample of variables for estimating lower extremity deformities

Disorders in the knee joint, "X" leg, "O" leg and hyperextension of the leg were treated to assess the frequency and magnitude of lower extremity deformities.

1. Genu valgum ("X" - legs) ..... (GEVALG),
2. Genu varum ("O" - legs) ..... (GEVARU),
3. Genu recurvatum (Hyperextension of the legs) ..... (GERECU).

predškolskog uzrasta korišćena je metoda po Volanskom. Po Volanskom postoje tri ocjene: 0, 1, 2.

Ocjena 0 *podrazumijeva normalan posturalni status (odsustvo poremećaja).*

Ocjena 1 *podrazumijeva manje odstupanje od normalnog posturalnog statusa, koje u suštini podrazumijeva funkcionalni stadijum poremećaja gdje je došlo do popuštanje mišićnog dijela lokomotornog aparata.*

Ocjena 2 *podrazumijeva znatno odstupanje od normalnog statusa koji odgovara strukturalnim promjenama lokomotornog aparata i spada u nadležnost zdravstvenih institucija.*

Uzorak ispitanika obuhvatio je 266 ispitanika PU "Zvjezdica" iz Banja Luke od čega je dječaka 139 i djevojčica 127. Izbor uzorka ispitanika bio je uslovljen organizacijskim, ekonomskim i kadrovskim mogućnostima za sprovođenje mjerenja. Svi ispitanici redovno pohađaju nastavu tjelesnog odgoja.

Uzorak varijabli

Uzorak varijabli za procjenu deformiteta donjih ekstremiteta

Za procjenu učestalosti i veličine deformiteta donjih ekstremiteta treirani su poremećaji u zglobu koljena, „X" noge, „O" noge i hiperekstenzija nogu.

Genu valgum („X"- noge).....(GEVALG),
Genu varum („O"- noge).....(GEVARU),
Genu recurvatum (Hiperekstenzija nogu) .....(GERECU).

Data processing methods

Statistical procedures determined the relevant frequencies and the percentage of the presence of certain deformities of the lower extremities according to gender and age.

Lower extremity deformity technique

Determination of the postural status of the lower extremities was performed by observation from the anterior lateral side. Subjects with straight legs and knees and feet touching were recorded as subjects with normal lower extremity status (0).

Metode obrade podataka

Statističkim postupcima utvrđene su relevantne frekvencije i procenat prisutnosti pojedinih deformiteta donjih ekstremiteta prema pripadnosti polu i uzrasnoj dobi.

Tehnika utvrđivanja deformiteta donjih ekstremiteta

Utvrđivanje posturalnog statusa donjih ekstremiteta izvršeno je posmatranjem sa prednje bočne strane. Ispitanici kod kojih su noge prave, a koljena i stopala se dodiruju evidentirani su kao ispitanici sa normalnim statusom donjih ekstremiteta (0).

If the distance in the knee joint was greater than 20 mm, the subjects were recorded as subjects with "O" legs.

If the distance between the heels was greater than 20 mm, such subjects were recorded as subjects with "X" feet.

Hyperextension of the legs is characterized by the so-called. knee extension 10° or more than full extension. When standing still, it is characterized by hypotonic quadriceps femoris - m. quadriceps, stretched biceps femoris - m. biceps femoris (Cooper et al., 2012). The measurement can be performed in open and closed kinetic chains, ie. lying or sitting and standing. In this paper, the determination of hyperextension of the legs was performed in a standing position.

The mark 0 indicates normal postural status - the absence of postural disorders.

Mark 1 indicates a minor deviation from normal postural status.

Mark 2 indicates a larger deviation from normal postural status.

RESULTS AND DISCUSSION

Basic data on the sample of respondents

The sample of respondents included 266 respondents of preschool age of the preschool institution "Zvjezdica" from Banja Luka aged 4 to 6 years who represented the population of preschool children of both sexes. The selection of the sample of respondents was conditioned by organizational, economic and personnel possibilities for conducting measurements.

Table 1 shows the structure of the sample of respondents by age and gender. As can be seen from Table 1, the study included a total of 266 respondents of both sexes. Of the total number of respondents, 137 or 51.5% were male and 129 or 48.5% were female. Therefore, the sample of respondents can be considered representative both in terms of size and in terms of selection.

Table 1. *Data on the sample of respondents by age and gender*

Ako je razmak u zglobu koljena bio veći od 20 mm, ispitanici su evidentirani kao ispitanici sa „O"nogama.

Ako je razmak između peta bio veći od 20 mm, takvi ispitanici su evidentirani kao ispitanici sa „X" nogama.

Hiperekstenziju nogu karakteriše tzv. preopružanje koljena 10° ili više od pune ekstenzije. Pri stajanju na mjestu obilježava ga hipotoniziran četveroglavi mišić natkoljenice – m. quadriceps, istegnut dvoglavi mišić natkoljenice – m. biceps femoris (Cooper i sur., 2012). Mjerenje se može izvoditi u otvorenom i zatvorenom kinetičkom lancu, tj. u ležanju ili sjedu i u stajanju. U ovom radu utvrđivanje hiperekstenzije nogu vršeno je u stojećem stavu.

Oznaka 0 označava normalni posturalni status – odsustvo posturalnih poremećaja.

Oznaka 1označava manje odstupanje od normalnog posturalnog statusa.

Oznaka 2 označava veće odstupanje od normalnog posturalnog statusa.

REZULTATI IDISKUSIJA

Osnovni podaci o uzorku ispitanika

Uzorak ispitanika obuhvatio je 266 ispitanika predškolskog uzrasta predškolske ustanove „Zvjezdica" iz Banja Luke uzrasne dobi od 4 do 6 godina koji su predstavljali populaciju djece predškolskog uzrasta oba pola. Izbor uzorka ispitanika bio je uslovljen organizacijskim, ekonomskim i kadrovskim mogućnostima za sprovođenje mjerenja.

U tabeli 1 prikazana je struktura uzorka ispitanika po uzrasnoj dobi i prema pripadnosti polu. Kao što se vidi iz tabele 1 istraživanjem je obuhvaćeno ukupno 266 ispitanika oba pola. Od ukupnog broja ispitanika, ispitanika muškog pola bilo je 137 ili 51,5%, a ispitanika ženskog pola 129 ili 48,5%. Prema tome uzorak ispitanika se može smatrati reprezentativnim i sa aspekta veličine i sa aspekta načina izbora.

Tabela 1. *Podaci o uzorku ispitanika prema uzrasnom dobu i po pripadnosti polu*

***Age* / Uzrast**	***Male* / Muški**	***Female* / Ženski**	***Total* / Ukupno**
4 years / godine	70	52	122
5 years / godina	48	65	113
6 years / godina	19	12	31
Total / Ukupno	137/51.5%	129/48.5%	266/100%

Table 2 shows the frequency and structure of body deformities of the lower extremities in the entire sample

U tabeli 2 prikazana je frekvencija i struktura tjelesnih deformacija donjih ekstremiteta kod cjelokupnog

of subjects. Analyzing Table 2, which shows the number of postural status and frequency of physical deformities of the lower extremities in preschool children PU "Zvjezdica" from Banja Luka, it can be seen that out of a total of 266 respondents, "X" legs were found in 45 or 16, 9% of respondents, mostly with a small deviation from normal postural status.

Disorder of the "O" leg was found in 26 or 9.8% of respondents, with a smaller deviation, while a larger deviation was not found.

Hyperextension in the knee joint was found in only 7 or 2.6% of subjects with a smaller deviation, while a larger deviation was not recorded. The results indicate that X leg disorder is most present (16.9%, O leg disease is slightly less present (9.8%), and hyperextension disorder is present in the lowest percentage, only 2.6%

Table 2. *Frequency of physical disorders of the lower extremities for the entire sample of subjects (N = 266)*

uzorka ispitanika. Analizirajući tabelu 2 u kojoj je brojčano i procentualno prikazano stanje posturalnog statusa i frekvencija tjelesnih deformacija donjih ekstremiteta kod djece predškolskog uzrasta PU „Zvjezdica" iz Banja Luke može se uočiti da od ukupno 266 ispitanika, „X" noge su utvrđene kod 45 ili 16,9 % ispitanika i to uglavnom sa manjim odstupanjem od normalnog posturalnog statusa.

Poremećaj „O" noge utvrđen je kod 26 ili 9,8 % ispitanika i to manje odstupanje, dok veće odstupanje nije utvrđeno.

Hiperekstenzija u zglobu koljena utvrđena je samo kod 7 ili 2,6 % ispitanika i to manje odstupanje, dok veće odstupanje nije evidentirano. Rezultati ukazuju da je poremećaj X noge najviše prisutna (16,9%, nešto manje je prisutno O noge (9,8%), a u najmanjem procentu je prisutan poremećaj hiperekstenzija nogu, svega 2,6%

Tabela 2. *Frekvencija tjelesnih poremećaja donjih ekstremiteta za cjelokupan uzorak ispitanika (N=266)*

Variable / **Varijable**	***Disorder assessment /*** **Procjena poremećaja**							
	0		***1***		***2***		***Total /*** **Ukupno**	
	No / **broj**	***%***	***No /*** **broj**	***%***	***No /*** **broj**	***%***	***No /*** **broj**	***%***
GEVALG	221	83.1	45	16.9	-	-	266	100
GEVARU	240	90.2	26	9.8	-	-	266	100
GERECU	259	97.4	7	2.6			266	100

Legend: *GEVALG-X legs, GEVARU-O legs, GERECU-hyperextension legs*

Legenda: *GEVALG-X noge, GEVARU-O noge, GERECU-hiperekstenzija nogu*

Table 3 shows the frequency and structure of physical disorders of the lower extremities in the subjects by gender. Analyzing Table 3, which shows numerically and percentage the state of postural status and frequency of physical disorders of the lower extremities in preschool children PU "Zvjezdica" from Banja Luka by gender, it can be seen that all three forms of lower extremity disorders are more present in boys than girls . "X" leg disorder is present in 24 boys or 17.5%, and 21 or 16.3% in girls. O-leg disorder was found in 16 or 11.7% of boys and 10 or 7.8% in girls.

Leg hyperextension was found in 5 or 3.6% of boys and 2 or 1.6% of girls. The identified disorders are related to minor deviations.

U tabeli 3 prikazana je frekvencija i struktura tjelesnih poremećaja donjih ekstremiteta kod ispitanika prema polu. Analizirajući tabelu 3 u kojoj je brojčano i procentualno prikazano stanje posturalnog statusa i frekvencija tjelesnih poremećaja donjih ekstremiteta kod djece predškolskog uzrasta PU „Zvjezdica" iz Banja Luke prema polu može se uočiti da su sva tri oblika poremećaja donjih ekstremiteta prisutniji kod dječaka u odnosu na djevojčice. Poremećaj „X" noge je prisutno kod 24 dječaka ili 17,5%, a 21 ili 16,3% kod djevojčica. Poremećaj" O" noge je utvrđen kod 16 ili 11,7% dječaka i 10 ili 7,8% kod djevojčica.

Hiperekstenzija nogu utvrđena je kod 5 ili 3,6% kod dječaka i 2 ili 1,6% kod djevojčica. Utvrđeni poremećaji se odnose na manje odstupanje.

Table 3. *Frequency of lower extremity physical disorders by sex of respondents (M = 137; F = 129)*

Tabela 3. *Frekvencija tjelesnih poremećaja donjih ekstremiteta prema polu ispitanika (M=137; Ž=129)*

Var	*Sex* / Pol	*Disorder assessment* / Procjena poremećaja							
		0		*1*		*2*		*Total* / ukupno	
		No / broj	*%*	*No* / broj	*%*	*No* / broj	*%*	*No* / broj	*%*
GEVALG	*M* / M	113	82.5	24	17.5	-	-	137	100
	F / Ž	108	83.7	21	16.3	-	-	129	100
GEVARU	*M* / M	121	88.3	16	11.7	-	-	137	100
	F / Ž	119	92.2	10	7.8	-	-	129	100
GERECU	*M* / M	132	96.4	5	3.6	-	-	137	100
	F / Ž	127	98.4	2	1.6	-	-	129	100

Legend: *GEVALG-X legs, GEVARU-O legs, GERECU-hyperextension legs*

Legenda: *GEVALG-X noge, GEVARU-O noge, GERECU-hiperekstenzija nogu*

Table 4 shows the frequency and structure of lower extremity deformities for a sample of boys according to age. The table shows the presence of lower extremity deformities especially for the 4-year-old, especially for the 5-year-old , and especially for the 6-year-old.

The presence of deformity of the lower extremities showed a certain specificity in relation to age. Thus, in the sample of subjects aged 4 years, it can be seen that X legs were found in 21 boys, and in the age of 5 years only 3 boys. O legs were found in 16 boys over 4 years of age, and no presence was found in five-year-olds and six-year-olds. The presence of hyperextension was not determined. Characteristically, the presence of lower extremity deformities was not determined in six-year-olds.

U tabeli 4 prikazana je frekvencija i struktura deformacija donjih ekstremiteta za uzorak dječaka prema uzrasnoj dobi. Iz priložene tabele može se vidjeti prisutnost deformiteta donjih ekstremiteta posebno za uzorak uzrasne dobi od 4 godine, posebno za uzorak uzrasne dobi od 5 godina i posebno za uzorak uzrasne dobi od 6 godine.

Prisutnost deformacije donjih ekstremiteta pokazalo je određenu specifičnost u odnosu na uzrasnu dob. Tako se kod uzorka ispitanika uzrasta 4 godine može se vidjeti da su X noge utvrđene kod 21 dječaka, a kod uzrasta 5 godina svega 3 dječaka. O noge su utvrđene kod 16 dječaka urasta 4 godine, a kod petogodišnjaka i šestogodišnjaka nije utvrđena prisutnost. Nije utvrđena prisutnost hiperekstenzije. Karakteristično je da prisutnost deformiteta donjih ekstremiteta nije utvrđena kod šestogodišnjaka.

Table 4. *Frequency of lower extremity physical disorders for a sample of boys in relation to age*

Tabela 4. *Frekvencija tjelesnih poremećaja donjih ekstremiteta za uzorak dječaka u odnosu na uzrasnu dob*

Variable / Varijable		*4 years* / uzrast 4 godine			*5 years* / uzrast 5 godina			*6 years* / uzrast 6 godina			*Total* / Ukupno
		0	*1*	*2*	*0*	*1*	*2*	*0*	*1*	*2*	
GEVALG	*Frequency* / frekvencija	49	21	-	45	3	-	19	-	-	137
	% / procenat	70.0	30.0	-	93.8	6.3		100	-	-	100
GEVARU	*Frequency* / frekvencija	54	16	-	48	-	-	19	-	-	137
	% / procenat	77.1	22.9	-	100	-	-	100	-	-	100
GERECU	*Frequency* / frekvencija	65	5	-	48	-	-	19	-	-	137
	% / procenat	92.9	7.1	-	100	100	-	100	-	-	100

Legend: *GEVALG-X legs, GEVARU-O legs, GERECU-hyperextension legs*

Legenda: GEVALG-X *noge, GEVARU-O noge, GERECU-hiperekstenzija nogu*

Table 5 shows the frequency and structure of lower extremity deformities for a sample of girls by age. The table shows the presence of lower extremity deformities especially for the 4-year-old, especially for the 5-year-old, and especially for the 6-year-old.

The presence of deformity of the lower extremities showed a certain specificity in relation to age. Thus, in girls aged 4 years, it can be seen that X legs were found in 18 girls, and in children aged 5 years only 3 girls.

O legs were found in 10 girls aged 4 years, and in girls aged 5 and 6 years no presence was found.

Hyperextension of the legs was found in one 4-year-old girl and one 5-year-old girl. The presence of lower extremity deformities in girls has not been established.

Table 5. *Frequency of lower extremity physical disorders for the sample of girls in relation to age*

U tabeli 5 prikazana je frekvencija i struktura deformacija donjih ekstremiteta za uzorak djevojčica prema uzrasnoj dobi. Iz priložene tabele može se vidjeti prisutnost deformiteta donjih ekstremiteta posebno za uzorak uzrasne dobi od 4 godine, posebno za uzorak uzrasne dobi od 5 godina i posebno za uzorak uzrasne dobi od 6 godine.

Prisutnost deformacije donjih ekstremiteta pokazalo je određenu specifičnost u odnosu na uzrasnu dob. Tako se kod djevojčica uzrasta 4 godine može se vidjeti da su X noge utvrđene kod 18 djevojčica, a kod uzrasta 5 godina svega 3 djevojčice.

O noge su utvrđene kod 10 djevojčica urasta 4 godine, a kod djevojčica uzrasta 5 i 6 godina nije utvrđena prisutnost.

Hiperekstenzij nogu utvrđena je kod jedne djevojčice od 4 godine i jedne djevojčice od godina. Prisutnost deformiteta donjih ekstremiteta kod djevojčica nije utvrđena.

Tabela 5. *Frekvencija tjelesnih poremećaja donjih ekstremiteta za uzorak djevojčica u odnosu na uzrasnu dob*

Variable / Varijable		4 years / uzrast 4 godine			5 years / uzrast 5 godina			6 years / uzrast 6 godina			Total / Ukupno
		0	1	2	0	1	2	0	1	2	
GEVARU	Frequency / frekvencija	34	18	-	62	3	-	12	-	-	137
	% / procenat	65.4	34.6	-	95.4	4.6		100	-	-	100
GEVALG	Frequency / frekvencija	42	10	-	65	-	-	12	-	-	137
	% / procenat	80.8	19.2	-	100	-	-	100	-	-	100
GERECU	Frequency / frekvencija	51	1	-	64	1	-	12	-	-	137
	% / procenat	98.1	1.9	-	98.5	1.5	-	100	-	-	100

Legend: *GEVALG-X legs, GEVARU-O legs, GERECU-hyperextension legs*

Legenda: *GEVALG-X noge, GEVARU-O noge, GERECU-hiperekstenzija nogu*

Based on the results shown in Tables 4 and 5, which show the frequencies of lower extremity deformities, it can be concluded that the presence of lower extremity deformities is most common in boys and girls aged 4 years, slightly less in five-year-olds and five-year-olds and no presence of deformities was determined in six-year-olds.

Discussion

Proper posture in children is of great importance for the proper growth and development of children. Posture is influenced by endogenous factors that cannot be influenced and exogenous factors that can be influenced, including physical activity, environment, habits, family environment, playing video games on TV, computer ...). The period of growth and development of children from

Na osnovu rezultata prikazanih u tabelama 4 i 5 u kojima su prikazane frekevencije deformiteta donjih ekstremiteta moguće je konstatovati da je prisutnost deformiteta donjih ekstremiteta najviše zastupljena kod dječaka i djevojčica od 4 godine, nešto manje kod petogodišnjaka I petogodišnjakinja, a kod ispitanika od 6 godina nije utvrđena prisutnost deformiteta.

Diskusija

Pravilno držanje tijela kod djece ima veliki značaj za pravilan rast i razvoj djece. Na držanje tijela utiču endogeni faktori na koje nije moguće uticati i egzogeni faktori na koje je moguće uticati u koje spadaju, fizička aktivnost, okruženje, navike, porodični ambijent, igice na tv, kompjuteru ....). Period rasta i razvoja djece od rođenja pa do polaska u školu je izuzetno važan, jer u

birth to school is extremely important, because at this age there are two so-called. critical period of development. The first critical period is the age of the first year of life and the second critical period is from the 6th to the 7th year. Getting children up too early has a negative effect on the lower extremities, creating changes in the knee joint and pelvic joint, especially in children who have a congenital predisposition to some damage (Kosinac, 2008; 2011).

It is at this age that the identification of postural disorders in children is extremely important, because of the early formation and adoption of a "proper posture pattern" is essential and if it is formed in early childhood it will not only contribute to proper growth and development, but will later have a positive impact on their health and quality of life.

Insight into the results of the research shows that in our sample, boys had a slightly higher overall frequency of lower extremity disorders in the knee area (X legs, O legs, hyperextension of the legs) compared to girls.

The highest frequency of postural disorders was found in subjects of both sexes aged 4 years, and slightly lower in subjects aged 5 years. A comparative analysis of the incidence of the disorder by age between boys and girls also indicates that the incidence of the disorder is slightly higher in boys aged 4 and 5 years.

It is surprising that the presence of deformities was not determined in subjects of both sexes aged 6 years. The probable reason for this data is in a small number of respondents of both sexes (boys 19 and girls 12).

The obtained results are a little surprising, because the opinion that boys are more active in this period of life than girls, in terms of greater participation in games in which physical activity dominates, is not in line with the results of this research.

Having in mind the obtained results of research on the presence of lower extremity disorders in preschool children, prophylaxis of keeping body anomalies is especially important from the earliest age. This implies the creation of favorable conditions for the normal physical development of children and youth with a special emphasis on the critical phases of childhood. Children should be enabled natural and free development with a lot of physical activities, because the basis for the proper status of the locomotor system should be created from the earliest age. Therefore, it is necessary to conduct systematic physical exercise with preschool children, because physical exercise and frequent outings in nature, with various games can significantly ensure quality mobility and functioning of the locomotor system and the body as a whole.

ovom uzrasnom dobu se nalaze dva tzv. kritična perioda razvoja. Prvi kritični period je doba prve godine života i drugi kritični period je od 6. do 7. godine. Prerano ustajanje djece na noge negativno utiče na donje ekstremitete stvarajući promjene u zglobu koljena i karličnom zglobu, posebno kod djece koja imaju urođenu predispoziciju prema nekom oštećenju (Kosinac, 2008; 2011).

Upravo u ovom uzrasnom dobu je od izuzetne važnosti identifikacija posturalnih poremećaja kod djece, zbog toga što je upravo u ovom dobu prijeko potrebno rano formiranje i usvajanje „obrasca pravilnog držanja tijela" i ako se ono formira u ranom djetinjstvu ne samo da će doprinijeti pravilnom rastu i razvoju, nego kasnije će imati pozitivan uticaj na njihovo zdravlje i kvalitet života.

Uvidom u rezultate istraživanja vidljivo je da su kod našeg uzorka ispitanika, dječaci imali nešto veću ukupnu frekvenciju poremećaja donjih ekstremiteta u predjelu koljena (X noge, O noge, hiperekstenzija nogu) u odnosu na djevojčice.

Najveća frekvencija prisutnosti posturalnih poremećaja utvrđena je kod ispitanika oba pola uzrasta 4 godine, a nešto manja kod uzrasta ispitanika 5 godina. Uporedna analiza učestalosti poremećaja prema dobnom uzrastu između dječaka i djevojčica takođe ukazuje da je učestalost poremećaja nešto veća kod dječaka u uzrastu 4 i 5 godina.

Iznenađuje podatak da kod ispitanika oba pola uzrasta 6 godina nije utvrđena prisutnost deformacija. Vjerovatni razlog za ovakav podatak je u malom broju ispitanika oba pola (dječaka 19 i djevojčica 12).

Dobiveni rezultati malo iznenađuju, jer mišljenje da su dječaci aktivniji u ovom životnom periodu od djevojčica, u smislu većeg učešća u igrama u kojima više dominira fiziča aktivnost, nije u skladu sa rezultatima ovog istraživanja.

Imajući u vidu dobivene rezultate istraživanja o prisutnosti poremećaja donjih ekstremiteta kod djece predškolskog uzrasta, profilaksa držanja anomalija tijela je posebno važna od najranijeg uzrasnog doba. To podrazumijeva stvaranje povoljnih uslova za normalan fizički razvoj djece i omladine s posebnim akcentom na kritične faze dječijeg uzrasta. Djeci treba omogućiti prirodan i slobodan razvoj sa dosta fizičkih aktivnosti, jer osnovu za pravilan status lokomotornog aparata treba stvarati od najranijeg uzrasta. Zato je sa djecom predškolskog uzrasta potrebno provoditi sistematsko fizičko vježbanje, jer fizičko vježbanje i česti izlasci u prirodu, uz razne igre moguće je značajno obezbijediti kvalitetnu mobilnost i funkcionisanje lokomotornog aparata i organizma u cjelosti.

Conclusion

The research was conducted on a sample of 266 respondents of preschool age PU "Zvjezdica" from Banja Luka of both sexes with the aim of determining the actual state of frequency and structure of postural disorders of the lower extremities in preschool children of both sexes. The study included 266 children, of which the male population consisted of 137 respondents, and the female population consisted of 129 respondents.

The figures in the obtained results warn that the presence of postural disorders of the lower extremities in the children of the preschool institution "Zvjezdica" from Banja Luka is not good, on the contrary it is bad.

The results impose as the primary task of educators in the preschool institution and the obligation of parents to constantly instruct their children in the correct posture when sitting, standing, walking and physical activities. Also, in order to preserve and improve the health of children, it is necessary to:

- continuous monitoring of the postural status of children with the aim of timely identification (recognition) of the disorder,
- undertaking activities on preventive and corrective work with children of PU "Zvjezdica",
- to conduct systematic physical exercise with the children of PU "Zvjezdica",
- introduction of regular systematic examinations of children during the year,
- Inclusion of preschool children in organized programs of corrective exercise under the supervision of professionals (professor of physical education - kinesiologist).

The obtained results refer exclusively to the treated sample of respondents. The possibility of comparing the results with other research is ungrateful due to the sample of respondents (number and structure), living environment, applied instruments and methods for identifying disorders.

After the research of PU "Zvjezdica", institutions and parents were offered information about the results of the research for each child.

Zaključak

Istraživanje je provedeno na uzorku od 266 ispitanika predškolskog uzrasta PU „Zvjezdica" iz Banja Luke oba pola s ciljem utvrđivanja stvarnog stanja frekvencije i strukture posturalnih poremećaja donjih ekstremiteta kod djece predškolskog uzrasta oba pola. Istraživanjem je obuhvaćeno 266 djece od čega je mušku populaciju činilo 137 ispitanika, a žensku populaciju činilo je 129 ispitanika.

Brojke u dobivenim rezultatima upozoravaju da prisutnost posturalnih poremećaja donjih ekstremiteta kod djece predškolske ustanove „Zvjezdica" iz Banja Luke nije dobro, naprotiv loše.

Rezultati nameću kao primaran zadatak vaspitača u predškolskoj ustanovi i obavezu roditelja da djecu neprekidno upućuju u pravilno držanje tijela pri sjedenju, stajanju, hodanju i fizičkim aktivnostima. Takođe, za očuvanje i unapređenje zdravlja djece neophodno je:

- kontinuirano praćenje posturalnog statusa djece s ciljem pravovremene identifikacije (prepoznavanja) poremećaja,
- preduzimanje aktivnosti na preventivnom i korektivnom radu sa djecom PU „Zvjezdica",
- provoditi sistematsko fizičko vježbanje sa djecom PU „Zvjezdica",
- uvođenje redovnih sistematskih pregleda djece u toku godine,
- uključivanje djece predškolskog uzrasta u organizovane programe korektivnog vježbanja pod nadzorom stručnih lica (profesora fizičkog vaspitanja-kineziologa).

Dobijeni rezultati se odnose isključivo na tretirani uzorak ispitanika. Mogućnost komparacije rezultata sa drugim istraživanjima je nezahvalna iz razloga samog uzorka ispitanika (broja i srukture), ambijenta življenja, primijenjenog instrumentarija i metoda za identifikaciju poremećaja.

Poslije istraživanja PU „Zvjezdica" ustanovama i roditeljima je ponuđena informacija o rezultatima istraživanja za svako dijete.

References

Bajrić, O., Bajrić, S., Lolić, D., Srdić,V., Mandić, P. (2011). Regresiona povezanost nekih pokazatelja narušenog posturalnog statusa i skolioze. *Zbornik radova 15. Međunarodnog naučnog skupa, FIS komunikacije,* str. 249-255. Niš: Fakultet za fizičko vaspitanje i sport.[in Serbian]

Bajrić, O., Lolić, S., Lolić, D., Bašinac, I. (2012). Povezanost nekih morfoloških odlika i deformiteta kičmenog stuba kod učenika osnovne škole. *Zbornik radova 8. Međunarodne konferencije „Menadžment u sportu", str. 32-38*. Beograd: Alfa Univerzitet. [in Serbian]

Bajrić, O., Lolić, V. (2012). Prisustvo deformiteta donjih ekstremiteta kod učenika osnovnoškolskog uzrasta. *Zbornik radova 8. Međunarodne konferencije „Menadžment u sportu"*, str. 182-188. Beograd: Alfa Univerzitet. [in Serbian]

Bajrić, O., Bajrić, S., Vrbanac, D. (2012). Lower-extremity deformities in students of primary school-age, *Sport Science* 5 (2012) 2: 75-78.

Bajrić, O., Bajrić, S., Jovanović, M. (2013). Kanoničke relacije nekih morfoloških odlika i deformiteta donjih ekstremiteta kod učenika starijih razreda osnovne škole. *Zbornik rezimea VI. Međunarodne interdisciplinirane naučno-stručne konferencije „Vaspotno-obrazovni i sportski horizonti",* str. 63. Subotica. [in Serbian]

Bajrić, O., Mikić, B., Jovanović, M. (2014). Analiza posturalnog statusa stopala žena različite životne dobi. *Zbornik radova 1. Međunarodne naučne konferencije „Sport, zdravlje, okolina".* Beograd: Fakultet sporta „Union Nikola Tesla". [in Serbian]

Bajrić, S., Bajrić, O. (2020). *Korektivna gimnastika*. Banja Luka: Panevropski Univerzitet „Apeiron". [in Serbian]

Bajrić, O., Srdić, V., Bajrić, S., Vukajlović,V. (2021). Monitoring fizičkog i motoričkog razvoja djece pre4dškolskog i mlađeg školskog uzrasta u gradu Banja Luka. Monografija. Banja Luka: Panevropski Univerzitet „Apeiron". [in Serbian]

Bogdanović, Z. (2007). Uloga nastavnika na formiranju pravilnog držanja tijela. *Sport mont* br. 12,13,14,/ V, Podgorica, str. 694-703. [in Serbian]

Bogdanović, Z., Milenković, S. (2008). Uticaj programiranog vežbanja korektivne gimnastike na morfološki i posturalni prostor devojčica osnovnoškolskog uzrasta. *Zbornik radova sa 4. Međunarodne konferencije „Menadžment u sportu"* str. 123 - 131, Beograd. [in Serbian]

Bogdanović, Z., Aćimović, D., Špirtović, O. (2009). Prisustvo deformiteta „X" i „O" nogu u zavisnosti od deformiteta stopala. *Zbornik radova sa 5. Međunarodne konferencije „Menadžment u sportu"* str. 101 - 109, Beograd. [in Serbian]

Bogdanović, Z., Koničanin, A. (2009). Prisustvo deformiteta donjih ekstremiteta u zavisnosti od pripadnosti polu. *Zbornik naučnih i stručnih radova,* str.101-105.Tuzla: Fakultet za tjelesni odgoj i sport. [in Serbian]

Hadžikadunić, M., Balta, S. (2010). *Korekcija držanja tijela kod djece predškolskog uzrasta.* Diplomski rad, Sarajevo: Fakultet sporta i tjelesnog odgoja Univerziteta u Sarajevu. [in Serbian]

Čolakhodžić, E., Vuk, N., Habul, Ć., Vujica, S., Tanović, S. (2017). *Pretilost i posturalni status djece osnovnoškolskog uzrasta u Gradu Mostaru*. Mostar: Nastavnički fakultet Univerziteta „Džemal Bijedić" u Mostaru. [in Croatian]

Jovović, V. (2010). Frekvencija i struktura sagitalnih poremećaja kičmenog stuba kod učenika adoloscenata. *Sport Mont*, br. 23-24/VIII, str.98-103. Podgorica: Crnogorska sportska akademija. [in Serbian]

Kosinac, Z. (2008). *Kineziterapija sustava za kretanje*. Sveučilište u Splitu. Udruga za šport i rekreaciju djece i mladeži grada Splita. [in Croatian]

Kosinac, Z. (2011). *Morfološko-motorički i funkcionalni razvoj djece uzrasne dobi 5. do 11. godine.* Sveučilište u Splitu. Split. [in Croatian]

Lolić, S., Bajrić, O., Lolić, V. (2012). Prisustvo deformiteta donjih ekstremiteta kod učenika osnovnoškolskog uzrasta. *Zbornik radova 8.Međunarodne konferencije „Manadžment u sportu",* str. 182-188. Beograd: Alfa Univerzitet. [in Serbian]

Lovrić, A. (2015). Metodički postupci korekcije držanja tijela kod učenika nižih razreda osnovne škole. Master rad. Edukacijski fakultet Univerziteta u Travniku. [in Serbian]

Nikšić, E., Rašidagić, F., Beganović, E., Nemeth, Z. (2015). Examination of the differences in the representation of deformities of individual body parts in initial and final measuring. *Sport Science* 12 (2019) Suppl 1: 36-45.

Obradović, B., Milošević, Z. (2008). *Postularni status dece novosadskih predškolskih ustanova uzrasta 6 godina,* Glasnik Antropološkog društva Srbije, br. 45, str. 375 – 383. [in Serbian]

Paušić, J. (2005). *Procjene promjene tjelesnog držanja u djece životne dobi od sedam do devet godina.* Magistarski rad. Kineziološki fakultet Sveučilišta u Zagrebu, Zagreb. [in Croatian]

Primljen: 04. jun 2021. / Received: June 04, 2021
Prihvaćen: 14. decembar 2021. / Accepted: December 14, 2021

https://doi.org/10.7251/SSH2102161E
UDC: 796.035:613.72/.73
Original scientific paper
Originalni naučni rad

Improvement of Repeated Sprint Ability for a male amateur football team through the Cometti concatenations method

Francesca D'Elia[1], Giovanni Esposito[1], Sara Aliberti[1], Tiziana D'Isanto[2], Gaetano Raiola[2]
[1]Department of Human, Philosophical and Education Sciences, University of Salerno, Fisciano, Salerno, Italy
[2]Department of Political and Ssocial Studies, University of Salerno, Fisciano, Salerno, Italy

Correspondence:
Sara Aliberti, Department of Human, Philosophical and Education sciences, University of Salerno, Fisciano, Salerno, Italy, s.aliberti17@studenti.unisa.it

Abstract: *This study aimed to examine the improvement of the Repeat Sprints Ability (RSA), during a competitive season in amateur football players (Italian 4th Division, 2019-2020) through the use of the Cometti concatenations method. Twenty (n=20) amateur footballers, participated in this study (age: 23 ± 0.3; height: 184.4±5.5; body weight: 80.92±3.4; training experience: 8 ± 0.3 yrs), without goalkeepers. In the pre-season (4 weeks, from July to August), the players performed Capanna test, to evaluate the RSA before the start of the season. Every player has been analysed with a K-GPS Live device 50Hz (K-Sport Universal STATS, Italy). After 12 weeks of training (in-season), based on specific workouts of Cometti method, the same players repeated Capanna test to check performance improvements and verify whether the training programme is effective. After 12 weeks of training, the difference between the first trial (pre-season) and the second one (in-season) is statistically significant ($p<0.05$). The results obtained, suggested that the strength work was optimized as well as work times, and the RSA was improved. In addition, thanks to better physical shape, which resulted in better performances of individual players, the team in the last period of the championship achieved more positive results in the matches played.*
Keywords: *Sprint Performance, Physical Preparation, Capanna Test, Aerobic Evaluatio.*

Introduction

The training of repeated sprint ability in football is well documented, since the performance of the competition is characterized not only by intermittent efforts often carried out at high intensity, but also by the presence of accelerations and decelerations that are determined in the frequent changes of direction and sense. The latter made by the players to determine useful disturbances to the game's economy. For RSA (Repeated Sprint Ability) is meant the ability to repeat sprint with reduced decrease of performance (Barbero-Álvarez et al., 2010). It is considered the ability to produce the best average performance over a series of short sprints (≤ 10 seconds), separated by short recovery periods (≤ 60 seconds), with a minimum decrease in maximum performance (Bravo et al., 2008; Castagna et al., 2020). Some benefits of RSA include improved VO2 max, maximum aerobic speed and improved distance on the football specific yo-yo intermittent recovery test (YYIRT). A recent meta-analysis indicated that a repeated sprint training (RST) is useful for improving high intensity intermittent running and sprint performance (Martin et al., 2018; Faude et al., 2012). These training modes usually include continuous aerobic training, aerobic interval training, or explosive leg training (Izzo et al., 2020). The scientific literature in relation to the conditional preparation of the player, has produced descriptive training studies in various forms, reporting extremely interesting results for the training practice. In addition, the game analysis (time-motion analysis) has shown that the presence of attack and counterattack actions, supported by high intensity phases produced without interruption, are increasingly frequent and decisive for the outcome of the matches (Alptekin et al., 2013; Carling et al., 2012). In the topic relating to the RSA, two implementation arguments are distinguished, that of production and maintenance, which are characterized by continuity of exercise and recovery between exercises. Specifically, we talk about maintenance RSA, when the work and recovery ratio is less than 1: 5; while it refers to production RSA, when the ratio is equal or higher (> 1: 5). The experimentation both on the field and in the laboratory, has identified in the production mode the most effective method for the physiological development of the player's anaerobic capacity. In football, therefore, aerobic capacity is an essential skill, and the RSA methodology plays a decisive role, as it not only promotes metabolic improvement, but also neuromuscular development (Calandro et al., 2020; D'Isanto et al., 2019). The player must improve the same

muscle groups as the sprinter and add the football training to the ball which consists of a throw of the free leg. In the case of football, and especially during the competitive season, it is necessary to improve maximum strength with caution; it is therefore necessary to create combinations that match pre-fatigue and isometry. Cometti concatenations method is a widely used method in football for strengthening the lower limbs (Spencer et al., 2011). This method of work is based on the combination of the various contraction regimes (eccentric, concentric, plyometric, isometric, and gesture-specific work). These contractions, in this case, may not even be analyzed separately. According to Cometti, the concatenations make it possible to couple situations very close to the competition needs with strength exercises, with the aim of transferring the new muscular stresses into the technical gesture, working on technical and conditional aspects (Cometti et al., 2001). The same author suggests several examples of concatenations carried out with general and specific exercises and even gesture-specific exercises. This working principle can be applied during the training session by alternating series of different contraction regimes or performing repetitions with different contractions within the same series (Raiola, 2017). Concatenations are therefore combined exercises to work both on technical aspects and on conditional aspects which, if well designed, allow to optimize the work of force and optimize the working times. It is certainly a very particular exercise methodology, as indeed all strength exercises with or without overloads, but above all, it must be proposed to athletes suitable to withstand such loads (Impellizzeri et al., 2007). To improve the synchronization of the drive units, it is necessary to work with heavy loads close to the maximum, indeed higher than the maximum, as in the case of eccentric work. The ability to repeat the sprint (RSA), can be evaluated through various types of field tests. However, the main field tests are the Capanna - Sassi test and the 5x30m test. The Capanna-Sassi test consists of repeating a 20 + 20-meter shuttle line sprint 6 times, with a change of direction after 20m and a recovery of 20 seconds between one sprint and the next. In a recent study, all players in a Scandinavian National League were tested with both the Yo-Yo Intermittent recovery Test level 1 (Yo-Yo IR1) and with the RSA 7x30m 30 "recovery test (Intermittent Endurance and Repeated Sprint Ability in Soccer Players). The study showed that intermittent high intensity endurance and the ability to repeat sprints should be considered semi-independent physical abilities. The group that achieved the highest Yo-Yo IR1 test values showed a decrease in the lowest RSA test. In addition, the group with the lowest results on the Yo-Yo IR1 test had the fastest decreases on the RSA test. In fact, a good strategy could be to train these two physical skills with two different and specific protocols. The purpose of this study is to verify whether a training mesocycle based on the Cometti concatenations method, carried out for twelve weeks, produces a significant improvement of the RSA.

Methods

Subjects

Twenty (n=20) amateur football players participated in this study (age: 23 ± 0.3; height: 184.4±5.5; body weight: 80.92±3.4; training experience: 8 ± 0.3 yrs) without goalkeepers. All athletes are free from musculoskeletal injuries, participated in ≥ 95% of training sessions per year. All athletes are amateur players by Italian football championship. To be included in the study, subjects had to 1) ensure regular participation in all the training sessions, 2) have competed regularly during the previous competitive season, and 3) possess medical clearance. Before entering the study, participants were fully informed about the study aims and procedures, and they provided written informed consent before the testing procedure. The study protocol was conformed to the code of Ethics of the World Medical Association (Declaration of Helsinki). The football team trained for approximately 1h three times per week (always on Monday, Wednesday, and Friday) plus the official match played on Saturday or Sunday. The study was conducted during the 2019–2020 competitive season (i.e., from July to October). Before and after 12 weeks, each player completed Capanna test on the same grass surface.

Design

Each participant had the following evaluation. In the pre-season, after anthropometric measurements, all 20 players underwent the Capanna field test. This test is one of the most popular in football for investigating the lactic acid characteristics of players. The test consists in repeating a shuttle sprint of 20 + 20 m six times, with a change of direction after the first 20 m and recovery of 20 seconds between one sprint and the next. The test is preceded by a 15-minute warm-up and a single maximum sprint that provides a reference data (criterion). It allows to measure

the travel times of each individual sprint using a stopwatch connected to a system of photocells. From the data it was then obtained the time of the best test expressed in seconds (RSAbest), the average time related to all the tests (RSAmean) and the decrease in performance percentage (RSAdec) obtained from the ratio between the average time related to all the tests (RSAmean) and the best time of the test (RSAbest). The tests carried out followed the original test protocols present in the literature. Multiple athletes cannot be tested simultaneously. After that, specific workouts based on the Cometti concatenations method were carried out over a period of twelve weeks. These workouts after a general activation of about 25 minutes with the ball, initially involved a shuttle run performed at maximum speed on 4 sections of 20 meters each. Three sets were performed with a four-minute recovery time between them. The second exercise consisted of running pace at an active recovery for a 30-meter stretch. Running pace at active recovery speed is approximately 65% of Maximum Aerobic Speed; for a mid-level player (with a VAM of 17 km / h) it is a question of covering 30 meters in about 10 seconds. Also, in this case, the same series number of the previous exercise were provided, with a similar recovery time between one series and another. The third exercise involved the execution of five to six semi-squat jumps for each of the four series, with a load equal to 30-35% of the maximum load. The fall could be performed in two ways: either by keeping the legs straight (without causing stiffening of the muscles of the lower limbs), with minimal angular variations (approximately 170 ° of the knee angle in the cushioning-inversion of movement) and short contact; or where the position of departure and arrival on the ground must always take place with the lower limbs in a semi-short stance (90-110 ° knee angle). With this exercise, the extensor muscles of the foot are stressed more. Finally, the final part of the session was dedicated to shooting on goal. Each player had six shots available to be executed at maximum executive power, compatible with the request to direct the ball at a specific target. In this case the distance of the shot was variable and at the discretion of the coach. Some variants included a series of sprints with stop and instant change of direction (20m + 10m + 20m), or even the execution of a narrow slalom with the ball, at maximum speed, on a 15 m stretch with the cones spaced 1.5 m apart, or 4 repetitions of ½ squats performed with a load relative to 70% of the maximum, which allowed a maximum of 11 repetition maximum (RM). After 12 weeks of training based on specific workouts based on the Cometti concatenations method (in season), the same players repeat Capanna test to check performance improvements and verify whether the training programme is correct. The first element was to determine whether the improvement in distance covered during a test is better, the same, or worse with respect to the pre-season.

Statistical analysis

Quantitative variables are presented using their mean and standard deviation and qualitative variables with their absolute frequencies and percentages. Furthermore, the normality of the distributions with the Shapiro Wilk test was determined, a dependent sample t-test was conducted to combine the results obtained from the tests before the start of the specific training mesocycle, and at the end of it, after twelve weeks. The analyses were performed with 95% confidence interval and $p \leq 0.05$. Statistical analysis were performed with SPSS Statistics version 23.

Results

The RSA results of the six shuttles of the Capanna test administered on entry and divided by role are shown in Table 1.

Table 1. *The results obtained in the first Capanna test (pre-season)*

Players	RSA_{best}	RSA_{mean}	RSA_{dec}	RSA_{change}	RSA_1	RSA_2	RSA_3	RSA_4	RSA_5	RSA_6
Defenders	7.27	7.73	6.20%	10.90%	7.32	7.50	7.60	7.83	7.93	8.12
Midfielders	7.29	7.69	5.40%	9.00%	7.35	7.49	7.58	7.87	7.94	8.03
Strikers	7.18	7.65	6.60%	11.90%	7.21	7.39	7.58	7.75	7.91	8.09
Mean	7.24	7.69	6.00%	10.60%	7.29	7.46	7.58	7.78	7.92	8.08
SD	±0.05	±0.04	±0.01	±0.01	±0.07	±0.06	±0.01	±0.06	±0.01	±0.04

Note: RSAchange $= (RSA_{last} - RSA_{first} / RSA_{first}) \times 100$; **RSAmean** $= (RSA_1 + RSA_2 + RSA_3 + RSA_4 + RSA_5 + RSA_6)/6$; **RSAdec** $= [(RSA_{total} / RSA_{best} \times 6) \times 100] - 100$

The RSA results of the six shuttles of the Capanna test administered on exit and divided by role are shown in Table 2.

Table 2. *The results obtained in Capanna test (in-season)*

Players	RSA_{best}	RSA_{mean}	RSA_{dec}	RSA_{change}	RSA_1	RSA_2	RSA_3	RSA_4	RSA_5	RSA_6
Defenders	7.24	7.58	4.60%	8.60%	7.27	7.38	7.52	7.64	7.77	7.91
Midfielders	7.11	7.55	4.70%	8.00%	7.24	7.36	7.50	7.63	7.73	7.85
Strikers	7.12	7.51	5.30%	9.40%	7.17	7.28	7.45	7.58	7.72	7.85
Average	7.19	7.54	5.00%	8.70%	7.22	7.34	7.49	7.61	7.74	7.87
SD	±0.07	**±0.03**	**±0.03**	**±0.07**	**±0.05**	**±0.05**	**±0.03**	**±0.03**	**±0.02**	**±0.03**

Note: ***RSAchange***$= (RSA_{last} - RSA_{first} / RSA_{first}) \times 100$; **RSAmean**$= (RSA_1 + RSA_2 + RSA_3 + RSA_4 + RSA_5 + RSA_6)/6$; **RSAdec** $= [(RSA_{total} / RSA_{best} \times 6) \times 100] - 100$

The improvements found between RSA time values between entry and exit test divided by role are shown in Table 3.

Table 3. *The improvement found, in terms of duration, in the execution of the two tests.*

Players	RSA_{best}	RSA_{mean}	RSA_1	RSA_2	RSA_3	RSA_4	RSA_5	RSA_6
Defenders	0.03	0.15	0.05	0.12	0.08	0.19	0.16	0.21
Midfielders	0.08	0.13	0.11	0.13	0.08	0.14	0.21	0.18
Strikers	0.06	0.14	0.04	0.11	0.13	0.17	0.19	0.24
Average	0.05	0.15	0.07	0.12	0.09	0.17	0.18	0.21
SD	**±0.02**	**±0.01**	**±0.03**	**±0.01**	**±0.02**	**±0.02**	**±0.02**	**±0.03**

A significant difference found between RSA values before and after a specific training mesocycle is shown in Table 4.

Table 4. *Dependent sample t-test results* (RSA_{best})

	N	Mean	SD	SE	t	p
Pre-season	20	7.69	004	0.46	8.54	0.00
In-season	20	7.54	0.03	0.45		

The total difference between RSA on entry and exit of the Capanna test without division by role is shown in Figure 1.

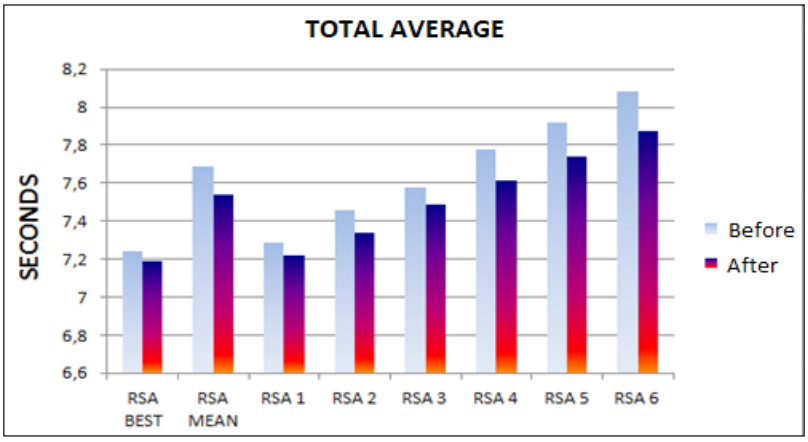


Figure 1. *Results of Capanna Test pre-season and in-season*

Discussion

From the results, the hypothesis of the study regarding the effectiveness of the Cometti method can be confirmed, as it effectively allows to improve the Repeated Sprint Ability by positively influencing motor performance. By observing the results of the group of players, it is possible to understand how to obtain a correct execution of the most important technical gestures, it is necessary to enable the players to respond to the multiple requests that constantly occur in the game. As shown in the tables, the data obtained by the players was grouped by position (7 defenders, 8 midfielders, 5 forwards). The results of these studies demonstrate the possibility of practically applying this operational monitoring tool presented as valid for the individual evaluation of players, since it has a real and significant impact on the result of the game. This study offers itself as a further contribution to strengthen the methodology presented since it produces greater effects than the training process to which the survey group was subjected. Different studies have highlighted repeated-sprint ability as important physical fitness components for soccer players (Rosch et al., 2000; Campa et al., 2019; Izzo et al., 2020). Moreover, similar studies (Helgerud et al., 2001; Rampinini et al.,2009), reported improved soccer performance, assessed by the number of sprints and the number of involvements with the ball, after the implementation of an 8-week aerobic power training program. As regards the use of the Cometti concatenations method, several authors believe that if well designed, it allows to optimize the working time for competitive athletes, often engaged in long and daily physical training sessions. In many cases, it also allows to vary the monotony of the exercises and to insert valid metabolic tasks that create the fatigue necessary to optimize individual recovery qualities (Ali, 2011; Altavilla et al., 2017). It must be said, however, that this form of training certainly does not contribute to refining the tactical and mental aspects, which are decisive for the leap in football quality, but it can well combine two secondary elements that support the player: conditional qualities and the specific gestures (Buchheit et al., 2010; Padulo et al., 2017). For the athlete not motivated to repeat the same training methods every day, it is preferable, however, to suggest other training solutions, more engaging and with adequate psycho-physical commitment (Wragg et al., 2000). Regarding the cognitive aspect, this work acquires a special meaning because it is the essence of a sports game (Chamari et al., 2005; Izzo et al., 2020). The ability to adapt a learned behaviour quickly and effectively can only be acquired when the player is subjected from the beginning, and up to the high-performance phase, to a systematic development of his mental abilities (Helgerud et al., 2001). These are considered, more than in the past, as the fundamental and essential skills for good performance. Obviously, there is not just one training method that can be recommended to best improve RSA and all the factors believed to be responsible for performance decrements during repeated sprint tasks. This is not surprising, as RSA is a complex fitness component that depends on both metabolic and neural factors, among others (Buchheit et al., 2010; Dellal et al., 2013). Regarding practical applicability, as many studies to date have used amateur players, we consider that future research will have to recruit highly skilled team sports athletes and be extended to sport-specific test contexts with, in parallel, a high level of standardization and reliability of measures.

Conclusion

The results obtained suggest o the strength work is optimized; the work times have been optimized and the RSA is improved thanks to the feedback obtained through the comparison of the averages of the times obtained during the execution of the tests. In addition, thanks to better physical shape which resulted in better performances of individual players, the team in the last period of the championship achieved more positive results in the matches played.

Announcement
We announce that the authors have equally contributed to this paper.

Conflict of interests
There is no conflict of interests among the authors themselves.

References

Ali, A. (2011). Measuring soccer skill performance: a review. Scandinavian journal of medicine & science in sports, 21(2), 170–183. https://doi.org/10.1111/j.1600-0838.2010.01256.x

Alptekin, A., Kilic, O., & Marvis, M. (2013).The effect of an 8-week plyometric training program on sprint and jumping performance. Serbian Journal of Sports Sciences, 7(2), 45-50.

Altavilla, G., Riela, L., Tore, A. D., & Raiola, G. (2017). The Physical Effort Required from Professional Football Players in Different Playing Positions. Journal of physical education and sport, 17, 2007-2012.

Barbero-Alvarez, J. C., Coutts, A., Granda, J., Barbero-Alvarez, V., & Castagna, C. (2010). The validity and reliability of a global positioning satellite system device to assess speed and repeated sprint ability (RSA) in athletes. Journal of science and medicine in sport, 13(2), 232–235. https://doi.org/10.1016/j.jsams.2009.02.005

Ferrari Bravo, D., Impellizzeri, F. M., Rampinini, E., Castagna, C., Bishop, D., & Wisloff, U. (2008). Sprint vs. interval training in football. International journal of sports medicine, 29(8), 668–674. https://doi.org/10.1055/s-2007-989371

Buchheit, M., Mendez-villanueva, A., Simpson, B. M., & Bourdon, P. C. (2010). Repeated-sprint sequences during youth soccer matches. *International Journal of Sports Medicine*, 31(10), 709–716. https://doi.org/10.1055/s-0030-1261897

Buchheit, M., Mendez-Villanueva, A., Delhomel, G., Brughelli, M., & Ahmaidi, S. (2010). Improving repeated sprint ability in young elite soccer players: repeated shuttle sprints vs. explosive strength training. *Journal of Strength and Conditioning Research*, 24(10), 2715–2722.

Calandro, A., Esposito, G., & Altavilla, G. (2020). Intermittent training and improvement of anthropometric parameters and aerobic capacity in youth football. *Journal of Human Sport & Exercise*, 15(3), 656-663.

Campa, F., Semprini, G., Júdice, P. B., Messina, G., & Toselli, S. (2019). Anthropometry, Physical and Movement Features, and Repeated-sprint Ability in Soccer Players. *International Journal of Sports Medicine*, 40(2), 100–109. https://doi.org/10.1055/a-0781-2473

Carling, C., Le Gall, F., & Dupont, G. (2012). Analysis of repeated high-intensity running performance in professional soccer. *Journal of Sports Sciences*, 30(4), 325–336. https://doi.org/10.1080/02640414.2011.652655

Chamari, K., Hachana, Y., Kaouech, F., Jeddi, R., Moussa-Chamari, I., & Wisløff, U. (2005). Endurance training and testing with the ball in young elite soccer players. British journal of sports medicine, 39(1), 24–28. https://doi.org/10.1136/bjsm.2003.009985

Cometti, G., Maffiuletti, N. A., Pousson, M., Chatard, J. C., & Maffulli, N. (2001). Isokinetic strength and anaerobic power of elite, subelite and amateur French soccer players. International journal of sports medicine, 22(1), 45–51. https://doi.org/10.1055/s-2001-11331

Dellal, A., & Wong, d. (2013). Repeated sprint and change-of-direction abilities in soccer players: effects of age group. Journal of strength and conditioning research, 27(9), 2504–2508. https://doi.org/10.1519/JSC.0b013e31827f540c

D'Isanto, T., D' Elia, F., Raiola, G., & Altavilla, G. (2019). Assessment of sport performance: Theoretical aspects and practical indications. Sport Mont, 17(1), 79-82.

Faude, O., Koch, T., & Meyer, T. (2012). Straight sprinting is the most frequent action in goal situations in professional football. Journal of sports sciences, 30(7), 625–631. https://doi.org/10.1080/02640414.2012.665940

Helgerud, J., Engen, L. C., Wisloff, U., & Hoff, J. (2001). Aerobic endurance training improves soccer performance. Medicine and science in sports and exercise, 33(11), 1925–1931. https://doi.org/10.1097/00005768-200111000-00019

Ferrari Bravo, D., Impellizzeri, F. M., Rampinini, E., Castagna, C., Bishop, D., & Wisloff, U. (2008). Sprint vs. interval training in football. International journal of sports medicine, 29(8), 668–674. https://doi.org/10.1055/s-2007-989371

Izzo, R., Raiola, G., D'Isanto, T., Cejudo, A., & Giovanelli, G.M. (2020). Modelling an adequate profile for a more targeted work methodology, with dedicated technologies, for elite-level footballers: Comparison between sub 17 vs sub 19, highlights and shadows. Sport Science, 13(1), 36-42.

Izzo, R., Altavilla, G., Cejudo, A., Raiola, G., D'Isanto, T., & Giovannelli, M. (2020). Performance improvement in yo-yo intermittent recovery test Level 2 and during official matches: The role of speed endurance training production in Élite football players. Sport Mont, 18 (3), 61-66.

Izzo, R., D'Isanto, T., Raiola, G., Cejudo, A., Ponsano, N., & Varde'i, C.H. (2020). The role of fatigue in football matches, performance model analysis and evaluation during quarters using live global positioning system technology at 50hz. Sport Science, 13 (1), 30-35.

Martin, V., Sanchez-Sanchez, J., Ramírez-Campillo, R., Nakamura, F. Y., & Gonzalo-Skok, O. (2018). Validity of the RSA-RANDOM Test for Young Soccer Players. International journal of sports medicine, 39(11), 813–821. https://doi.org/10.1055/a-0637-2094

Padulo, J., Attene, G., Ardigò, L. P., Bragazzi, N. L., Maffulli, N., Zagatto, A. M., & Dello Iacono, A. (2017). Can a Repeated Sprint Ability Test Help Clear a Previously Injured Soccer Player for Fully Functional Return to Activity? A Pilot Study. Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine, 27(4), 361–368. https://doi.org/10.1097/JSM.0000000000000368

Raiola, G. (2017). Motor learning and teaching method. Journal of Physical Education and Sport, 17, 2239-2243.

Rampinini E, Sassi A, Morelli A, Mazzoni S, Fanchini M, Coutts AJ. Repeated-sprint ability in professional and amateur soccer players. Applied Physiology, Nutrition, and Metabolism. 2009; 34(6); 1048-1054.

Rösch, D., Hodgson, R., Peterson, T. L., Graf-Baumann, T., Junge, A., Chomiak, J., & Dvorak, J. (2000). Assessment and evaluation of football performance. The American journal of sports medicine, 28(5 Suppl), S29–S39. https://doi.org/10.1177/28.suppl_5.s-29

Spencer, M., Pyne, D., Santisteban, J., & Mujika, I. (2011). Fitness determinants of repeated-sprint ability in highly trained youth football players. International journal of sports physiology and performance, 6(4), 497–508. https://doi.org/10.1123/ijspp.6.4.497

Wragg, C. B., Maxwell, N. S., & Doust, J. H. (2000). Evaluation of the reliability and validity of a soccer-specific field test of repeated sprint ability. European journal of applied physiology, 83(1), 77–83. https://doi.org/10.1007/s004210000246

Primljen: 02. juli 2021. / Received: July 02, 2021
Prihvaćen: 06. oktobar 2021. / Accepted: October 06, 2021

https://doi.org/10.7251/SSH2102167M
UDC: 796.921:338.48(438)
Original scientific paper
Originalni naučni rad

Skiing Tourist Activity in Polish Forests

Anna K. Mazurek-Kusiak
University of Life Sciences in Lublin, Department of Tourism and Recreation, Poland

Correspondence:
Anna Mazurek, University of Life Sciences in Lublin, Department of Tourism and Recreation, Poland, anna.mazurek@up.lublin.pl

Abstract: *The aim of the research was to determine the frequency, motifs and barriers to practicing the hiking ski tourism in Polish forests. Recreational activity in this respect was analyzed in terms of the occupational status of Poles. The research used an original questionnaire carried out among 900 Poles practicing hiking ski tourism, among which 859 respondents were taken into account in statistical calculations after verification. Physically working Poles and freelancers most often use hiking ski tourism in Polish forests. The most important motives for practicing this activity are: contact with nature, clean air, taking care of physical condition, relaxation and taking care of mental health. The largest barriers are: expensive ski equipment, lack of snow, lack of free time, few ski trails, unfavorable weather conditions, short daylight, large distance to the trail, insufficient infrastructure on the forest ski trails and lack of organized forms of hiking ski tourism.* ***Tourist*** *routes and trails are an important place for skiing tourism for Poles due to the proper microclimate, clean air and contact with nature.*

Keywords: *skiing, Poles, forest environment, recreation, sport.*

Introduction

Hiker skiing is not a typical model of spending the free time by Poles, and winter sports are still largely a niche in Poland (Berbeka 2016). This is mainly due to the fact that Poland, despite being one of the lowland countries with an average height of 169 m a.s.l., the winter season is too short (Nowacki, Kasperczak 2001). The snow cover necessary for snow skiing lasts on average only for about 2-3 months a year, although in recent years, it lasts much shorter (Nowicki, Kasperczak 2001). Snow cover has similar thickness both in the forest and outside, but it stays in the forest 1-2 weeks longer. This is one of the reasons why skiers prefer forest areas for this type of recreation (Mandziuk, Janeczko 2009). Skiing is important for both hardening and comprehensive motor development (Milleer 1991; Stróżecki 1991; Mandziuk, Janeczko 2009). It also increases the fitness and physical condition, as it promotes the development of fitness not only of the lower, but also of the upper body (Mruk-Tomaczak 2014). Working with poles and skis means that the skier uses a "four-legged" walk, which rhythmically engages the muscles of the whole body (Dorocki 2016). In addition, this tourism has a beneficial effect on the brain, as it improves its efficiency, promotes the formation of new cells and increases cognitive abilities at any age (Brain 2010). In addition, specific microclimate of the forest makes skiers improve their oxygen supply to the lungs and a soothing effect on the decrease in mental tension (Mazurek-Kusiak, Soroka 2021). The clean forest air promotes good condition of the respiratory system (Netherer, Schopf 2010). Being in the natural forest environment stimulates the immune system, which in turn causes better functioning of the nervous system (Rolfe, Windle 2015; Mazurek-Kusiak 2018). Immunity to all kinds of infections increases along with the resistance to depression (Brian 2010). Therefore, ski tourism in forests is the healthiest and most recommended form of winter physical activity (Dudek 2016) and has a positive effect on the human body (Klimek 2010). In addition, practicing the ski tourism in the forests makes it possible to explore interesting natural, cultural and historical regions and corners, and communing with nature provides many aesthetic experiences related to the beauty of a winter landscape (Sadowski 2003).

Ski tourism is an optimal form of leisure time management in the winter, and its development is influenced by the number and quality of elements of the tourist base, efficient communication, extensive tourist information and access to appropriate ski equipment (Gilbert, Hudson 2000).

The aim of the research was to determine the frequency, motives and barriers of practicing the hiker skiing tourism in Polish forests. It is important knowledge in order to create optimal conditions for practicing ski tourism,

improve tourist infrastructure in forests and promote skiing activity. Recreational activity in the above regard was analyzed in terms of the professional status of Poles.

Purpose, material and research methods

The research used a proprietary survey, which was conducted among 900 Poles practicing hiker skiing, of which 859 was used for statistical calculations. The form consisted of two blocks of questions—the first concerned the frequency, reasons, and barriers to activity skiing tourism. The second was the questions enabling the characteristics of the respondents (sex, profession, age, type of place of residence). A five-point Likert scale was used to measure attitudes (where 1 = low importance for consumer and 5 = high importance for consumer). The survey questionnaire is presented in Table 1.

Table 1. *Questionnaire for skiing tourist*

You are kindly requested to fill in this questionnaire, which serves the purpose of researching the development of the ski tourism in Poland. It is anonymous and serves only scientific purposes. We are grateful for honest and precise completion of the form.

1. How often do you go skiing in forests?
   - □ I don't use it
   - □ very rarely
   - □ rarely
   - □ often
   - □ very often
2. Who do you do ski tourism with?
   - □ family
   - □ work colleagues
   - □ friends
   - □ club members
   - □ alone
3. Your motives for activity skiing: 1 – not important 5 – very important

Specification	Grade				
	1	2	3	4	5
contact with nature					
caring for mental health					
relaxation					
caring for physical condition					
the beauty of landscapes					
fromstressing					
spending time with your own children					
clean air					

4. Your barriers of activity skiing: 1 – not important 5 – very important

Specification	Grade				
	1	2	3	4	5
lack of organized forms of ski tourism					
too expensive equipment					
time shortage					
too few ski trails					
insufficient infrastructure of ski routes					
unfavourable weather conditions (humidity, wind)					
too short day					
too long distance to the trail					
lack of snow					

5. Your sex
   - □ female
   - □ male
6. Your occupational status
   - □ white collar worker
   - □ manual worker
   - □ own business
   - □ freelancer
   - □ manager/director/president
   - □ student/pupil
7. Your Age
   - □ from 20 to 34 years
   - □ from 35 to 49 years
   - □ from 50 to 65 years
   - □ 65 years or over
8. Your place of residence
   - □ village
   - □ town <20.000
   - □ city =>20.000

Source: *Own study*

At the stage of the sampling procedure, random selection was applied using the stratified sample. The population was divided taking into account the occupational status.

The Statistica 13.1 PL software was used for statistical calculations. In order to determine which variables distinguish six emerging groups, a discriminant function analysis was applied, because it allows to study differences between groups of objects based on a set of selected independent variables (predictors). In addition, it is used in correlation studies, i.e. when causal relationships between variables are not well recognized. The study used a classification function in the form of calculating coefficients that were determined for each group of variables. The chi-square test was also used to present differences in individual groups. Mean differences, in which the probability of randomness was less than 0.05, were considered statistically significant.

Results

Statistically significant differences ($p = 0.0004$) in the frequency of practicing hiker skiing tourism in winter forests occur depending on the professional status of respondents (table 2).

Table 2. *Frequency of lowland ski tourism in the Polish forests depending on occupational status*

Specification	Size test	I don't use it	very rarely	rarely	often	very often
	data in%					
Occupational status	N=859	Chi-square test=50.24062; p=0.0004				
white collar worker	108	4.63	13.89	25.93	18.52	37.04
manual worker	180	2.78	2.78	10.00	20.00	64.44
own business	108	2.78	6.48	16.67	29.63	44.44
freelancer	82	1.22	2.44	13.41	32.93	50.00
manager/director/president	32	0.00	6.25	15.63	37.50	40.63
student/pupil	349	3.15	4.30	17.48	27.79	47.28

Source: *Own study based on the research*

This activity is most often used by skiers (table 2), who are physically working people (64.44% of indications - very often) and people practicing their profession (50.00% of indications - very often). Not much less (44.44%) skiers running their own business very often use the ski recreation in the forests. However, they do not use ski slopes in the woods of skiers who do mental work(4.63%), 3.15% who are pupils and students, 2.78% of each physically employed and self-employed and 1.22% of those doing freelance.

The choices of companions during skiing trips to the forest also differed significantly ($p < 0.0001$; $chi^2 = 100.9054$) due to their professional status (table 3). Most, as much as 59.22% of the mentally employed, use the skiing recreation together with family members and then with friends (32.04%). This professional group goes on a skiing trip to the forest with work colleagues the least rarely (only 0.97%) and alone (1.94%). The situation is similar in the case of people working physically - 56.00% of people go skiing with family, and 29.14% with friends.

This professional group, however, more often chooses their work colleagues (7.43%) for the ski trip to the forest than members of the ski group (2.86%). Entrepreneurs and freelancers usually go skiing with their family members (46.67% and 45.68%, respectively) and with friends (23.81% and 35.80%, respectively). Companions for ski recreation for managers, directors and CEOs are friends (40.63%), family (31.25%) and work colleagues (15.63%). Pupils and students also most often choose the company of friends (57.99%) and family (32.25%).

Table 3. *Who is used for hiking ski tourism in the forests according to occupational status*

Specification	test size	With family	With work colleagues	With friends	With club members	Alone
		data in%				
Occupational status	N=834	Chi-square test=100.9054; p<0.00001				
White collar worker	103	59.22	0.97	32.04	5.83	1.94
Manual worker	175	56.00	7.43	29.14	2.86	4.57
Own business	105	46.67	10.48	23.81	9.52	9.52
Freelancer	81	45.68	7.41	35.80	3.70	7.41
Manager/director/president	32	31.25	15.63	40.63	3.13	9.38
Student/pupil	332	32.25	3.85	57.99	2.96	2.96

Source: *Own study based on the research*

In the following stage, the research concerned the motives for practicing the hiker skiing tourism in Polish forests, taking into account professional status of respondents (table 4). Six of eight motifs entered the model, which are the main focus of respondents. Statistically significant discriminatory differences in the studied groups from the largest to the smallest are: contact with nature ($F = 7.325$; $p < 0.001$), clean air ($F = 5.879$; $p < 0.001$), taking care of physical condition ($F = 4.639$; $p < 0.001$); relaxation ($F = 4.580$; $p < 0.001$), de-stressing ($F = 4.267$; $p = 0.001$), caring for mental health ($F = 3.317$; $p = 0.006$). The model did not qualify for the motives: spending time with your own children ($F = 2.162$; $p = 0.056$) and the beauty of landscapes ($F = 1.463$).

Table 4. *Model of discriminant analysis - motives of hiking ski tourism in Polish forests depending on occupational status*

Factor	Model of discriminant analysis: λWilksa: 0.7507; F(40.3564)=6.0576; p<0.0001		
	λ Wilksa	F	p
Contact with nature	0.784	7.325	<0.001
Caring for mental health	0.766	3.317	0.006
Relaxation	0.772	4.580	<0.001
Caring for physical condition	0.772	4.639	<0.001
The beauty of landscapes	0.757	1.463	0.199
Fromstressing	0.770	4.267	0.001
Spending time with your own children	0.761	2.162	0.056
Clean Air	0.778	5.879	<0.001

Source: *Own study based on the research*

The classification function reached the highest values with the motive: contact with nature, due to which the nervous system regains balance (table 5). This factor is most important for people who are physically employed (3.153) and entrepreneurs running their own business (3.033). Practicing hiker skiing tourism in the forests due to caring

for their physical condition is the most important in the case of mentally working people; the classification function was 2.337. The de-stress motive appeals most to entrepreneurs (1.610) and to independent professionals (1.612). The classification function reached slightly lower level in these two professional groups in the case of the mental health care motive and amounted to 1.438 and 1.417, respectively. While practicing the ski tourism, relaxation is the most important for freelancers (1.207), and clean air for pupils and students (0.654).

Table 5. *Classification function - motives of hiking ski tourism in Polish forests depending on occupational status*

Factor	Classification function					
	A p=0.124	B p=0.211	C p=0.123	D p=0.098	E p=0.039	F p=0.406
Contact with nature	2.760	3.153	3.033	2.866	2.905	2.617
Caring for mental health	1.107	1.361	1.438	1.417	1.700	1.130
Relaxation	1.097	0.798	1.300	1.207	0.955	1.221
Caring for physical condition	2.337	1.640	1.962	2.284	1.956	2.173
The beauty of landscapes	0.884	1.157	1.159	0.978	1.376	1.000
Fromstressing	1.362	1.091	1.610	1.612	1.013	1.350
Spending time with your own children	0.445	0.445	0.418	0.447	0.518	0.674
Clean Air	0.301	0.466	0.603	0.907	0.426	0.654
Constant	-22.609	-21.242	-27.233	-27.986	-25.859	-22.877

Legend: *A – white collar worker; B - manual worker; C - own business; D - freelancer; E - manager/director/president; F - student/pupil*

Source: *Own study based on the research*

Then, tourists were asked about barriers to practicing the hiker skiing tourism in Polish forests (table 6). Nine barriers have entered the model, which respondents pay attention to. Statistically significant effects of individual discriminating factors, from the largest to the smallest are: too expensive equipment necessary for practicing the tourism in question ($F = 10.064$; $p < 0.001$), no snow on most days of the year ($F = 8.842$; $p < 0.001$), lack of respondents' time ($F = 8.471$; $p < 0.001$), too few ski trails ($F = 5.232$; $p < 0.001$), adverse weather conditions (humidity, wind) ($F = 3.887$; $p = 0.015$), too short day ($F = 3.331$; $p = 0.006$), too large distance to the trail ($F = 3.161$; $p = 0.008$), insufficient infrastructure on forest ski trails ($F = 2.826$; $p = 0.015$) and the lack of organized forms of hiker skiing tourism ($F = 2.599$; $p = 0.024$).

Table 6. *Model of discriminant analysis - barriers of hiking ski tourism in Polish forests depending on occupational status*

Factor	Model of discriminant analysis λ Wilksa: 0.7507; F(40.3564)=6.0576; p<0.0001		
	λ Wilksa	F	p
Lack of organized forms of ski tourism	0.693	2.599	0.024
Too expensive equipment	0.724	10.064	<0.001
Time shortage	0.717	8.471	<0.001
Too few ski trails	0.704	5.232	<0.001
Insufficient infrastructure of ski routes	0.694	2.826	0.015
unfavourable weather conditions (humidity, wind)	0.698	3.887	0.002
Too short day	0.696	3.331	0.006
Too long distance to the trail	0.695	3.161	0.008
Lack of snow	0.719	8.842	<0.001

Legend: *A – white collar worker; B - manual worker; C - own business; D - freelancer; E - manager/director/president; F - student/pupil*

Source: *Own study based on the research*

Table 7. *Classification function - barriers of hiking ski tourism in Polish forests depending on occupational status*

Factor	Classification function					
	A p=0.124	B p=0.211	C p=0.123	D p=0.098	E p=0.039	F p=0.406
Lack of organized forms of ski tourism	1.211	1.178	1.131	1.279	1.503	1.177
Too expensive equipment	2.353	2.757	2.715	2.734	2.574	2.334
Time shortage	1.795	1.960	2.237	2.167	1.741	1.701
Too few ski trails	0.106	0.341	0.582	0.564	0.237	0.462
Insufficient infrastructure of ski routes	1.101	0.889	1.060	1.217	1.137	0.865
Unfawourable weather conditions (humidity, wind)	0.381	0.557	0.602	0.726	0.118	0.622
Too short day	1.654	1.697	2.011	1.690	1.626	1.562
Too long distance to the trail	0.762	0.825	0.626	0.769	0.761	0.959
Lack of snow	2.384	1.783	2.395	2.499	2.504	2.146
Constant	0.647	0.762	0.735	0.952	1.145	1.042

Legend: *A – white collar worker; B - manual worker; C - own business; D - freelancer; E - manager/director/president; F - student/pupil*

Source: *Own study based on the research*

In the respondents' opinion (table 7), the biggest barrier to traveling hiker skiing tourism is too expensive equipment, especially for people who are physically working (2.757) and freelancers (2.734). Natural barrier came second, in the form of too few days a year, in which there is adequate snow cover on the ski trails. This barrier was primarily highlighted by: managers, directors and company presidents (2.504) as well as freelancers (2.499), but also entrepreneurs (2.395) and white-collar workers (2.384). In third place, there is barrier of the lack of time, especially among people who run their own business and work freelance. The classification function in this case adopted the values 2.237 and 2.167, respectively. Mostly entrepreneurs complained about the short day in winter (2.011). Another barrier pointed out by the respondents was the lack of organized forms of hiker skiing tourism, which is lacking primarily for persons managing and sitting on the boards of companies (1.503). This professional group also complains about insufficient infrastructure on forest ski trails (classification function 1.137). To a lesser extent, respondents are disturbed by too much distance to the ski trails. This barrier was primarily pointed out by pupils and students (0.959). Unfavorable weather conditions during skiing tourism are mostly complained by freelancers (0.726). The barrier concerning the insufficient number of ski trails in Polish forests came last. Entrepreneurs and freelancers mainly complained about this barrier. The classification function in this case reached low values, respectively: 0.582 and 0.564.

Discussion

The issues of skiing tourism in the forest have so far been rarely addressed by scientists. In Poland, these research were dealt with, among others, by Żemła, Żemła (2006), Mika (2014), Dorocki *et al.* (2014) and Krzesiwo (2015). Wheares among foreign researchers should be mentioned: Flagestad, Hope (2001), Hudson *et al*. (2004), Sánchez *et al.* (2016), Byun, Soo-Cheong (2018). However, conducting research in this direction is an important aspect from the point of view of implementing the sustainable development mechanisms in forests with highly developed tourist function (Dorocki 2014). Hiker skiing in the United States was practiced by 47% people (Cordell, Super 2015), while in Ontario, tourist skiing is the most popular form of recreation (Exall 2009). In Poland, however, the popularity of this form of recreation is low (Nowicki, Kasperczak 2001). Dorocki (2014) draws attention to the low level of physical activity of the Polish society, and skiing has a beneficial effect on the human body, which through the exercise and physical fatigue gets rid of stress and at the same time oxygenates the body with clean air. According to Hibner (2020), the motives for ski tourism are contact with nature, views, mental rest, the need for solitude, the need for physical activity, the need to spend time with loved ones. This is confirmed by the author's research. Also Olszewska (2018) obtained similar test results. Research of Borecki et al 2017 confirms that Polish skiers use tourist routes in forests primarily due to the contact with nature and clean air.

On the other hand, Krzesiwo (2015) draws attention to the fact that the development of ski trails in forests can contribute to additional income for the inhabitants of the surrounding towns. These people can offer catering, accommodation, rental and ski maintenance services. The social aspect of doing this type of recreation is also important, as it strengthens family and friend ties. Analysis of the research results showed that the majority of Poles practice skiing with family members and friends.

Research by Berbeka (2016) and Hudson *et al.* (2004), prove that the most important barriers to the development of skiing are financial barriers and the perception of it as a sport difficult to master and quite dangerous. And Sadowski (2010) draws attention to the lack of suitable ski routes. This is also confirmed by research carried out by the authors of this paper.

Conclusion

Ski trails in forests are an important place for Poles to practice ski tourism because of the appropriate microclimate, clean air and contact with nature. Most often, the users of forest ski trails are physically employed (64.44%) and freelancers (50.00%).The Directorate of State Forests should more widely promote hiker skiing tourism in forests among Polish society, for example by organizing joint family trips or organizing social cross-country skiing. By promoting the forest skiing tourism, areas are being activated where there is no possibility of downhill skiing, which may increase their attractiveness. An important element of this type of recreation is skiing with family members and friends, which strengthens both family and friend ties.

References

Berbeka J. (2016): Znaczenie innowacji w turystyce narciarskiej. *Handel Wewnętrzny* 6: 212-226.

Borecki T., Orzechowski M., Stępień E., Wójcik R. (2017): Przewidywane oddziaływanie zmian klimatu na ekosystemy leśne oraz ich konsekwencje w urządzaniu lasu. *Sylwan* 161 (7): 531−538.

Brian E. L. (2010): The concept of depression as a dysfunction of the immune system. *Current Immunology Reviews* 6(3): 205–212.

Byun J., Soo-Cheong J. (2018): To compare or not to compare?: Comparative appeals in destination advertising of ski resorts. *Journal of Destination Marketing & Management* 10: 143–151.

Cordell H., Super G. (2015): Trends in American Outdoor Recreation, In: Carther W. Line D.J. [eds.] Trends in Outdoor Recreation, Lesiure and Tourism, New York: Cabi Publisjing.

Dorocki S. (2014): Tourist regions as places of development of innovativeness. *Current Issues of Tourism Research* 4: 50–57.

Dorocki S. (2016): Wykorzystanie i stan infrastruktury narciarskiej w gminie Krynica-Zdrój w świetle badań ankietowych. Wyniki badań pilotażowych. *Annales Universitatis Paedagogicae Cracoviensis* 221: 206-217.

Dudek T. (2016): Needs of the local population related to development of forests for recreational purposes: example of south-eastern Poland. *Journal of Forest Science* 62 (1): 35–40.

Exall O.S. (2009): The implications of the greenhouse effect on cross country ski facilities within Ontario. Toronto: *Ministry of Tourism and Recreation Publishing*.

Flagestad A., Hope C.A. (2001): Strategic Success in Winter Sports Destinations: a Sustainable Value Creation Perspective. *Tourism Management* 22: 445–461.

Gilbert D., Hudson S. (2000): Tourism demand constraints: A skiing participation. *Annals of Tourism Research* 27(4): 906-925.

Hibner J. (2020): Wpływ doświadczenia na motywy uprawiania narciarstwa na przykładzie tatrzańskich ośrodków narciarskich. *Prace Geograficzne* 161: 7-40.

Hudson S. Ritchie, B., Timur S. (2004): Measuring Destination Competitiveness: An Empirical Study of Canadian Ski Resorts. *Tourism and Hospitality Planning and Development* 1: 79–94.

Klimek A.T. (2010): Fizjologiczne podstawy wysiłku fizycznego w dyscyplinach wytrzymałościowych ze szczególnym uwzględnieniem narciarstwa biegowego. Studia i Monografie 63: 34-45.

Krzesiwo K. (2015): Rozwój turystyki narciarskiej w świetle idei zrównoważonego rozwoju – stan badań. *Prace Geograficzne* 141: 117–140.

Mandziuk A., Janeczko K. (2009): Turystyczne i rekreacyjne funkcje lasu w aspekcie marketingowym. *Studia i Materiały Centrum Edukacji Przyrodniczo-Leśnej* 11(23): 66-68.

Mazurek-Kusiak A.K. (2018): Charakterystyka popytu na rekreację konną w polskich lasach. *Sylwan* 162 (9): 785-792.

Mazurek-Kusiak A.K., Soroka A. (2021): Motywy i bariery uprawiania orientacji sportowej w środowisku leśnym. Sylwan 165 (2):1 57-164.

Mika, M. (2014): *Założenia i determinanty podtrzymywalności lokalnego rozwoju turystyki*. Kraków: Instytut Geografii i gospodarki Przestrzennej Uniwersytet Jagielloński.

Milleer S. (1991): A relative analysis of downhill and cross-country ski injurie. In: Mote C., Johansor R. [eds.]. *Skiing Trauma and Safety. Eight International Symposium*. Philadelphia, ASTM:133-143.

Mruk-Tomaczak D. (2014): Wybrane formy turystyki i ich związki ze zdrowiem. *Polish Nursing* 1(51):66-71.

Netherer S., Schopf A. (2010): Potential effects of climate change on insect herbivores in European forests – General aspects and the pine processionary moth as specific example. *Forest Ecology and Management* 259: 831−838.

Nowacki M., Kasperczak M. (2001): Stan i perspektywy rozwoju narciarstwa turystycznego w Polsce. In: Krasicki S., Chojnacki K. [eds]: Sporty zimowe u progu XXI wieku oraz tradycje i perspektywy Zakopanego. Kraków. Akademia Wychowania Fizycznego: 253–260.

Olszewska B. (2018): Motywacje osób uprawiających ekstremalne formy sportu i turystyki. *Zeszyty Naukowe Uczelni Vistula* 60(3): 119-132.

Rolfe J., Windle J. (2015): Multifunctional recreation and nouveau heritage values in plantation forests, *Journal of Forest Economics* 21 (3): 131-151.
Sadowski G. (2003): Turystyka narciarska. Kultura Fizyczna 11(12): 17-21.
Sadowski G. (2010): Rekreacyjne biegi narciarskie. Studia i Monografie 63: 229-271.
Sánchez P.L., Daries R.N., Cristóbal F.E. (2016): Economic sustainability and financial situation of the ski resorts on the Catalan Pyrenees. *Intangible Capital* 12(5): 1451–1483.
Stróżecki A. (1991): Narciarstwo zjazdowe czy turystyka narciarska. *Gościniec* 1: 4-5.
Żemła M., Żemła A. (2006): Wpływ czynników lokalizacji na konkurencyjność ośrodka narciarskiego. *Turyzm* 16 (1): 71–83.

Primljen: 27. juli 2021. / Received: July 27, 2021
Prihvaćen: 28. septembar 2021. / Accepted: September 28, 2021

https://doi.org/10.7251/SSH2102175P
Original scientific paper

UDC: 618.728.3:[616-001:796.071.2
Originalni naučni rad

Investigating Reliability and Validity of the Tests of Change of Direction and Reactive Agility in Patients After Knee Surgery

Ispitivanje pouzdanosti i valjanosti testova promjene smjera kretanja i reaktivne agilnosti kod pacijenata nakon operacije koljena

Ivan Perić[1], Barbara Gilić[2,3], Damir Sekulić[2]

[1]Faculty of Dental Medicine and Health, Josip Juraj Strossmayer University of Osijek, Croatia
[2]Faculty of Kinesiology, University of Split, Croatia
[3]Faculty of Kinesiology, University of Zagreb, Croatia

Correspondence:
Ivan Perić, Faculty of Dental Medicine and Health, Josip Juraj Strossmayer University of Osijek, Croatia, iperic@fdmz.hr

[1]Fakultet za dentalnu medicinu i zdravstvo, Sveučilište Josip Juraj Strossmayer u Osijeku, Hrvatska
[2]Kineziološki fakultet, Sveučilište u Splitu, Hrvatska
[3]Kineziološki fakultet, Sveučilište u Zagrebu, Hrvatska

Korespondencija:
Ivan Perić, Fakultet za dentalnu medicinu i zdravstvo, Sveučilište Josip Juraj Strossmayer u Osijeku, Hrvatska, iperic@fdmz.hr

Abstract: *Agility is one of the key performance factors important for prevention of falls. There is a lack of tests applicable for testing agility in untrained, older and clinical populations. The aim of tis research was to investigate the reliability and validity of the newly-designed testing protocol of change of direction speed (CODS) and reactive agility (RAG) in the clinical population. Research comprised 25 individuals older than 40 years of age who underwent knee surgery. Variables included age, gender, anthropometric characteristics, RAG, and CODS tests. Results displayed new tests as being reliable among patients after knee surgery. Also, tests were valid with regard to body mass and age (with better results in younger and lighter participants). Participants achieved similar results in CODS and RAG, with strong correlation between tests, which implies that CODS and RAG represent similar abilities in this population. Future studies should investigate the metric characteristics of here proposed tests in other subsamples.*
Keywords: *motor capacities, change of direction, injury, clinical population, adults.*

Sažetak: *Agilnost je jedna od ključnih sposobnosti važnih za redukciju padova. Međutim, nedostaju testovi koji su primjenjivi za ispitivanje agilnosti kod netrenirane, starije i kliničke populacije. Cilj ovog istraživanja je bio ispitati pouzdanost i valjanost novih testova promjene smjera kretanja (change of direction speed-CODS) i reaktivne agilnosti (RAG) kod kliničke populacije. U istraživanju je sudjelovalo 25 osoba starijih od 40 godina koji su imali operaciju koljena. Varijable su uključivale dob, spol, antropometrijske karakteristike, te rezultate u novim testovima agilnosti. Rezultati su prikazali da su novi testovi agilnosti pouzdani za ispitivanje agilnosti kod pacijenata nakon operacije koljena. Testovi su se prikazali valjanima u smislu diferenciranja ispitanika prema dobi i tjelesnoj težini (mlađi ispitanici i lakši ispitanici su postizali bolje rezultate kod oba testa). Ispitanici su u oba testa postizali podjednake rezultate i rezultati su visoko povezani, što ukazuje da testovi RAG i CODS kod ove populacije predstavljaju slične sposobnosti. Buduća istraživanja bi trebala ispitivati metrijske karakteristike predloženih testova kod drugačijih podskupina ispitanika.*
Ključne riječi: *motoričke sposobnosti, promjena smjera kretanja, ozljede, klinička populacija, odrasli.*

Introduction

Agility in the context of sport is defined as the rapid whole-body movement with a change of direction and speed in response to an external stimulus. There are two basic forms of agility: change of direction and speed (CODS) and reactive agility (RAG) (Sheppard & Young, 2006). In CODS testing protocols, the individual is already acquainted with a particular direction of movement while in RAG the individual is not familiar with the task and

Uvod

Agilnost se u kontekstu sporta definira kao brzi pokret tijela s promjenom smjera i brzine kao odgovor na određeni podražaj. Postoje dva oblika agilnosti: brzina promjene smjera kretanja (CODS) i reaktivna agilnost (RAG) (Sheppard & Young, 2006). Kod CODS pojedinac unaprijed zna u kojem će smjeru trebati promijeniti kretanje, dok kod RAG pojedinac treba promijeniti smjer kretanja kao odgovor na vanjski podražaj koji nije una-

have to react and change the direction of movement in response to an external stimulus (e.g. visual, acustic, the trajectory of the ball, opponents changes of direction during the game). Previous studies have identified various factors affecting agility, testing methods, and agility training (Krolo et al., 2020; Paul, Gabbett, & Nassis, 2016). However, most conducted research has focused on professional athletes rather than the untrained population.

Agility is considered a crucial ability in preventing falls in untrained individuals (Davis, Donaldson, Ashe, & Khan, 2004). Consequently, agility was observed as the ability and potential of a person to rapidly change the motor pattern due to adjusting to the newly formed situation. For instance, changing the walking pattern and movement direction to avoid obstacles such as house furniture or objects on the ground (Miyamoto et al., 2008). Fall injuries are well-known to be in common, especially in the elderly and untrained individuals who are fragile and have impaired musculoskeletal system (Fhon, Rodrigues, Neira, Huayta, & Robazzi, 2016). Therefore, the requisite for conducting agility-related research has been warranted in both untrained and elderly populations (Davis et al., 2004). The authors of this study have previously emphasized the importance of agility in the elderly population and the development of specific tests that will represent real-life situations (Sekulic & Foretic, 2019). There are only a few studies on agility tests in untrained and elderly populations. One of those studies that investigated the reliability and validity of the Ten Step Test in the elderly concluded that the test was reliable and could predict the risk of falling (Miyamoto et al., 2008). Also, the "Agility test for Adults" design and developed for the untrained population were reliable and applicable for agility test assessment (Manderoos et al., 2016). Likewise, a reactive agility test intended for the elderly has present appropriate reliability and constructive validity differentiating groups by age (Sobolewski, Thompson, Conchola, & Ryan, 2018). Regarding agility training, research by Reed-Jones, Dorgo, Hitchings, and Bader (2012) was concluded that agility training with an emphasis on visual training may be beneficial for preventing falls in the untrained elderly population. It is obvious that only several studies have conducted research on agility in the untrained and elderly population. As far as familiar to authors, very few studies have investigated the reliability and validity of tests that are adapted to real-life situations in the untrained clinical population. Therefore, the aim of this study was to assay the reliability and validity of newly constructed agility tests for individuals after knee surgery.

prijed poznat. Brojna istraživanja su identificirala različite faktore koji utječu na agilnost, metode testiranja i treniranja agilnosti (Krolo et al., 2020; Paul, Gabbett, & Nassis, 2016). Međutim, većina istraživanja su se fokusirala na profesionalne sportaše, a ne na netreniranu populaciju.

Agilnost se smatra sposobnošću koja je ključna kod prevencije padova kod netreniranih osoba (Davis, Donaldson, Ashe, & Khan, 2004). U ovom smislu, agilnost je promatrana kao sposobnost brze promjene motoričkog obrasca uslijed promjene situacije. Primjerice, promjena obrasca i smjera hodanja zbog izbjegavanja prepreka kao što su pokućstvo ili predmeti na tlu (Miyamoto et al., 2008). Poznato je da su ozljede uslijed padova česte, posebice kod starijih i netreniranih osoba koje imaju slabiji i manje razvijen mišićno-koštani sustav (Fhon, Rodrigues, Neira, Huayta, & Robazzi, 2016). Stoga, uočila se potreba za istraživanjem agilnosti i kod netrenirane i starije populacije (Davis et al., 2004). Autori ove studije su već prije naglašavali važnost agilnosti kod starije populacije i razvoj specifičnih testova koji će predstavljati stvarne životne situacije (Sekulić & Foretić, 2019).

Postoji nekoliko istraživanja na testovima agilnosti kod netrenirane i starije populacije. Istraživanje u kojem je ispitana pouzdanost i valjanost testa agilnosti (Ten Step Test) kod starijih osoba je zaključilo da je test pouzdan i da može predvidjeti rizik od pada (Miyamoto et al., 2008). Slično, test „Agility test for Adults" namijenjen netreniranoj populaciji se pokazao pouzdanim i primjenjivim za testiranje agilnosti (Manderoos et al., 2016). Isto tako, test neplanirane agilnosti namijenjen starijim osobama je pokazao primjerenu pouzdanost i konstruktnu valjanost između različitih dobnih skupina (Sobolewski, Thompson, Conchola, & Ryan, 2018). Što se tiče treniranja agilnosti, istraživanje od Reed-Jones, Dorgo, Hitchings, and Bader (2012) je zaključilo kako treniranje agilnosti s naglaskom na vizualni trening može biti korisno za preveniranje padova kod netrenirane starije populacije.

Očito je kako se jako malo istraživanja bavilo istraživanjem agilnosti kod netrenirane i starije populacije. Koliko je autorima poznato, jako su rijetka istraživanja ispitivala pouzdanost i valjanost testova koji su prilagođeni uobičajenim životnim situacijama kod netrenirane kliničke populacije. Stoga, cilj ovog istraživanja je bio ispitati pouzdanost i valjanost novokonstruiranih testova agilnosti kod osoba nakon operacije koljena.

Methods

Participants

The study comprised 25 untrained individuals older than 40 years (56.3 ± 18.5 years). Respondents were patients who participated in a rehabilitation program after arthroscopic knee surgery and total knee arthroplasty. Rehabilitation was conducted at the Clinical Medical Center in Osijek, Croatia. The inclusion criteria for respondents was the ability to walk 100 meters and sit up and get up from the seat without knee pain. Participants were informed of the objective, risks, and protocol of the study prior to the start of the study.

Variables

Variables included age, gender, anthropometric characteristics (body height, body mass), CODS, and RAG tests.

Testing of CODS and RAG was performed using original equipment based on ATMEL microcontroller (model AT89C51RE2; ATMEL Corp, San Jose, CA, USA). An infrared sensor (IR) was used as the external measurer, and LED lights were used as controlled outputs. Respondents for the RAG test started from a standing upright position. They had to step out with the preferred foot, after that the IR signal would be intersected which initiated the time measurement and ignition on one of the LED lights located in the cone placed under the seat. The respondents had to perceive which cone was illuminated, walk to a certain seat, sit down, get up, return to the starting line as fast as possible, turn around and repeat the same moving form. When respondents have intersected the IR signal on the fourth return, time stopped. Respondents were not informed of the ignition order, and three different test scenarios were performed (different order of cones illumination). CODS testing protocols were performed on the same polygon, but the respondents were informed in advance of the cones illumination order (Figure 1).

Metode Rada

Ispitanici

Istraživanje je uključivalo 25 netreniranih osoba starijih od 40 godina (56,3 ± 18,5 godina). Ispitanici su bili pacijenti koji su sudjelovali u rehabilitacijskom programu nakon artroskopske operacije koljena i potpune artroplastike koljena. Rehabilitacija se odvijala u Kliničkom medicinskom centru u Osijeku, Hrvatska. Svi ispitanici su trebali biti u stanju prošetati 100 metara te sjesti i podići se sa sjedalice bez boli u koljenu. Sudionici su bili obaviješteni o cilju, rizicima i protokolu ispitivanja prije početka istraživanja.

Varijable

Varijable su uključivale dob, spol, antropometrijske karakteristike (tjelesna visina, tjelesna masa), CODS i RAG testove.

Testiranje CODS i RAG se odvilo koristeći uređaj na osnovi ATMEL mikrokontrolera (model AT89C51RE2; ATMEL Corp, San Jose, CA, SAD). Infracrveni senzor (IR) se koristio kao vanjski vremenski okidač, a LED svjetla su korištena kao kontrolirani izlazi. Ispitanici su za RAG startali iz stajaćeg uspravnog položaja. Trebali su iskoračiti s odabranom nogom nakon čega bi se prešao IR signal što je aktiviralo brojanje vremena i uključilo jedno od LED svjetala koje se nalazilo u čunju postavljenom ispod sjedalice. Ispitanik je trebao uočiti koji se čunj upalio, šetati do određene sjedalice, sjesti, podići se, vratiti se do startne linije što brže moguće, okrenuti se i ponoviti istu kretnu strukturu. Kada su ispitanici prekinuli IR signal na četvrtom povratku natrag, vrijeme se zaustavilo. Ispitanici nisu znali koji će se od čunjeva upaliti, a izvodila su se tri različita scenarija testiranja (različit redoslijed paljenja čunjeva). CODS testiranje se izvodilo na istom poligonu, ali ispitanici su unaprijed znali koji od čunjeva će se upaliti (Slika 1).

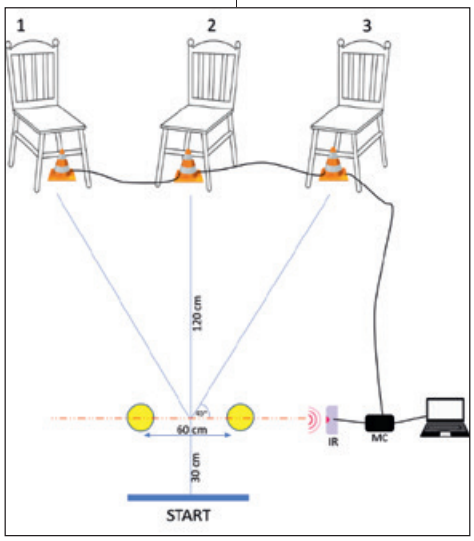


Figure 1. *Tests of change of direction and speed and reactive agility*

Slika 1. *Testovi brzine promjene smjera kretanja i reaktivne agilnosti*

Statistical analysis

The normality of the distribution was assesed by the Kolmogorov-Smirnov test. Arithmetic means and standard deviations for all variables were calculated. This paper presents the reliability within the test (based on three repeated measurements). Reliability is evidenced via Cronbach's alpha (CA) and Inter-item coefficient of correlation (IIR) values. Construct validity was determined by assaying the correlations of agility results with body weight and age of the subjects.

Results

Table 1. *Descriptive statistics and reliability measures*

Variables / Varijable	*MEAN* / AS	SD	Cronbach Alpha	IIR
CODS (s)	24.4	9.7	0.89	0.81
RAG (s)	24.2	10.2	0.88	0.86
Body height / Tjelesna visina (cm)	171.1	11.2		
Body mass / Tjelesna masa (kg)	81.9	13.9		

Legend: *CODS - change of direction and speed, RAG - reactive agility, MEAN - arithmetic mean, SD - standard deviation, IIR - inter-item coefficience of the correlation*

Table 1 represent the results of descriptive statistics and reliability measures. The suggested tests were demonstrated to be highly reliable.

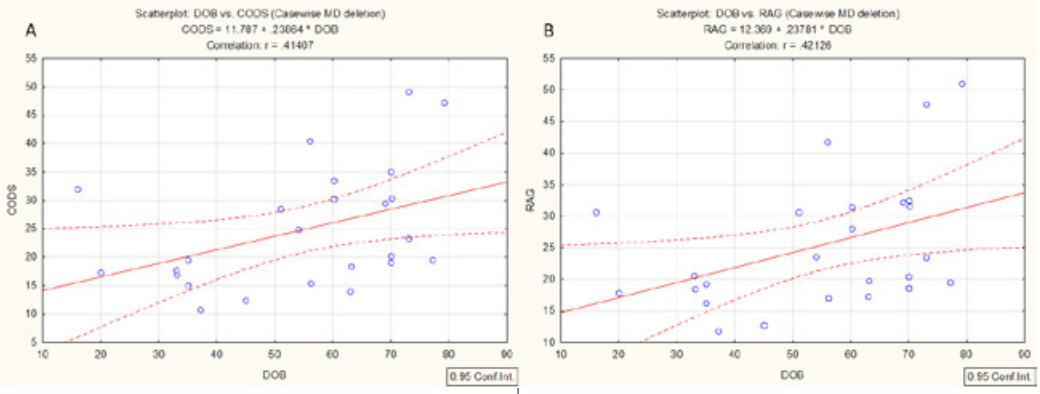


Figure 2. *Correlation of age of participants and results on tests CODS (1A) and RAG (1B)*

Significant age correlations of both CODS and RAG tests were evidenced.

Statistička analiza

Normalitet distribucije je provjeren Kolmogorov-Smirnovljevim testom. Izračunate su aritmetičke sredine i standardne devijacije za sve varijable. U ovom radu je prikazana pouzdanost unutar testiranja (temeljem tri čestice mjerenja). Pouzdanost je prikazana preko vrijednosti Cronbach alpha (CA) i Inter-item reliability (IIR). Konstruktna valjanost je određena ispitivanjem korelacija rezultata agilnosti s tjelesnom težinom i dobni ispitanika.

Rezultati

Tablica 1. *Deskriptivna statistika i mjere pouzdanosti*

Legenda: *CODS – brzina promjene smjera kretanja, RAG – reaktivna agilnost, AS – aritmetička sredina, SD – standardna devijacija, IIR – inter-item reliability*

U Tablici 1 prikazani su rezultati desktiptivne statistike i mjere pouzdanosti. Testovi su se prikazali visoko pouzdanima.

Slika 2. *Korelacija dobi ispitanika i rezultata na testovima CODS (1A) i RAG (1B)*

Zabilježene su značajne korelacije dobi i CODS i RAG testova.

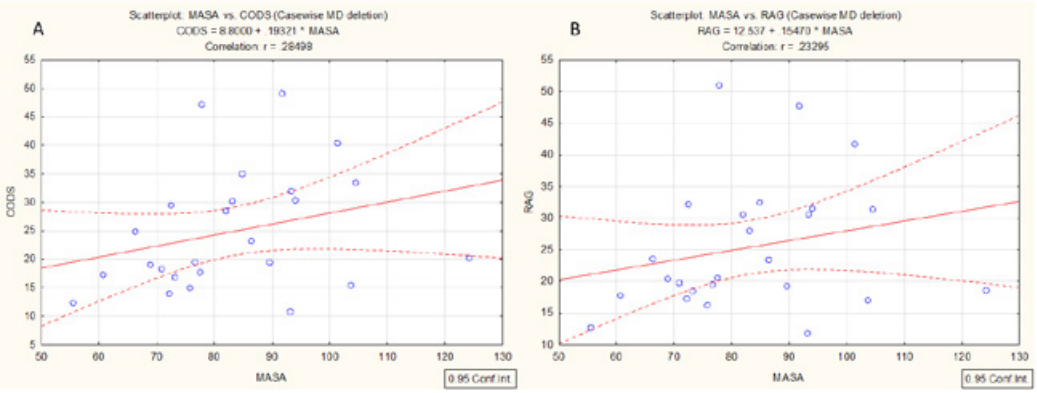


Figure 3. *Correlations of body weight and results on CODS (2A) and RAG (2B) tests*

Slika 3. *Korelacije tjelesne mase i rezultata na testovima CODS (2A) i RAG (2B)*

Significant correlations of body weight and CODS and RAG tests were evidenced

Discussion

There are several main findings of this study. First, newly constructed agility tests (RAG and CODS) have been demonstrated to be reliable in patients after knee surgery. Second, the tests evidenced construct validity with respect to the age and body mass of the participants.

The RAG and CODS tests have been demonstrated to be highly reliable. Surprisingly, both tests had similar reliability, which is not consistent with previous research on athletes where higher reliability of CODS was observed compared to RAG. In brief, research in the scope of football-specific agility tests has reported greater reliability of CODS tests compared to RAG (Krolo et al., 2020), the same conclusions were reported in both basketball and futsal players (Sekulic et al., 2019; Sekulic et al., 2017). The explanation most likely is concealing in the specificity of the used test. Specifically, the newly constructed test consisted of walking rather than maximum running as in studies on athletes. In athletes, RAG requires a rapid ability to make decisions, perceptions, observations, and generally developed cognitive capacities, whereas, in tests with a low rate of movement velocity like walking speed, cognitive capacities are unlikely to be as stimulated. Therefore, since cognitive capacities, which basically most differentiate RAG from CODS abilities, were probably not required, respondents had similar results in both newly constructed tests. More specifically, the results of RAG and CODS tests were highly intercorrelated (90% of the common variability), while the results of the RAG and CODS tests in athletes typically evidence an average of 20% of the common variability (Sekulic et al., 2019). Therefore, it is likely to assume that RAG and CODS represent a similar ability in the studied clinical population.

Zabilježene su značajne korelacije tjelesne mase i CODS i RAG testova.

Rasprava

Nekoliko je glavnih nalaza ove studije. Prvo, novokonstruirani testovi agilnosti (RAG i CODS) su se prikazali pouzdanima kod pacijenata nakon operacije koljena. Drugo, testovi su prikazali konstruktnu valjanost s obzirom na dob i tjelesnu masu ispitanika.

Testovi RAG i CODS su se prikazali kao visoko pouzdani. Neočekivano je što su oba testa imala sličnu pouzdanost, što nije u skladu s prijašnjim istraživanjima na sportašima gdje je zabilježena viša pouzdanost CODS u usporedbi s RAG. Ukratko, istraživanja u području nogomet-specifične agilnosti su zabilježila veću pouzdanost CODS u usporedbi s RAG (Krolo et al., 2020), što je zabilježeno i kod košarkaša i futsal igrača (Sekulic et al., 2019; Sekulic et al., 2017). Objašnjenje najvjerojatnije leži u specifičnosti korištenog testa. Konkretno, novokonstruirani test se sastojao od šetanja, a ne od maksimalnog trčanja kao u istraživanjima na sportašima. Kod sportaša, RAG zahtijeva brzu sposobnost donošenja odluka, percepcije, zapažanja i općenito razvijene kognitivne kapacitete, dok kod testa koji uključuje šetanje vjerojatno kognitivni kapaciteti ne dolaze toliko do izražaja. Stoga, s obzirom da kognitivni kapaciteti, koji u osnovi najviše razlikuju RAG od CODS, vjerojatno nisu bili toliko potrebni, ispitanici su imali slične rezultate kod oba novokonstruirana testa. Detaljnije, rezultati RAG i CODS testova bili su visoko međusobno povezani (90% zajedničkog varijabiliteta), dok rezultati kod RAG i CODS testova kod sportaša uobičajeno prikazuju prosječno 20% zajedničkog varijabiliteta (Sekulic et al., 2019). Stoga, može se pretpostaviti da RAG i CODS predstavljaju sličnu sposobnost kod ispitivane kliničke populacije.

Newly constructed agility tests for the clinical population have been demonstrated to be valid for differentiation by age and body mass. In particular, younger respondents performed better than older participants, while respondents with lower body mass performed better than their participants with higher body mass. These results were expected with regard that numerous studies have evidenced a negative association between age and fitness status (Gladyshev, 2016). The decline of neuromuscular and cognitive capacities that occurs by aging is certainly one of the reasons for this phenomenon (Gladyshev, 2016). Accordant to our results, Japanese research has recorded a deterioration of the agility capacities at the test for respondents older than fifty years of age (Miyamoto et al., 2008). Furthermore, it is established that body composition and body mass affects the motor tasks performance which includes whole-body movements (Nikolaïdis, 2012). A possible explanation seeks in the fact that for respondents with greater body mass is more demanding to move the body in different directions with regard to probably more "ballasts" in total mass (Sillanpä et al., 2009). However, it is requisite for a more detailed analysis of these correlations because the total body mass is consists of fat- and lean-body mass, so the final conclusions can not be presented only from these results.

Conclusion

The newly constructed RAG and CODS testing protocols have been demonstrated to be reliable for testing the agility of the untrained clinical population. Therefore, tests can be used to investigate agility with similar subgroups of respondents in future research, but also in clinical practice. The presented tests were valid in the differentiation of groups by age and body mass, which confirms the applicability of tests in this regard. The study findings are of crucial importance for the untrained and clinical population because agility is one of the most important motor abilities directly related to prevention of falls, and injury-prevention. By designing specific tests, it is possible to accurately determine the capacity of agility, which will consequently provide the knowledge necessary for development of appropriate training and rehabilitation programs. Further research on reliability and applicability for various samples of respondents is warranted.

Acknowledgments:
Authors are particularly grateful to all participants for their participation in the research. The support of the Croatian Science Foundation is gratefully acknowledged (Project No: IP-2018-01-8330).

Novokonstruirani testovi agilnosti za kliničku populaciju su se prikazali valjanima za diferencijaciju po dobi i tjelesnoj težini. Konkretno, mlađi ispitanici su postizali bolje rezultate u odnosu na starije, dok su ispitanici s manjom tjelesnom masom postizali bolje rezultate od težih ispitanika. Ovi rezultati su očekivani s obzirom da su brojna istraživanja zabilježila negativnu povezanost dobi i fitness statusa (Gladyshev, 2016). Razlog se može pronaći u opadanju živčano-mišićnih i kognitivnih sposobnosti sa starenjem (Gladyshev, 2016). U skladu s našim rezultatima, kod Japanskih ispitanika je zabilježeno pogoršanje rezultata kod testa agilnosti nakon pedesete godine života (Miyamoto et al., 2008). Nadalje, poznato je da tjelesna kompozicija i tjelesna masa utječu na izvedbu motoričkih zadataka kod kojih je potrebno pomicati i premještati položaj cijelog tijela (Nikolaïdis, 2012). Moguće objašnjenje leži u činjenici da je težim ispitanicima zahtjevnije brzo pomicati tijelo u različitim smjerovima s obzirom na vjerojatno veći „balast" (Sillanpää et al., 2009). Međutim, trebalo bi detaljnije analizirati ove poveznice jer se masa tijela sastoji od masne i bezmasne mase pa se ne mogu donositi konačni zaključci iz ovih rezultata.

Zaključak

Novokonstruirani testovi RAG i CODS su se prikazali pouzdanima kod ispitivanja agilnosti netrenirane kliničke populacije. Stoga, testovi se mogu koristiti za ispitivanje agilnosti kod sličnih skupina ispitanika u budućim istraživanjima. Testovi su se prikazali valjanima kod diferenciranja dobnih grupa i grupa po tjelesnoj masi što potvrđuje primjenjivost testova u ovom smislu. Ovakva istraživanja su od ključne važnosti kod netrenirane i kliničke populacije jer je agilnost jedna od važnijih sposobnosti odgovornih za redukciju padova i ozljeda. Kreiranjem specifičnih testova se može precizno odrediti stanje agilnosti pomoću čega se mogu kreirati adekvatni trenažni programi. Buduća istraživanja bi se trebala baviti identifikacijom pouzdanosti i primjenjivosti kod različitih uzoraka ispitanika.

Zahvala:
Rad je nastao uz potporu Hrvatske zaklade za znanost (IP-2018-01-8330, DOK-2018-09-1940).

References

Davis, J. C., Donaldson, M. G., Ashe, M. C., & Khan, K. M. (2004). The role of balance and agility training in fall reduction. A comprehensive review. *Eura Medicophys, 40*(3), 211-221.

Fhon, J. R., Rodrigues, R. A., Neira, W. F., Huayta, V. M., & Robazzi, M. L. (2016). Fall and its association with the frailty syndrome in the elderly: systematic review with meta-analysis. *Rev Esc Enferm USP, 50*(6), 1005-1013. doi:10.1590/s0080-623420160000700018

Gladyshev, V. N. (2016). Aging: progressive decline in fitness due to the rising deleteriome adjusted by genetic, environmental, and stochastic processes. *Aging Cell, 15*(4), 594-602. doi:10.1111/acel.12480

Krolo, A., Gilic, B., Foretic, N., Pojskic, H., Hammami, R., Spasic, M., . . . Sekulic, D. (2020). Agility Testing in Youth Football (Soccer) Players; Evaluating Reliability, Validity, and Correlates of Newly Developed Testing Protocols. *Int J Environ Res Public Health, 17*(1). doi:10.3390/ijerph17010294

Manderoos, S. A., Vaara, M. E., Mäki, P. J., Mälkiä, E. A., Aunola, S. K., & Karppi, S.-L. (2016). A New Agility Test for Adults: Its Test–Retest Reliability and Minimal Detectable Change in Untrained Women and Men Aged 28–55. *The Journal of Strength & Conditioning Research, 30*(8), 2226-2234. doi:10.1519/jsc.0000000000001318

Miyamoto, K., Takebayashi, H., Takimoto, K., Miyamoto, S., Morioka, S., & Yagi, F. (2008). A New Simple Performance Test Focused on Agility in Elderly People: The Ten Step Test. *Gerontology, 54*(6), 365-372. doi:10.1159/000146787

Nikolaïdis, P. T. (2012). Physical fitness is inversely related with body mass index and body fat percentage in soccer players aged 16-18 years. *Med Pregl, 65*(11-12), 470-475. doi:10.2298/mpns1212470n

Paul, D. J., Gabbett, T. J., & Nassis, G. P. (2016). Agility in Team Sports: Testing, Training and Factors Affecting Performance. *Sports Med, 46*(3), 421-442. doi:10.1007/s40279-015-0428-2

Reed-Jones, R. J., Dorgo, S., Hitchings, M. K., & Bader, J. O. (2012). Vision and agility training in community dwelling older adults: Incorporating visual training into programs for fall prevention. *Gait & Posture, 35*(4), 585-589. doi:https://doi.org/10.1016/j.gaitpost.2011.11.029

Sekulic, D., & Foretic, N. (2019). *Agilnost i zdravstveni status-Razvoj i validacija specifičnih mjernih protokola.* Paper presented at the Deveta međunarodna konferencija''Sportfiske nauke i zdravlje''ZBORNIK RADOVA. [in Croatian]

Sekulic, D., Foretic, N., Gilic, B., Esco, M. R., Hammami, R., Uljevic, O., . . . Spasic, M. (2019). Importance of Agility Performance in Professional Futsal Players; Reliability and Applicability of Newly Developed Testing Protocols. *Int J Environ Res Public Health, 16*(18). doi:10.3390/ijerph16183246 [in Croatian]

Sekulic, D., Pehar, M., Krolo, A., Spasic, M., Uljevic, O., Calleja-González, J., & Sattler, T. (2017). Evaluation of Basketball-Specific Agility: Applicability of Preplanned and Nonplanned Agility Performances for Differentiating Playing Positions and Playing Levels. *The Journal of Strength & Conditioning Research, 31*(8), 2278-2288. doi:10.1519/jsc.0000000000001646 [in Croatian]

Sheppard, J. M., & Young, W. B. (2006). Agility literature review: classifications, training and testing. *J Sports Sci, 24*(9), 919-932. doi:10.1080/02640410500457109

Sillanpää, E., Laaksonen, D. E., Häkkinen, A., Karavirta, L., Jensen, B., Kraemer, W. J., . . . Häkkinen, K. (2009). Body composition, fitness, and metabolic health during strength and endurance training and their combination in middle-aged and older women. *European Journal of Applied Physiology, 106*(2), 285-296. doi:10.1007/s00421-009-1013-x

Sobolewski, E. J., Thompson, B. J., Conchola, E. C., & Ryan, E. D. (2018). Development and examination of a functional reactive agility test for older adults. *Aging Clinical and Experimental Research, 30*(4), 293-298. doi:10.1007/s40520-017-0785-9

Primljen: 03. jun 2021. / Received: June 03, 2021
Prihvaćen: 24. novembar 2021. / Accepted: November 24, 2021

https://doi.org/10.7251/SSH2102182R
Original scientific paper

UDC: 159.923.5:616.711-009.7-08
Originalni naučni rad

Relationship Betwen the Quality of Life and the Lumbar Syndrome, in Middle-Aged Persons

Povezanost kvaliteta života i lumbalnog sindroma osoba srednje životne dobi

Romana Romanov[1], Milan Nešić[1], Dragan Grujičić[1], Josip Lepeš[2], Slobodan Andrašić[3]

[1]Faculty of Sports and Tourism, Novi Sad, Serbia
[2]University of Novi Sad Hungarian Language Teaching Training Faculty, Subotica, Serbia
[3]Faculty of Economics, Subotica, Serbia

Correspondence:
Dragan Grujučić, Faculty of Sports and Tourism, Novi Sad, Serbia, dragan.grujucic@tims.edu.rs

[1]Fakultet za sport i turizam, Novi Sad, Srbija
[2]Učiteljski fakultet, Subotica, Srbija
[3]Ekonomski fakultet, Subotica, Srbija

Korespondencija:
Dragan Grujičić, Fakultet za sport i turizam, Novi Sad, Srbija, dragan.grujicic@tims.edu.rs

Abstract: *Lumbar syndrome (LS) is very common in the population of middle-aged people, especially those who are physically insufficiently active. LS is characterized by lower back pain, and the frequency of pain is one of the risk factors for the quality of life. The aim of the study is to identify the quality of life in people with LS, in relation to the frequency of pain that occurs. The sample consisted of 202 respondents (93 male and 109 female, the average of 47.5 years of age) which was stratified in 3 subsamples, in relation to the frequency of the back pain. The data was collected by a questionnaire designed for the purposes of this research, PAL questionnaire (Perception of Active Lifestyle, Nešić, 2016), which is intended for self-assessment of the quality of life. Based on Spearman's Rho coefficient, it has been proven that with the more frequent back pain, the quality of life of the respondents' decreases (p=.000). Relatively high values of $\chi 2 = 23.09$ indicated a statistically significant difference in quality of life in people with different frequency of back pain (p=.000). Respondents who had occasional back pain had the highest quality of life, while the respondents with very frequent back pain, had the lowest. In people with a history of lumbar pain, physical activity occupies a very important place, it affects the reduction and the frequency of pain and thus directly on the quality of life of people in this population.*

Keywords: *lumbar syndrome, quality of life, relations, pain, exercise.*

Sažetak: *Lumbalni sindrom (LS) je veoma zastupljen u populaciji osoba srednje životne dobi, posebno onih koji su fizički nedovoljno aktivni. LS karakteriše bol u donjem delu leđa, a učestalost bola je jedan od riziko faktora za kvalitet života. Cilj istraživanja je identifikovanje kvaliteta života kod osoba sa LS, a u odnosu na učestalost bola koja se javlja. Uzorak je činilo 202 ispitanika (93 muškarca i 109 žena, prosečne starosti 47.5 godina) koji je stratifikovan u 3 subuzorka, a u odnosu na učestalost bola u leđima. Podaci su prikupljeni upitnikom koji je dizajniran za potrebe ovog istraživanja, PKŽS upitnik (Percepcija Aktivnog Životnog Stila, Nešić, 2016), a koji je namenjen samoproceni kvaliteta života. Na osnovu Spirmanovog Rho koeficijenta dokazano je da se sa učestalijim bolom u leđima smanjuje kvalitet života ispitanika (p=.000). Relativno visoke vrednosti $\chi^2=23.09$ ukazale su na statistički značajnu razliku u kvalitetu života kod osoba sa različitom učestalošću bolova u leđima (p=.000). Najviši kvalitet života su imali ispitanici koji su imali povremenu bol u leđima, a najniži osobe sa veoma čestim bolom u leđima. Kod osoba sa istorijom lumbalnog bola fizička aktivnost zauzima veoma važno mesto, utiče na smanjenje i učestalost bola, pa time direktno i na kvalitet života osoba ove populacije.*

Ključne riječi: *lumbalni sindrom, kvalitet života, relacije, bol, vežbanje.*

Introduction

Pain in the lumbar spine, lasting more than 12 weeks, is defined as Lumbar Syndrome (LS) (Patrick, Emanski & Knaub, 2014). Pain may be present intermittently or constantly (often recurrent), and the intensity of pain can range from mild to intense. At least one episode of lumbar pain is experienced by as many as 80% of peo-

Uvod

Bol u lumbalnom delu kičme koji traje duže od 12 nedelja, definiše se kao Lumbalni sindrom (LS) (Patrick, Emanski & Knaub, 2014). Bol može biti prisutan povremeno ili konstantno (često se ponavlja), a intenzitet bola se može kretati od slabog do intenzivnog. Najmanje jednu epizodu lumbalnog bola, doživi čak 80% ljudi to-

ple during their lifetime (Nachemson & Jonsson, 2000). A distinction should be made between pain characteristic of LS and nonspecific back pain that may be caused by other pathologies (tumor, osteoporosis, rheumatoid arthritis, fracture...) (Hoy et al., 2010; Chou, 2011).

The cause of LS is usually unknown and is most likely multifactorial (Wallach et al., 2003). The causes of LS can be related to risk factors that include a sedentary behavior (Barone Gibbs et al, 2018), insufficient physical activity, but also more difficult physical work (frequent bending, lifting loads and prolonged static positions). In younger people, the cause of LS is most often related to muscle imbalance, poor flexibility of the muscles and tendons of the hind thigh, structural (degenerative) changes in the spine, as well as inadequate training procedure (dosage, intensity). During growth, muscles and ligaments often do not follow bone growth, which leads to muscle imbalance and lumbar pain. (Purcell, 2009). LS can also occur in people with reduced hip muscle strength (Alsufiany et al., 2020) and reduced physical activity and sitting time longer than 7 hours per day (Park et al, 2018). n middle-aged people, the most common cause is a sitting position at work, during which most time is spent (Senba & Kami, 2017; Citko at al., 2018; Bontrup et al., 2019).

A review study found that psychological factors, anxiety, and depression were associated with pain in LS (Chou, 2011, Bletzer et al, 2016). Also, it was found that in the later stage of diagnosed LS, psychological factors anxiety, depression and mental changes affect the reduction of the quality of social relations (Bair et al, 2008), and thus the quality of life. Factors related to professional activities are also linked to LS, i.e., the transition from acute to chronic condition (Chou, 2011; Dennerlein, 2018). It must be said that the impact of LS on socioeconomic conditions is very significant, because it is a common cause of disability of middle-aged people who should be in active labor. The specific pain reported by people with LS (self-assessment), which leads to limitations in physical functioning, increased from 20.7% to 24.7% since 1997 to 2005 (Alleva et al., 2016). Massive and more frequent LS related illness is a major medical, social and economic problem and leads to huge costs of treatment and rehabilitation. Therefore, the aim of this study is to determine the relationship between pain and quality of life (physiological and psychological health, social relations and environment) in middle-aged people with LS, who reported different frequency of pain.

kom života (Nachemson & Jonsson, 2000). Treba praviti razliku između bola koji karakteriše LS i nespecifičnog bola u leđima koji može biti izazvan drugom patologijim (tumor, osteoporoza, reumatoidni artritis, fraktura...) (Hoy et al., 2010; Chou, 2011).

Uzrok LS je najčešće nepoznat i najverovatnije je multifaktorijalan (Wallach et al., 2003). Uzročnici LS mogu se dovesti u vezu sa faktorima rizika koji uključuju sedentaran način ponašanja (Barone Gibbs et al, 2018), nedovoljnu fizičku aktivnost, ali i teže fizičke poslove (često savijanje, podizanje tereta i dugotrajne statičke pozicije). Kod mlađih osoba uzrok nastanka LS, najčešće je u vezi sa mišićnim disbalansom, slabom gipkošću mišića i tetiva zadnje lože natkolenice, strukturalnim (degenerativnim) promenama na kičmi, kao i neadekvatnim trenažnim postupkom (doziranje, intenzitet). Tokom rasta, mišići i ligamenti često ne prate rast kostiju, što dovodi do mišićnog disbalansa i pojave lumbalnog bola (Purcell, 2009). Lumbalni sindrom se može javiti i kod osoba s smanjenom snagom mišića zgloba kuka (Alsufiany et al., 2020) i smanjenom fizičkom aktivnošću i vremenom sedenja dužim od 7 h na dan (Park et al, 2018). Kod osoba srednje životne dobi najčešći uzročnik je sedeća pozicija na poslu, tokom koje se provodi najviše vremena (Senba & Kami, 2017; Citko at al., 2018; Bontrup et al., 2019).

Preglednom studijom utvrđeno je da su psihološki faktori, zabrinutost i depresija, povezani sa bolom kod LS (Chou, 2011, Bletzer et al, 2016). Takođe, utvrđeno je da u kasnijoj fazi dijagnostifikovanog LS, pshološki faktori: anksioznost, depresija i mentalne promene utiču na smanjenje kvaliteta socijalnih odnosa (Bair et al, 2008), a time i kvaliteta života. Faktori koji su u vezi sa profesionalnim aktivnostima, takođe se dovode u vezu sa LS, odnosno, prelazom iz akutnog u hronično stanje (Chou, 2011; Dennerlein, 2018). Mora se reći da je uticaj LS na društveno-ekonomske prilike veoma značajan, jer je on čest uzročnik invaliditeta osoba srednje starosne dobi koja bi trebala biti radno aktivna. Specifičan bol koji prijavljuju osobe sa LS (samoprocena) i koji dovodi do ograničenja u fizičkom funkcionisanju, povećao se sa 20,7% na 24,7% od 1997. do 2005. godine (Alleva et al., 2016). Masovnije i učestalije oboljevanje od LS predstavlja veliki medicinski, socijalni i ekonomski problem i dovodi do ogromnih troškova lečenja i rehabilitacije. Stoga, cilj ovog istraživanje je da kod osoba srednje životne dobi sa LS koji su prijavili različitu učestalost bola, upravo utvrdi relacije bola i kvaliteta života (telesno i psihološko zdravlje, socijalni odnosi i okruženje).

Method

The study presents an empirical non-experimental research of a transversal character. The study sample consisted of a total of 202 respondents (M = 93; F = 109), the average of 47.5 years of age, who were undergoing physiatric treatment in four cities at the time of the study (Novi Sad, Subotica, Kanjiža and Bačka Palanka). The sample was stratified into 3 subsamples, in relation to the frequency of back pain: intermittent pain (113 respondents or 55.94%), frequent pain (48 respondents or 23.76%) and very frequent pain (41 respondents or 20.30%) and it was a categorical variable in the study. The research data was collected by a questionnaire designed for the purposes of this study. In designing the instrument, items whose construct was based on a modified version of the WHOQOL-BREF questionnaire were used (*World Health Organization Quality of Life Questionnaire – BREF*) (WHOQOL group, 1998) and PAL questionnaire (Perception of Active Lifestyle) (Nešić, 2016), for the self-assessment of the quality of life. The designed questionnaire included 29 items distributed in 5 variables: Physical Health (8 items), Mental Health (7 items), Social Relations (5 items) and Environment (9 items).

The results of the study are presented textually and tabularly. For all examined variables, the frequencies and the percentage value of the results at the level of the entire sample of respondents were calculated. A non-parametric statistical method, the chi-square test, was used to determine differences in life habits (the level of significance $p \leq 0,05$). The relationship between self-assessment of the quality of life and the frequency of the back pain was tested by *Spearman's Rho correlation coefficient*. The collected data was processed in a statistical package SPSS.20 (Statistical Package for the Social Sciences, V.20; SPSS Inc., Chicago, Illinois, USA).

Results

Based on the results of *Spearman's Ro coefficient* and its statistical significance (Table 1), it can be concluded that all four variables for self-assessment of the quality of life satisfaction, Physical Health, Psychological Health, Social Relations and the Environment are in negative statistically significant correlations ($p = 0.00$) with the variable Back Pain. That is, the more frequent the back pain, the worse the satisfaction with the quality of life of the respondents. The greatest negative correlation can be observed in the variable Physical Health (r=-.415). Observing the relations between the variables for the self-assessment of the quality of life satisfaction in respondents with back pain, a positive statistically signif-

Metod

Rad predstavlja empirijsko neeksperimentalno istraživanje, transverzalnog karaktera. Uzorak istraživanja činilo je ukupno 202 ispitanika (M=93; Ž=109), starosti 47.5 godina, koji su u vreme ispitivanja bili pod fizijatrijskim tretmanom u četiri grada (Novi Sad, Subotica, Kanjiža i Bačka Palanka). Uzorak je stratifikovan u 3 subuzorka, a u odnosu na učestalost bola u leđima: povremena bol (113 ispitanika ili 55.94%), česta bol (48 ispitanika ili 23.76%) i veoma česta bol (41 ispitanika ili 20.30%) i predstvaljala je kategorijalnu varijablu u istraživanju. Istraživački podaci su prikupljeni upitnikom koji je dizajniran za potrebe ovog istraživanja. Pri dizajniranju instrumenta korišćeni su ajtemi čiji se konstrukt zasnivao na modifikovanoj verziji, WHOQOL-BREF upitnika (*World Health Organization Quality of Life Questionnare – BREF*) (WHOQOL group, 1998) i PKŽS upitnika (*Percepcija Aktivnog Životnog Stila*) (Nešić, 2016), a za samoprocenu kvaliteta života. Dizajnirani upitnik obuhvatio je 29 ajtema raspoređenih u 5 varijabli: Telesno zdravlje (8 ajtema), Psihičko zdravlje (7 ajtema), Socijalni odnosi (5 ajtema) i Okruženje (9 ajtema).

Rezultati istraživanja su prikazani tekstualno i tabelarno. Za sve ispitane varijable su bile računate frekvencije i procentualna vrednost rezultata na nivou celokupnog uzorka ispitanika. Za utvrđivanje razlika u životnim navikama korišćena je neparametrijska statistička metoda *hi-kvadrat* test (nivoom značajnosti $p \leq 0,05$). Relacija samoprocene kvaliteta života i učestalosti bola u leđima testirana je *Spirmanovim Ro koeficijentom korelacije*. Prikupljeni podaci su obrađeni u statističkom paketu SPSS.20 (Statistical Package for the Social Sciences, V.20; SPSS Inc, Chicago, Illinois, USA).

Rezultati

Na osnovu rezultata *Spirmanovog Ro koeficijenta* i njegove statističke značajnosti (Tabela 1) može se konstatovati da su sve četiri varijable za samoprocenu zadovoljstva kvalitetom života, Telesno zdravlje, Psihološko zdravlje, Socijalni odnosi i Okruženje u negativnim statistički značajnim korelacijama ($p=0.00$) sa varijablom Bol u leđima. Odnosno, da što je bol u leđima bila učestalija to je zadovoljstvo kvalitetetom života ispitanika bilo lošije. Najveću negativnu povezanost možemo uočiti u varijabli Telesno zdravlje (r=-.415). Posmatrajući odnose između varijabli za samoprocenu zadovoljstva kvalitetom života kod ispitanika sa bolom u leđima, može se konstatovati pozitivna statistički značajna korelacija ($p=.000$), što upućuje na činjenicu da

icant correlation can be stated (p = .000), which indicates the fact that the respondents with better physical health had better psychological health and social relations as well as a better environment (Table 1).

Table 1. *Correlation of back pain and quality of life self-assessment variables*

su ispitanici sa boljim telesnim zdravljem imali i bolje psihološko zdravlje i socijalne odnose kao i bolje okruženje (Tabela 1).

Tabela 1. *Korelacija bola u leđima i varijabli samoprocene kvaliteta života*

Variables Statistics / **Varijable Statistici**		***Physical health /*** **Telesno zdravlje**	***Psychological health /*** **Psihološko zdravlje**	***Social relations /*** **Socijalni odnosi**	***Environment /*** **Okruženje**
Back pain / Bolovi u leđima	*Correlation Coefficient /* Correlation Coefficient	-.415	-.299	-.345	-.298
	Sig. (2-tailed)	.000	.000	.000	.000
	N	202	202	202	202
Physical health / Telesno Zdravlje	*Correlation Coefficient /* Correlation Coefficient		.674	.615	.542
	Sig. (2-tailed)		.000	.000	.000
	N		202	202	202
Psychological health / Psihološko zdravlje	*Correlation Coefficient /* Correlation Coefficient			.732	.682
	Sig. (2-tailed)			.000	.000
	N			202	202
Social relations / Socijalni odnosi	*Correlation Coefficient /* Correlation Coefficient				.711
	Sig. (2-tailed)				.000
	N				202

The results of the chi-square test shown in Table 2 show that there are statistically significant differences in the variable for assessing quality of life satisfaction, the Satisfaction with quality of life (p=.000) value χ^2=23.09. The highest percentage of respondents who had occasional back pain and a good quality of life was noticeable (42.48%). 20.84% of respondents had frequent back pain and good quality of life, while 17.07% of respondents had very frequent pain and good quality of life. To make the results even more justified, the data indicate that the average quality of life again had the highest percentage of respondents who had occasional back pain (42.48%).

Rezultati testiranja *hi-kvadrat* testom prikazani u Tabeli 2 pokazuju da postoje statistički značajne razlike u varijabli za procenu zadovoljstva kvaliteta života, Zadovoljstvo kvalitetom života (p=.000) pri vrednosti χ^2=23.09. Primetan je najveći procenat ispitanika koji su imali povremenu bol u leđima i dobar kvalitet života (42.48%). Čestu bol u leđima i dobar kvalitet života imalo je 20.84% ispitanika, dok je veoma čestu bol i dobar kvalitet života imalo 17.07% ispitanika. Da bi rezultati bili još opravdaniji ukazuju i podaci da je prosečan kvalitet života opet imao najveći procenat ispitanika koji su imali povremenu bol u leđima (42.48%).

Table 2. *Contingency table Satisfaction with quality of life and Back pain*

Tabela 2. *Kontigencijska tabela Zadovoljstvo kvalitetom života i Bolovi u leđima*

Variable / **Varijable**	***Satisfactory /*** **Zadovoljavajući**	***Average /*** **Prosečan**	***Good /*** **Dobar**	***Total /*** **Ukupno**
Occasionally / Povremeno	21 (18.58%)	44 (38.94%)	48 (42.48%)	113 (100.0%)
Frequently / Često	19 (39.58%)	19 (39.58%)	10 (20.84%)	48 (100.0%)
Very frequently / Veoma često	22 (53.66%)	12 (29.27%)	7 (17.07%)	41 (100%)
Total / Ukupno	62 (30.7%)	75 (37.1%)	65 (32.2%)	202 (100.0%)
χ2(4, 202)=23.09, p=.000				

Legend: *χ2 - chi-square test value; p - level of statistical significance of the chi-square test*

Legenda: *χ^2 – vrednost hi-kvadrat testa; p – nivo statističke značajnosti hi kvadrat testa*

Discussion

In this study, all respondents had a history of LS, which means that they fully felt the consequences, first of all pain, and then other accompanying changes (limited range of motion, anxiety...). Based on the results and application of *Spearman's Ro correlation coefficient*, it was determined that the frequency of pain is in a negative, statistically significant correlation (p=.000) with variables for self-assessment of quality of life, namely Physical Health, Psychological Health, Social Relations and the Environment. It is to be expected that the more frequent the back pain, the worse the quality of life. More frequent back pain is related to poorer physical health, because pain is a limiting factor for many conditions and activities (Hoy et al, 2010), also reduces participation in daily physical activity (DFA) (Marshall, Schabrun & Knox, 2017), sports and recreational activities, etc. Based on the above, a reduced level of fitness impairs the overall health (National Institutes of Neurological Disorders and Stroke, 2020). On the other hand, pain and discomfort in the body negatively affect the quality of sleep (Marin, Cyhan & Miklos, 2016) and rest, and sometimes on the quality and regularity of daily meals.

The application of kinesitherapy treatment, that is, exercise, is one of the most effective in the treatment of LS. Based on the results of this study, it is identified that the respondents with a reduced frequency of pain were more physically active, which implied a higher level of quality of life, taking into account the factors of psychosocial health. Studies that have treated the problem of pain in LS have confirmed the connection between pain and psychosocial health factors (Vlaeyen & Linton, 2000; Bair et al, 2008; Bletzer et al, 2016).

Diskusija

U ovoj studiji, svi ispitanici imali su istoriju lumbalnog sindroma, što znači da su u potpunosti osetili posledice, u prvom redu bol, a zatim i druge propratne promene (ograničen obim pokreta, anksioznost...). Na osnovu rezultata i primene *Spirmanovog Ro koeficijenta korelacije* utvrđeno je da je učestalost bola u negativnoj, statistički značajnoj korelaciji (p=.000) sa varijablama za samoprocenu kvaliteta života, i to za Telesno zdravlje, Psihološko zdravlje, Socijalne odnose i Okruženje. Za očekivati je da, što je bol u leđima učestalija, kvalitet života je lošiji. Učestaliji bol u leđima je u vezi sa lošijim telesnim zdravljem, jer je bol limitirajući faktor za mnoga stanja i aktivnosti (Hoy et al, 2010), takođe umanjuje i učešće u dnevnoj fizičkoj aktivnosti (DFA) (Marshall, Schabrun & Knox, 2017), sportsko-rekreaktivnim aktivnostima i sl. Na osnovu gore navedenog, smanjeni nivo kondicije narušava zdravlje u celini (National Institutes of Neurological Disorders and Stroke, 2020). Sa druge strane, bol i nelagodnost u telu negativno utiče i na kvalitet sna (Marin, Cyhan & Miklos, 2016) i odmora, a ponekad i na kvalitet i redovnosti dnevnih obroka.

Primena kineziterapijskog tretmana, odnosno vežbe, jedan je od najefikasnijih u terapiji LS. Na osnovu rezultata ove studije, identifikuje se da su ispitanici sa smanjenom učestalošću bola bili fizički aktivniji što je impliciralo i na njihov viši nivo kvaliteta života, uzimajući u obzir i faktore psiho-socijalnog zdravlja. Studije koje su tretirale problem bola kod LS, potvrdile su povezanost bola i faktora psiho-socijalnog zdravlja (Vlaeyen & Linton, 2000; Bair et al, 2008; Bletzer et al, 2016).

U drugom delu istraživanja, potvrđen je dobar kvalitet života kod ispitanika kod kojih se bol javljao samo

In the second part of the study, a good quality of life was confirmed in respondents in whom pain occurred only occasionally (42.48%), while in 53.66% of respondents in whom pain occurred very often the quality of life was satisfactory. This result is in line with review studies that investigated the relation between pain and quality of life (Van Middelkoop et al., (2010); Lee et al (2015) Marshall, Schabrun & Knox (2017).

Conclusion

Based on this research, it can be concluded that people with LS who report more frequent lower back pain, have a poorer perception of their own quality of life. Poor quality of life was most often associated with physical health and restriction to participate in daily physical activities (movement), but also sports and recreational activities. They also significantly report the connection between pain and poorer quality of life in the psycho-social sense. Therefore, it can be concluded that quality of life can and must be related to the current state and frequency of pain in the population with LS.

povremeno (42,48%), dok je kod 53,66% ispitanika kod kojih se bol javljala veoma često, kvalitet života bio zadovoljavajući. Ovaj rezultat je u skladu sa preglednim studijama u kojima je istraživana relacija bola i kvaliteta života (Van Middelkoop et al., (2010); Lee et al (2015) Marshall, Schabrun & Knox (2017).

Zaključak

Na osnovu ovog istraživanja može se zaključiti do osobe sa LS koje prijavljuju učestaliji bol u donjem delu leđa, imaju i lošiju percepciju sopstvenog kvaliteta života. Loš kvalitet života najčešće su dovodili u vezu sa telesnim zdravljem i ograničenjem da učestvuju u svakodnevnim fizičkim aktivnostima (kretanje), ali i sportsko rekreativnim aktivnostima. Takođe, značajno prijavljuju i povezanost bola sa lošijim kvalitetom života u psiho-socijalnom smislu. Stoga, može se zaključiti da se kvalitet života može i mora dovesti u vezu sa trenutnim stanjem i učestalošću bola kod populacije sa lumbalnim sindromom.

References

Alleva, J., Hudgins, T., Belous, J., & Kristin Origenes, A. (2016). Chronic low back pain. *Disease-a-Month, 62*(9), 330–333.

Alsufiany, M. B., Lohman, E. B., Daher, N. S., Gang, G. R., Shallan, A. I., & Jaber, H. M. (2020). Non-specific chronic low back pain and physical activity. *Medicine, 99*(5), e18544.

Bair, M. J., Wu, J., Damush, T. M., Sutherland, J. M. & Kroenke, K. (2008) Association of depression and anxiety alone and in combination with chronic musculoskeletal pain in primary care patients. *Psychosomatic Medicine*, *70*(8), 890–897.

Barone Gibbs, B., Hergenroeder, A. L., Perdomo, S. J., Kowalsky, R. J., Delitto, A., & Jakicic, J. M. (2018). Reducing sedentary behaviour to decrease chronic low back pain: the stand back randomised trial. *Occupational and Environmental Medicine, 75*(5), 321–327.

Bletzer, J., Gantz, S., Voigt, T., Neubauer, E., & Schiltenwolf, M. (2016). Chronische untere Rückenschmerzen und psychische Komorbidität. *Der Schmerz, 31*(2), 93–101.

Bontrup, C., Taylor, W. R., Fliesser, M., Visscher, R., Green, T., Wippert, P.-M., & Zemp, R. (2019). Low back pain and its relationship with sitting behaviour among sedentary office workers. *Applied Ergonomics,* 81, 102894.

Chou, R. (2011). Low back pain (Chronic). *American Family Physician, 84*(4), 437-438.

Citko, A., Górski, S., Marcinowicz, L., & Górska, A. (2018). Sedentary Lifestyle and Nonspecific Low Back Pain in Medical Personnel in North-East Poland. *BioMed Research International,* 2018, 1–8.

Dennerlein, J. T. (2018). Chronic low back pain: a successful intervention for desk-bound workers. *Occupational and Environmental Medicine, 75*(5), 319–320.

Hoy, D., Brooks, P., Blyth, F. & Buchbinder, R. (2010). The Epidemiology of low back pain. *Best Practice & Research Clinical Rheumatology*, vol. 24: 769–781.

Lee, H., Hübscher, M., Moseley, G. L., Kamper, S. J., Traeger, A. C., Mansell, G., & McAuley, J. H. (2015). How does pain lead to disability? A systematic review and meta-analysis of mediation studies in people with back and neck pain. *Pain, 156*(1), 988–997.

Marin, R., Cyhan, T. & Miklos, W. (2016). Sleep Disturbance in Patients with Chronic Low Back Pain. American Journal of Physical Medicine & Rehabilitation, vol. 85(issue 5): 430-435.

Marshall, P. W. M., Schabrun, S., & Knox, M. F. (2017). Physical activity and the mediating effect of fear, depression, anxiety, and catastrophizing on pain related disability in people with chronic low back pain. *PLOS ONE, 12*(7), e0180788.

Nachemson, A. L. & Jonsson, E. J. (2000). *Neck and Back Pain. The Scientific Evidence of Causes, Diagnoses and Treatment.* Philadelphia, Lippincott, 241-304.

National Institute of Neurological Disorders and Stroke. Low Back Pain, U.S. Department of Health and Human Service, preuzeto sa https://www.ninds.nih.gov/disorders/patient-caregiver-education/fact-sheets/low-back-pain-fact-sheet April 2020.

Nešić, M. (2016). Valorizacija upitnika namenjenog proceni kvaliteta života studenata. *Nastava i vaspitanje*, *65*(2), 329-343. [in Serbian]

Park, S.-M., Kim, H.-J., Jeong, H., Kim, H., Chang, B.-S., Lee, C.-K., & Yeom, J. S. (2018). Longer sitting time and low physical activity are closely associated with chronic low back pain in population over 50 years of age: a cross-sectional study using the sixth Korea National Health and Nutrition Examination Survey. *The Spine Journal, 18*(11), 2051-2058.

Patrick, N., Emanski, E., & Knaub, M. A. (2014). Acute and Chronic Low Back Pain. *Medical Clinics of North America, 98*(4), 777–789.

Purcell, L. (2009). Causes and prevention of low back pain in young athletes. *Paediatric Children Health, 14*(8), 533-535.

Senba, E., & Kami, K. (2017). A new aspect of chronic pain as a lifestyle-related disease. *Neurobiology of Pain, 1,* 6–15.

Van Middelkoop, M., Rubinstein, S. M., Kuijpers, T., Verhagen, A. P., Ostelo, R., Koes, B. W., & van Tulder, M. W. (2010). A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. *European Spine Journal, 20*(1), 19–39.

Vlaeyen, J. W. S., & Linton, S. J. (2000). Fear-avoidance and its consequences in chronic musculoskeletal pain: a state of the art. *Pain, 85*(3), 317–332.

Wallach, C. J., Sobajima, S., Watanabe, Y., Kim, J. S., Georgescu, H. I., Robbins, P., Gilbertson, L. G., Kang, J. D. (2003) Gene transfer of the catabolic inhibitor TIMP-1 increases measured proteoglycans in cells from degenerated human intervertebral discs. *Spine, 28*(20), 2331-2237.

Primljen: 25. jun 2021. / Received: June 25, 2021
Prihvaćen: 15. septembar 2021. / Accepted: September 15, 2021

https://doi.org/10.7251/SSH2102189B
Original scientific paper

UDC: 37.064.2-057.875:159.942
Originalni naučni rad

The Emotional-Social Interaction Between Teachers and Student During the Physical Education and Sports Lessons

Harbach Brahim[1], Guezgouz Mohamed[1], Bensmicha Eleid[2]
[1]*Institute of Sports and Physical Education, University of Abdelhamid Ibn Badis - Mostaganem, Algeria*
[2]*Laboratory of Programs Optimization in APS, University of Abdelhamid Ibn Badis - Mostaganem, Algeria*

Correspondence:
Harbach Brahim, Institute of Sports and Physical Education, University of Abdelhamid Ibn Badis -Mostaganem, Algeria, brahim.harbach@univ-mosta.dz

Abstract: *The study aimed to find out the correlation between the emotional-social interaction of a professor of physical education and sports and the activity of his students during the physical education and sports lesson.*
It was used the descriptive approach, and the sample comprised (14) teachers and (398) students from some Middle school of El Bayadh state, and the researchers used the questionnaire form and the Weethol scale to measure the social-emotional interaction.
The results showed the existence of a positive and strong correlation between the first three behavioral groups of the tool, and the extent of student activity. The researchers recommend using indirect methods by professors in teaching, whether verbal or kinesthetic.
Keywords: *emotional interaction, physical education, teachers, students.*

Introduction

The teaching process consists of a group of important components or elements, namely the teacher and the student(Sumirattana, Makanong, & Thipkong, 2017), the educational objectives, the skill or the content of the lesson(Papi & Abdollahzadeh, 2012), the tools and equipment used, the methods, methods and teaching strategies, the professor's interactions and social interactions with the pupils, the procedures and steps followed in organizing the lesson, classroom management, evaluation and all of these The components need a teacher with a sufficient degree of experience to deal with them and in a way that achieves the desired goals. (Ardalan, 2008; Westwood, 2008)The component of the professor's socio-emotional interactions with students is among the most important components of the teaching process(Delahunty, Verenikina, & Jones, 2014), and it is the critical element that if the teacher mastered it, he helped him achieve The greatest amount of motivation for pupils and their revitalization of the teaching process and the participation of pupils in the output of the lesson(Händel et al., 2020).

Through the above, we wanted from our research this link between pupils' activity during their exercise of the lesson of physical education and sports and the social emotional interaction of the professor who is distinguished by means of adaptation, cooperation, communication, communication, etc(Ahmed et al., 2017).

The physical education and sports lesson is considered one of the forms of academic subjects, such as natural sciences, physics, and literature, as they meet in methods and objectives, and their curricula and content differ, but they fall into one point, which is to provide students with knowledge and direct them to a healthy future. The presentation of the physical education and sports lesson differs from these subjects in He does not care about the cognitive and scientific fields, but goes beyond that to the physical, psychological, social and health fields through activities. In this regard, Renshaw (2010) noted that Physical education and sports do not aim to train through education the individual from the physical point of view only, but rather its purpose is higher than that, it is the formation of the individual. Balanced in all its physical, moral, mental, social and psychological aspects(Kirk, 2005), in addition to what the individual acquires in terms of health-related information in terms of hygiene and healthy behavior(Pereira, Duarte, Rebelo, & Noriega, 2014; Ryan, Patrick, Deci, & Williams, 2008), as the general information of the individual increases through his contact and mixing with different external societies and interacting with them socially and culturally(Belkadi et al., 2015), which confirms that physical education And sports are not less important than the rest of the subjects(Bailey et al., 2009), given their necessity in developing important aspects of the student's per-

sonality, especially from the social aspect(Kirk, 2012). Which brings the student to adaptation and integration within the class(Zepke & Leach, 2010), meaning the strengthening of relationships between students and the decoupling of isolation from each other, thus promoting proper adaptation.

The success of the physical education and sports lesson is limited to the role of the professor in presenting the various aspects of physical and sports activities(Pill, 2008), but he has a greater role than that, as he works to provide educational duties through physical activities that aim to develop and shape the values and high morals of students, taking into account the tendencies and desires of students (Gil-Arias, Harvey, Cárceles, Práxedes, & Del Villar, 2017) where both (Fabelico & Afalla, 2020; Ryan et al., 2008) indicate that there is a correlational relationship in a positive direction between each feature of the teacher's calmness and the motivation of perseverance(Pill, 2008) among students and the existence of a correlational relationship in a positive direction between the social characteristic of the professor and the motivation of achievement behavior among students(Ghanizadeh & Moafian, 2011), (Andriani, Kesumawati, & Kristiawan, 2018; Fabelico & Afalla, 2020; Ghanizadeh & Moafian, 2011; Pill, 2008) concluded that Social relations have a great impact on learning among adolescents in the study of physical education and sports and relying on group formation helps a lot in science and raising the level of students (Harahsheh, 2017) in contrast to the study of (Bailey et al., 2009) noted that a weak correlation between the competencies of a professor of physical education and sports and the dimensions of the following trend scale(Haerens et al., 2013) social experience, health experience, stress reduction and athletic excellence(Cury et al., 1996)

The purpose of the study is to determine the emotional social interaction that the teacher of physical education and sports could have on motivating and stimulating students to practice physical and sports activities during the pandemic covid -2019.

Materials and Method

Participants

The researchers used the descriptive method to study the correlation between the emotional interaction of a professor and the activity of the students.

The study population consisted of teachers and students of Al Bayadh state schools.

Table 1. *The distribution of the research sample (teachers and students) by municipalities*

Number of pupils	Professor's name	Name of the educational institution	Municipal
30	Khalil	Zidouri Abdel kader Intermediate school	Sidi Cheikh
29	Benyoucef	Karkab abdelmalek intermediate school	Arboit
28	Mbrek	Shirfawi Mohamed Intermediate School	Bouktab
29	Fechfouch	Madani mamar intermediate school	Echkik
27	Djeffel houari	Belakid mohamed intermediate school	Elkaf
31	Boucek elhadj	Abdali mohamed intermediate school	Elghasoul
27	Slimani	Hamitou elbachir intermediate school	Echalala
25	Farji	Eldjadida elkhaither intermediate school	Elkhaither
30	Talbi tahar	Mahari kouider intermediate school	Tesmouline
29	Zair mourad	Tajdin abdelkader intermediate school	El Bayadh
26	Laribi amer	Lkhadari mohamed intermediate school	Sidi amer
31	Rajaa salem	Tarek ben ziad intermediate school	Bousamgho
27	Bachiri	Youcefi mohamed elwassini intermediate school	Ain elirak
29	Koiadri salem	Boukhabza elbay intermediate school	Brizina
398	14	Total summation	

Materials

- The pilot survey from 09/08/2019 to 09/18/2019.
- The basic experiment was conducted from 09/29/2019 to 11/21/2019.
- Spatial domain:
- Filming was done for the exploratory experience in the Al Bayadh state schools.

Data collection tools:

First: Arab and foreign sources and references.

Second: The cameras are not for filming for the classes, then half an hour is taken from each class.

Study design

The cinematography of the teaching sessions, 14 classes, was conducted for professors in some of the Al Bayadh state schools.

To build the questionnaire (related to student activity), we consulted with some teachers and phrases were extracted on teacher motivation for students, then conducting an exploratory study for the purpose of surveying and knowing the extent of the validity of the form (the student form) and judging it by the teachers so that we used in analyzing the results and unpacking them the five-point scale of the Likart which is as follows:

- The first axis: the psychological role (includes 12 phrases)
- The second axis: an educational and social role (includes 12 phrases)
- Method of evaluating the scale scores. Drafting the scale paragraphs with a positive form and the evaluation of the answer is based on a five-year scale. Graduation (practiced to a very large degree, we give it "5" degrees, it is practiced to a large extent "4", it is practiced with a medium degree "3" it is practiced weakly "2", it is practiced very weakly we give it "1" degrees

Through this, we have reached a review of this form and its correction by the professors. The appropriate phrases for the subject of our study (for the form and the tool) were extracted. And after viewing it A group of arbitrators: The final version of the form intended for middle school students has been reached.

Weephole tool to measure social-emotional interaction

Therefore, we developed the Test of Regulation in and Understanding of Social Situations in Teaching (TRUST), which is a theory-based situational judgment test measuring teachers' knowledge about strategies for emotion regulation and relationship management in emotionally and socially challenging situations with students, which allwed to observe and record with the Weethol tool in observing the social emotional interaction of the professor: The Weethol tool is used to observe the professor in places of study during his teaching of any systematic topic. Where the Weethol tool for observing the social emotional interaction of the class members consists of seven behavioral categories: the first three are reinforcing for the pupils and their behavior (reinforcing behavior for the pupils, the behavior of accepting and clarifying what the students show, the behavior that helps the students to solve) and the fourth is neutral (neutral behavior), and the last three are reinforcing For the teacher and for the behavior and roles he performs in classroom education (behavior directed at students, behavior of rebuke, reprimand, reprimand and condemnation, the behavior of strengthening the teacher for himself) and when observing the teaching with a tool, the observer intends to sit in an area of the classroom that enables him to see what is happening in the place of study and hear what the professor is showing And students of phrases, comments, inquiries, directions, instructions and questions. The best classroom site that enables him to do all this, seeing and hearing the course of the class without interfering or negatively affecting it is one of the back corners of the class. The observer takes a Weethol model with him to record what happens from the seven types of professor behavior. It is preferable for the observer to attend the class at the beginning of the class, where he spends the first minutes in identifying the general components of the class and the method of organizing them, and also distinguishes the occasion or the behavioral beginning that the teacher or students initiate in the first session and usually directs the nature of events, methods of interaction and its content in the following minutes or during the whole session Sometimes the observer can, in order to facilitate the recording and the multiplicity of types of behavior, divide the session into periods of ten or fifteen minutes each, where he places a sign, Next to the type of behavior that he notices each time it occurs. The observer uses the following procedural principles to observe and distinguish the seven behavioral types that are embodied in the present Weethol tool: We

summarize them in the classification of any statement, comment, question or reference that focuses on the teacher or the student and aims in the appropriate field for it(Mohamed, Mohamed, Mohammed, Mokrani, & Belkadi, 2019) .

Procedures

After the exploratory study, we started our basic study where one of the researchers tends to the intermediate level and then takes a suitable place to register with a tool for emotional-social interaction, as we mentioned above, then after the end of the class, we distribute the form to 30 students for each pupil's share of direct registration classes and give a chance of 10 to 12 d at most. To retrieve the form, with the researcher answering students 'questions for some vague phrases (the form directed to them). Then we calculate the average total of (10 d) classes for each of the phrases of the tool and the thawl and the average of the total of the students 'answers to the questionnaire, then calculate the correlational relationship between the emotional-social interaction and the extent to which the teacher motivated students to perform the physical education and sports class well.

The exploratory study

The exploratory experiment was conducted by the method of conducting the test and returning it in two phases, where the time difference was a week, so the researchers reached the following results: The validity coefficient ranged by using Pearson's coefficient of the questionnaire directed to the pupils of the two axes, the lowest correlation coefficient was 0.882 and the highest value 0.938 and this shows That the tool (the questionnaire directed to students) is characterized by a high degree of validity and reliability coefficient

The researchers used the stability factor, and its value ranged respectively: 0.939 and 0.968), which indicates that the tool is characterized by a high degree of stability. As for objectivity, the two tools, after being presented to the aforementioned arbitrators, agreed that the tool actually used measures what it was intended to measure, as the following table shows the validity and reliability of the students 'questionnaire: where the exploratory sample was represented by students of some averages from the white state of (07) students without the study sample The original and very similar to the original sample to ensure the validity of the measuring instrument.

Table 2. *Results of the Pearson correlation coefficient to calculate the validity and reliability of the measuring instrument*

Honesty Lab	Computed correlation coefficient	Sample volume	Behaviors (talk of learning and pupils)
0.90	0.82	07	The first axis
0.99	0.98		The second axis
The tabular value of (t) is at the significance level 0.05 and below the sine degree 06 = 0.81			

Through Table 2 it is evident that the validity coefficient of the axes that make up the measuring tool (the students 'questionnaire) reached the lowest correlation coefficient (0.82) and the highest value (0.98). This shows that the tool is characterized by a high degree of honesty, and the researchers used the reliability coefficient. Self, where its lowest value ranged from (0.90) and its highest value (0.99). This indicates that the tool is characterized by a high degree of honesty and stability.

Statistical analysis

Statistical analysis was performed using the using SPSS software (version 22) and Significance levels were set at $p \leq 0.05$.

Results

The study indicates the lack of significant differences between the indicators studied.

The link between the emotional interaction of the professor and his encouragement for the students.

Table 3. *The arithmetic averages, standard deviations and percentages of the results of unloading a tool and a weethol (emotional interaction) and the form of teacher encouragement for students and the correlation between them.*

Relationship type	Statistical significance	The computed value (t)	Standard deviation	SMA	The axes of the student motivation form	Percentages	Standard deviation	SMA	Thule's phrases of behavior
Positive	Function	0.94	4.62	48.59	The first axis	18.3	11.5	54.4	Reinforced behavior of pupils
Positive	Function	0.92	4.99	48.20	The second axis				
Positive	Function	0.98	4.62	48.59	The first axis	29.7	20.4	88.3	Acceptance behavior and clarification
Positive	Function	0.97	4.99	48.20	The second axis				
Positive	Function	0.96	4.62	48.59	The first axis	18.7	11.5	55.6	Assistant to solve problems
Positive	Function	0.98	4.99	48.20	The second axis				
Positive	Not function	0.05	4.62	48.59	The first axis	1.7	1.1	5.0	Impartial behavior
Positive	Not function	0.11	4.99	48.20	The second axis				
Positive	Not function	0.24	4.62	48.59	The first axis	24.5	7.5	72.7	Pupil-directed behavior
Positive	Not function	0.34	4.99	48.20	The second axis				
Negative	Not function	-0.59	4.62	48.59	The first axis	0.8	1.2	2.3	Behavior. reprimand and forgiveness
Negative	Not function	-0.62	4.99	48.20	The second axis				
Negative	Not function	-0.97	4.62	48.59	The second axis	6.3	6.3	18.9	Self-reinforcing behavior of the professor
Negative	Not function	-0.97	4.99	48.20	The third axis				

Tabular value (t) at the level of significance 0.05. degree of freedom 13 = 0.55. sum of averages = 297. and deviation = 31.4

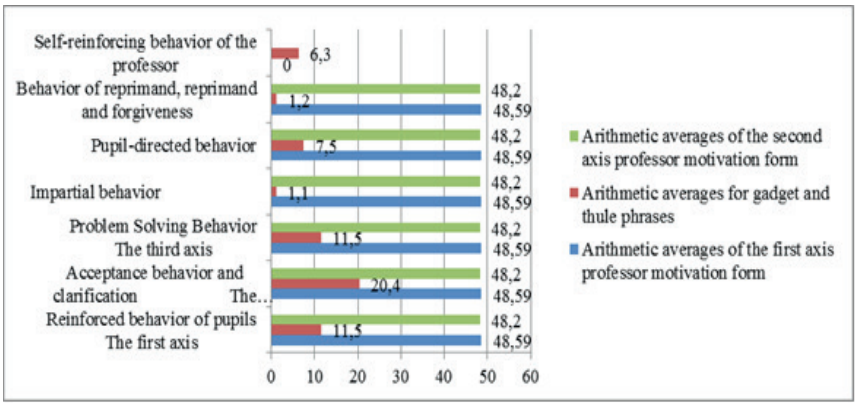


Figure 1. *The arithmetic averages for the phrases Gadha and Thawal (the emotional interaction of the professor and the arithmetic averages for the phrase, a comment, a question or a reference that focuses on the professor or the student to encourage the teacher to his students)*

Discussion

It is clear to us from Table 3 and Chart (01) that the calculated value of "R" is greater than the tabular "R" (0.55) in the classes or types of social emotional interactions of the indirect professor (reinforcing behavior of students - behavior of acceptance and clarification - supportive behavior. On problem solving (with two axes, the pupils motivation form, which is evidence of a strong positive correlation between the type of indirect social emotional climate that prevailed in the class atmosphere and the interaction of the teacher to encourage students and increase student activity in class No.(3.2.1) the reinforcing behavior of pupils - acceptance behavior and Explanation - Helping behavior to solve problems) where the percentage of professor's behavior and interaction reached 18.3% 29.7% 18.7 respectively in category No. 3.2.1. It can be said according to the "Weethol" tool that the professor was indirect in his interaction and building on his emotional-social interaction with the students and thus This leads to stimulating pupils' activity during the class. As for the other groups, the calculated "t" was less than the tabular but rather the relation In the two categories, 7.6, where the teacher's interaction and interaction rate was in the 7.6.5 category (behavior directed at pupils - rebuking and reprimanding behavior - self-reinforcing behavior of the teacher) 24.4%, 0.8,6.3%, respectively, so here the teacher is direct in his dealings with students and is constructive In his social emotional interaction, and thus the return on pupils' activity is in a rapid and noticeable decline, as the percentage "R" calculated for the last three categories of tool and was less than the tabular and negative evidence of the existence of an inverse relationship between the direct categories of tool and thaw and stimulating student activity.

The first hypothesis, in which we assume that there is a positive correlation between the three direct categories of a tool, a tool, and the extent to which the teacher encourages and motivates students to perform physical activity. To prove this hypothesis, it is shown to us through Table 4, and this result we have reached is consistent with the findings of previous studies, (Kirk, 2005), where they came out with the conclusion that there is a strong positive correlation between some characteristics of the professor's personality and the motivation of achievement among pupils towards the class of physical education and sports. Social relations have a great impact on learning among adolescents in the study of physical education and sports and relying on forming groups helps a lot in Knowledge and raising the level of pupils) and the researchers attribute this result in the fact that the teachers were indirect in their teaching and it becomes a work The professor is easy and effective, and Sarhan asserts, "The teachers' work becomes easier and more productive if the students are driven to self-learning and thus more attainable (Moseley et al., 2005). Hall and others add, "It is the tendency to feel and act as if the individual is an influential factor in life events and not a helpless person. And weak " (Fabelico & Afalla, 2020). Hence, indirect methods of teaching are effective in stimulating students to participate in the work.

With regard to the second hypothesis, in which we assume that there is a negative negative relationship between the last three direct categories of a tool and a thule (behavior directed to students, behavior of reprimand and reprimand and forgiveness, the behavior of strengthening the teacher for himself) and the extent to which the teacher encourages and motivates students to perform physical activity and to prove this hypothesis, it is shown to us through

the three boxes The last of Table No. (04) and this result is in line with the findings of previous studies. It is clear to the Secretary where he came out with a result (that there is a negative relationship between the trait of aggression of the professor and the motivation of the level of ambition of third-stage secondary education pupils and a correlational relationship in the direction of Positive between the calm character of the professor's personality and the motivation of perseverance among the students in the third year of high school) and the researchers attribute this result in that the more direct teachers they are in their teaching, the greater the behavior of rebuking, reprimanding and asking for forgiveness for the professor and the behavior of the professor's reinforcement of himself on his students and that is due to the large number of behavior directed to students, as teaching strategies can To talk to students and create motivation for them to learn this subject (Abu Saima, 1995, p. 24) and the professor here is less intrusive. It is only directed, and the professor's speech is little, which contradicts the concept of "the student at the center of the educational process" (Lotkowski, Robbins, & Noeth, 2004). Consequently, direct methods in teaching are ineffective to stimulate students to participate in work and thus not achieving teaching with competencies. Like what is stipulated in the second generation curricula Algeria and the goals remain mere rhetorical statements and slogans that rise above reality and distract from its concerns (Ghanizadeh & Moafian, 2011; Händel et al., 2020). Finally, we recommend the use of indirect methods by professors in teaching, whether verbal or kinesthetic - giving a large space when teachers form emotional-social interactions during Teaching - Holding training sessions for professors in various teaching stages and emphasizing the importance of social studies.

Conclusion

Through the results of the hypothesis, we conclude that the relationship is correlative between the behavioural groups: the first three of the tools and the thule and the extent of pupils' activity, which is consistent with the study of Clear Al-Amin and Saibi's study that "the relationship between the social trait of the professor and the motivation of achievement behaviour among students is positively high" (wadah A. E.-A., 2014) (Mokhtari, Yassin. Bin Saibi Youssef, 2018) where previous studies, as well as our study, recommend attention to the psychological and social aspect of the education stage for pupils to move away from complete control and roughness in the treatment of students and try to approach them in solving their problems, which is what Zamali indicates that the use of teaching with competencies, i.e. indirect methods in teaching, strengthens Some psychological skills such as self-confidence (Lotkowski et al., 2004) As for the inverse relationship between the behavioral groups: the last three and the extent of student activity, we find that they are consistent with the study of (Sumirattana et al., 2017). There is a weak correlation between the competencies of the professor of physical education and sports and the dimensions of the following trends scale: Social experience Health experience, stress reduction and athletic excellence (Fink, 2013), meaning that the study sample was direct in its work and did not take into account social relations in the teaching of Tala This requires us to prepare curricula that satisfy the emotional-social relations and to work with them with the establishment of training courses for teachers and to emphasize in them the importance of the professor's personality and his social interactions with students according to our curriculum.

ACKNOWLEDGMENTS

We thank the Algerian General Directorate for Scientific Research and Technological Development (DGRSDT-MESRS) for their co-operation and help in setting up the study. also, for maintaining and supporting finances and quality of research.

References

Ahmed, H. E. H., Mohammedi, S., Abdelhafid, L., Adel, B., Mohamed, B., & Jacques, G. (2017). study of perception of professional competences in teachers in relation to the requirements of the profession of teaching physical education. *European Journal of Education Studies*, *3*(7), 681.

Andriani, S., Kesumawati, N., & Kristiawan, M. (2018). The influence of the transformational leadership and work motivation on teachers performance. *International Journal of Scientific & Technology Research*, *7*(7), 19-29.

Ardalan, K. (2008). The philosophical foundation of the lecture-versus-case controversy : Its implications for course goals, objectives, and contents. *International Journal of Social Economics*.

Bailey, R., Armour, K., Kirk, D., Jess, M., Pickup, I., Sandford, R., & Education, B. P. (2009). The educational benefits claimed for physical education and school sport : An academic review. *Research papers in education*, *24*(1), 1-27.

Belkadi, A., Othman, B., Mohamed, S., M, B. H., Gleyse, J., Adel, B., … Gleyse, J. (2015). Contribution to the Identification of the Professional Skills Profile of Coaches in the Algerian Sport Judo System. *International Journal of Sports Science*, *5*(4), 145-150.

Cury, F., Biddle, S., Famose, J.-P., Sarrazin, P., Durand, M., & Goudas, M. (1996). Personal and situational factors influencing intrinsic interest of adolescent girls in school physical education : A structural equation modelling analysis. *Educational Psychology*, *16*(3), 305-315.

Delahunty, J., Verenikina, I., & Jones, P. (2014). Socio-emotional connections : Identity, belonging and learning in online interactions. A literature review. *Technology, Pedagogy and Education*, *23*(2), 243-265.

Fabelico, F., & Afalla, B. (2020). Perseverance and Passion in the Teaching Profession : Teachers' Grit, Self-Efficacy, Burnout, and Performance. *Journal of Critical Reviews*.

Fink, L. D. (2013). *Creating significant learning experiences : An integrated approach to designing college courses*. John Wiley & Sons.

Ghanizadeh, A., & Moafian, F. (2011). The relationship between Iranian EFL teachers' sense of self-efficacy and their pedagogical success in Language Institutes. *Asian EFL Journal*, *13*(2), 249-272.

Gil-Arias, A., Harvey, S., Cárceles, A., Práxedes, A., & Del Villar, F. (2017). Impact of a hybrid TGfU-Sport Education unit on student motivation in physical education. *PloS one*, *12*(6), e0179876.

Haerens, L., Aelterman, N., Van den Berghe, L., De Meyer, J., Soenens, B., & Vansteenkiste, M. (2013). Observing physical education teachers' need-supportive interactions in classroom settings. *Journal of Sport and Exercise Psychology*, *35*(1), 3-17.

Händel, M., Stephan, M., Gläser-Zikuda, M., Kopp, B., Bedenlier, S., & Ziegler, A. (2020). Digital readiness and its effects on higher education students' socio-emotional perceptions in the context of the COVID-19 pandemic. *Journal of Research on Technology in Education*, 1-13.

Harahsheh, A. H. (2017). Perceived Self-Efficacy and Its Relationship to Achievement Motivation among Parallel Program Students at Prince Sattam University. *International Journal of Psychological Studies*, *9*(3), 21-34.

Kirk, D. (2005). Physical education, youth sport and lifelong participation : The importance of early learning experiences. *European physical education review*, *11*(3), 239-255.

Kirk, D. (2012). *Defining physical education (Routledge revivals) : The social construction of a school subject in postwar Britain*. Routledge.

Lotkowski, V. A., Robbins, S. B., & Noeth, R. J. (2004). The Role of Academic and Non-Academic Factors in Improving College Retention. ACT Policy Report. *American College Testing ACT Inc*.

Mohamed, K. S., Mohamed, K., Mohammed, S., Mokrani, D., & Belkadi, A. (2019). The Effect of Heavy Weight Training on Physiological Abilities of Soccer Players Under the Age 21 Years Old. *Acta Facultatis Educationis Physicae Universitatis Comenianae*, *59*(1), 33-43. https://doi.org/10.2478/afepuc-2019-0004

Moseley, D., Baumfield, V., Elliott, J., Gregson, M., Higgins, S., Miller, J., & Newton, D. P. (2005). *Frameworks for thinking : A handbook for teaching and learning.* Cambridge University Press.

Papi, M., & Abdollahzadeh, E. (2012). Teacher motivational practice, student motivation, and possible L2 selves : An examination in the Iranian EFL context. *Language learning*, *62*(2), 571-594.

Pereira, P., Duarte, E., Rebelo, F., & Noriega, P. (2014). A review of gamification for health-related contexts. *International conference of design, user experience, and usability*, 742-753. Springer.

Pill, S. (2008). A teacher's perceptions of the Sport Education model as an alternative for upper primary school physical education. *ACHPER Australia Healthy Lifestyles Journal*, *55*(2-3), 23-29.

Renshaw, I., Chow, J. Y., Davids, K., & Hammond, J. (2010). A constraints-led perspective to understanding skill acquisition and game play : A basis for integration of motor learning theory and physical education praxis? *Physical Education and Sport Pedagogy*, *15*(2), 117-137.

Ryan, R. M., Patrick, H., Deci, E. L., & Williams, G. C. (2008). Facilitating health behaviour change and its maintenance : Interventions based on self-determination theory. *The European health psychologist*, *10*(1), 2-5.

Sumirattana, S., Makanong, A., & Thipkong, S. (2017). Using realistic mathematics education and the DAPIC problem-solving process to enhance secondary school students' mathematical literacy. *Kasetsart Journal of Social Sciences*, *38*(3), 307-315.

Westwood, P. S. (2008). *What teachers need to know about teaching methods*. Aust Council for Ed Research.

Zepke, N., & Leach, L. (2010). Improving student engagement : Ten proposals for action. *Active learning in higher education*, *11*(3), 167-177.

Primljen: 10. jun 2021. / Received: June 10, 2021
Prihvaćen: 14. septembar 2021. / Accepted: September 14, 2021

https://doi.org/10.7251/SSH2102197A
UDC: 613.25:796.015.572-055.2
Original scientific paper
Originalni naučni rad

Three workouts compared: interval training, intermittent training and steady state training for the improvement of VO_2max and BMI

Sara Aliberti[1], Antonio Calandro[1], Giovanni Esposito[1], Gaetano Altavilla[1], Gaetano Raiola[2]
[1]Department of Human, Philosophical and Education Sciences, University of Salerno, Fisciano, Salerno, Italy
[2]Department of Political and Social Studies, University of Salerno, Fisciano, Salerno, Italy

Correspondence:
Sara Aliberti, Department of Human, Philosophical and Education Sciences, University of Salerno, Fisciano, Salerno, Italy, s.aliberti17@studenti.unisa.it

Declaration
The study adhered to ethical code of the Declaration of Helsinki and written informed consent was obtained from all participants.

Abstract: *An optimal soccer training, among many objectives, should allow both the improvement of VO2max, or the maximum oxygen supply, and of the anthropometric data. The purpose of the study was to examine the effects of intermittent training, interval training and steady state training methodologies on VO2max and BMI of the players. The sample was made up of 30 young amateur players (age, Mean ± standard deviation [SD] = 16 ± 0.74 years old) randomly divided into three 3 groups of 10. Each group performed a different resistance training methodology for 3 months: group 1 performed intermittent training, group 2 interval training and group 3 steady state training. The parameters taken into consideration were BMI and VO2max, obtained from Gacon test. Paired Sample T Test was performed to check the difference between pre and post 12 training weeks of each group regarding VO2max and BMI. A 3x2 mixed ANOVA was used to test for differences in training programs induced changes in maximal strength and functional capacity variables. The independent variables included one between-subjects factor (training intervention) with three levels (IT, HIIT, and SST), and one within-subject factor (time) with two levels (pre- and post-intervention). A significant difference ($p<0.05$) between pre and post all of the three training protocols on VO2max was found, but no significant interaction ($p>0.05$) between group and time. BMI had no significant improvement ($p>0.05$). Intermittent, interval and endurance training all were equally effective improving VO2max, but not BMI.*

Keywords: *soccer, resistance, VO2max, BMI, training method.*

Introduction

Soccer has become one of the most famous sports in the world (Dvorak et al., 2004; Reilly et al., 2000) requiring excellent technical, tactical, mental and motor training (Kalinowski et al., 2019; Kalinowski et al. , 2020). On a performance level, football involves explosive physical actions that require strength, power and agility (Katushabe & Kramer, 2020). In particular, the aerobic capacity of athletes is an important element of success in sports results (Rankovic et al., 2010); in fact, it plays a key role in competitive football (Federici et al., 2019; Raiola & Altavilla, 2020). An optimal football training, among other objectives, should improve both maximal oxygen uptake (VO_2max) and body mass index (Calandro et al., 2020). Maximum oxygen uptake (VO2max) refers to the intensity of aerobic processes (Coppola & Raiola, 2019), and effectively represents the body's ability to use the maximum amount of oxygen at a given time (Živanić et al., 1999). It is the highest rate of oxygen consumption attainable during maximal/exhaustive exercise (Wilmore & Costill, 2005). Research suggests that the aerobic system is the main source of energy in football, looking at the duration of work and rest (Belegišanin, 2017). Consequently, aerobic fitness tests are performed regularly in soccer players, to assess Vo_2max, such as Gacon test. Several studies used Gacon, a valid and reliable test in soccer (Castagna et al., 2014) to assess VO_2max (Calandro et al., 2020; Pastore et al., 2019). The assessment of endurance in young players is of fundamental importance (Ceruso et al, 2019). The development and training of endurance is a focal point in the growth of all players (Esposito et al, 2019). Training endurance improves the aerobic power of the athlete. Three methods are used to improve aerobic endurance: intermittent training, interval training and steady state training. High intensity interval training, called HIIT, or intermittent, is a very popular form

of exercise, as it takes little time and results in excellent results (Foster et al., 2015), characterized by alternating maximum effort and actively performed recovery (Gaetano & Rago, 2014). According to a study (Calandro et al., 2020), Intermittent training was useful and brought about an improvement in BMI as well as in VO_2max. Interval training is another method improving aerobic capacity (Billat, 2001), whose peculiarity is the variation in training intensity: it goes from low-impact to high-intensity exercises. Recovery can be active or passive, unlike HIIT, where recovery is always active. Steady State Training (SST) or constant training, on the other hand, is the third methodology that involves prolonged training over time. The cardiac rate is constant usually within a period ranging from moderate to medium-high intensity (physical effort), roughly between 60 and 80% of your maximum heart rate (HRmax), or between 50 and 75% of the maximum oxygen consumption VO_2max (Francini et al., 2019). It is certainly much easier to program: it requires extended time and constant frequency. Each type of physical activity always brings changes to the body. Training determines physiological effects with consequent functional responses that promote an improvement in performance (D'Isanto et al., 2020; Izzo et al., 2020). The observed training-induced changes in body composition, aerobic capacity, anaerobic power and strength can be attributed to appropriate load dynamics (B&S, 2014). However, scientific evidence is insufficient to determine which method is best for improving aerobic endurance (Barker, 2004) and BMI. The aim of the study was to examine the effects of the methodologies of intermittent training, interval training and steady state training on the VO_2max and BMI of the players taken into consideration.

Methods

Participants

The present study was designed to describe the characteristics of 30 players (age, mean ± standard deviation [SD] = 16 ± 0.74 years), who participated in the under 17/16 regional championship in 2021. To be included in the study, athletes had to be injury-free and no training suspension in the previous 6 months. All players were familiar with the use of the three training methods. Data were stored and processed anonymously.

Design and data collection

Anthropometric parameters, such as weight and height, from which the BMI is derived, were measured before and after 12 weeks. BMI is considered a generic index of a player's physical fitness and is very useful because it allows players to be classified into categories. In young people, BMI has considerable variability related mainly to age and sex, so for this parameter the percentiles and the Z score BMI-for-age (5-19 years) by WHO (World Health Organization) were calculated with a software. A detailed description of BMI benchmarks is shown in Table 1.

Table 1. *BMI benchmarks*

CLASSIFICATION	PERCENTILES
Underweight	<5
Normal weight	≥5 e <85
Overweight	≥85 e <95
Obese	≥95

Next, the players performed Gacon test before and after 12 training weeks to determine VO_2max. The test consists of alternating running sections of 45 s, with recovery periods of 15 s. The initial speed is 10 km/h, which corresponds to a section of 125 m (covered in 45 s). The initial speed is 10 km/h, which corresponds to a stretch of 125 m (run in 45 s). After a break of 15 s, a further 6.25 m is run (total 131.25 m, or 10.5 km/h) and so on until the athlete can no longer cover the planned distance in 45 s.

Training protocol

The players were randomly divided into 3 groups of 10 athletes, each of whom carried out a different training protocol. All athletes performed the protocol training twice a week in the preparation phase and once a week in the competition phase.

Group 1 *(G1) performed intermittent training (HIIT), as follows.*

G1	Workouts/ week	Sprints/week	Sprint duration (s)	Rest duration (s)	Rest intensity
Week 1	2	4	10 s	10 s	1
Week 2	2	6	10 s	10 s	1
Week 3	2	8	10 s	10 s	1
Week 4	2	4	20 s	20 s	1
Week 5	2	6	20 s	20 s	1
Week 6	2	8	20 s	20 s	1
Week 7	2	4	30 s	30 s	1
Week 8	2	4	30 s	30 s	1
Week 9	2	4	30 s	30 s	0-1
Week 10	3	4	30 s	30 s	0-1
Week 11	3	4	30 s	30 s	0-1
Week 12	3	4	30 s	30 s	0-1

Group 2 *(G2) performed interval training (IT), as follows.*

Week	Time repetition	Time sprint	Repetition	Pause
1	5’33”	45”	3	35”
2	5’33”	45”	3	35”
3	5’33”	45”	3	35”
4	5’33”	50”	3	30”
5	5’33”	50”	3	30”
6	5’33”	50”	3	30”
7	7’	45”	3	25”
8	7’	45”	3	25”
9	7’	45”	3	25”
10	8’	45”	2	15”
11	8’	45”	2	15”
12	8’	45”	2	15”

Group 3 *(G3) performed steady state training (SST), as follows.*

Volume	Repetition	Pause
Da 30’ a 45’/50’	1	End repetition
Da 2 a 4 Km	4x500mt	3’
Da 2 a 4 Km	3x1000mt	4’
Da 2 a 4 Km	500-1000-1500-500mt	3’-3’30”-4’

Statistical analyses

After verifying the normality of the data with the Kolmogorov-Smirnov test, the central tendency and dispersion indices were calculated. Paired Sample T Test was performed to check the difference between pre and post 12 training weeks of each group against VO_2max and BMI. A 3x2 mixed ANOVA was perfomed to test for differences in training programs induced changes in maximal strength and functional capacity variables. The independent variables included one between-subjects factor (training intervention) with three levels (IT, HIIT, and SST), and one within-subject factor (time) with two levels (pre- and post-intervention). To examine the influence of training intervention on the development of our dependent variables, we used these ANOVAs to test the null hypothesis of no different change over time between groups (training intervention × time interaction). To qualitatively interpret the magnitude of differences, effect sizes (d) and associated 95% confidence intervals (95%CI) were classified as small (0.2–0.5), moderate (0.5–0.8) and large (>0.8). Statistical analyzes were performed using the Statistical Package for Social Sciences (SPSS 15.0 for Windows) software. The level of significance was fixed at $p < 0.05$.

Results

A detailed description of anthropometric characteristics' results before the administration of the training protocol is shown in Table 2.

Table 2. *Anthropometric characteristics of pre and post training players*

Players	Age	Pre					Post				
		Weight	Height	BMI	Z score	Percentiles	Weight	Height	BMI	Z score	Percentiles
Player 1	17	67.2	183	20.1	-0.5	32.6	67.3	183	20.1	-0.4	33
Player 2	17	82	190	22.7	0.5	68.1	86	190	23.8	0.8	77.9
Player 3	16	50.2	170	17.4	-1.5	6.7	47.8	170	16.5	2	2.1
Player 4	17	63.5	171	21.7	0.2	56.4	61.5	171	21	-0,1	46.8
Player 5	16	57.3	177	18.3	-1	16.4	56.3	177	18	-1.2	12.5
Player 6	16	55.9	172	18.9	-0.7	24.5	52.9	172	17.9	-1.0	14.9
Player 7	16	46.8	160	18.3	-1	16.1	44.8	160	17.5	-1.2	11.5
Player 8	16	86	185	25.1	1.2	89.1	88	185	25.7	1.3	91
Player 9	16	48.6	160	19	-0.6	26.1	45.6	160	17.8	-1.2	10.7
Player 10	16	63.3	181	19.3	-0.5	31.2	62.3	181	19	-0.6	26.4
Player 11	16	68.5	177	21.9	0.4	66.6	66.5	177	21.2	0.2	59.1
Player 12	16	69.2	177	22	0.5	69.1	68.2	177	21.8	0.4	65.5
Player 13	17	59.5	169	20.8	-0.1	44	57.5	169	20.1	-0.4	33.4
Player 14	17	82	186	23.7	0.7	77	80	186	23.1	0.6	72.2
Player 15	17	60	180	18.5	-1,2	11.9	59	180	18.2	-1,4	8.9
Player 16	17	66.5	182	20.1	-0,4	32.6	66.5	182	20.1	-0,4	32.6
Player 17	17	68.5	175	22.4	0.4	64.4	66.5	175	21.7	-2.6	0.5
Player 18	15	48	167	17.2	-1.2	10.7	50	167	17.9	-0.8	19.8
Player 19	16	56.4	173	18.8	-0.7	23.9	56.4	173	18.8	-0.7	23.9
Player 20	15	52.1	170	18	-0.8	21.5	52	170	18	-0.8	20.9
Player 21	16	52	168	18.4	-0.9	18.1	54	168	19.1	-0.6	28.1
Player 22	16	73.4	177	23.4	0.8	80	70	177	22.3	0.6	71.6
Player 23	15	55.6	170	19.2	-0.2	40.5	55.6	170	19.2	-0.2	40.5
Player 24	15	53.1	160	20.7	0.3	62.2	53.5	160	20.9	0.4	64.1

Player 25	15	48.6	165	17.9	-0.9	18.7	50	165	18.4	-0.6	26.4
Player 26	16	67	159	26.5	1.5	93.1	63	159	24.9	1.9	88.3
Player 27	15	49	161	18.9	-0.4	35.2	49	161	18.9	-0,4	35.2
Player 28	15	56	161	21.6	0.6	71.6	54	161	20.8	0.3	63.3
Player 29	15	52	163	19.6	-0,1	45.6	51	163	19.2	-0,3	39,7
Player 30	16	70.1	179	21.9	0.4	67	69	179	21.5	0.3	62.9
Mean	16	60.9	172.2	20.3	-0.5	67	60.1	172.2	20.3	-0.5	51.0
SD	0.74	10.8	8.8	2.3	0.6	16.3	11.1	8.8	2.0	1	26.8

A detailed description of Gacon Test results pre and post-intermittent training protocol in G1, interval training protocol in G2, steady state training protocol in G3 is shown in **Table 3, 4, 5.**

Table 3. *Gacon Test results pre and post intermittent training protocol in G1*

PLAYERS (G1)	Pre			Post		
	Fraction speed	Fraction distance	VO2max	Fraction speed	Fraction distance	VO2max
Player 1	16	200	48	16.5	206	50
Player 2	16	200	48	17	212	51
Player 3	16	200	48	19	237	57
Player 4	17.5	218	53	19.5	243	59
Player 5	17.5	218	53	18.5	231	56
Player 6	16	200	48	18	225	54
Player 7	18.5	231	56	19.5	243	59
Player 8	17.5	218	53	18	225	54
Player 9	17.5	218	53	19.5	243	59
Player 10	17	212	51	19.5	243	59
Mean	16.95	211.5	51.1	18.5	230.8	55.8
SD	0.89	10.38	2.77	1.10	12.92	3.24

Table 4. *Gacon Test results pre and post interval training protocol in G2*

PLAYERS (G2)	Pre			Post		
	Fraction speed	Fraction distance	VO2max	Fraction speed	Fraction distance	VO2max
Player 11	17	212	51	19.5	243	59
Player 12	17.5	218	53	19.5	243	59
Player 13	16	200	48	17.5	218	53
Player 14	16	200	48	16	200	48
Player 15	17	212	51	17.5	218	53
Player 16	17.5	218	53	19	237	57
Player 17	17	212	51	19.5	243	59
Player 18	17	212	51	18	225	54
Player 19	16	200	48	16.5	206	50
Player 20	17.5	218	53	18.5	231	56
Mean	16.85	210.2	50.7	18.15	226.4	54.8
SD	0.62	7.50	2.05	1.27	15.69	3.88

Table 5. *Gacon Test results pre and post steady state training protocol in G3*

Players (G3)	Pre			Post		
	Fraction speed	Fraction distance	VO2max	Fraction speed	Fraction distance	VO2max
Player 21	16	200	48	17.5	218	53
Player 22	17	212	51	17.5	218	53
Player 23	16	200	48	17.5	218	53
Player 24	17.5	218	53	18	225	54
Player 25	17.5	218	53	18.5	231	56
Player 26	16	200	48	17	212	51
Player 27	18.5	231	56	19	237	57
Player 28	16	200	48	16.5	206	50
Player 29	17	212	51	17.5	218	53
Player 30	17	212	51	18	225	54
Mean	16.85	210.3	50.7	17.7	220.8	53.4
SD	0.85	10.43	2.75	0.71	9.00	2.06

A significant difference ($p<0.05$) between pre and post all of the three training protocols on VO_2max is shown in **Table 6.**

Table 6. *T test for paired dependent samples of G1 G2 and G3*

Paired Samples Test									
Mean		Paired Differences					t	df	Sig. (2-tailed)
		Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
				Lower	Upper				
G1	Pre - Post	-4.70000	2.66875	.84393	-6.60911	-2.79089	-5.569	9	.000
G2	Pre - Post	-4.100	2.64365	.83600	-5.99115	-2.20885	-4.904	9	.001
G3	Pre - Post	-2.70000	1.41814	.44845	-3.71447	-1.68553	-6.021	9	.000

No significant interaction ($p>0.05$) is found between group and time as shown in **Table 7**. There is only a significant effect of time, so all programs were equally effective.

Table 7. *3X2 ANOVA*

	G1 (n=10)		G2 (n=10)		G3 (n=10)		Moment x group interaction	
Variable	p	d (95% CIs)	p	d (95% CIs)	p	d (95% CIs)	p	d (95% CIs)
Fraction speed	0.001	0.78 (0.33; 0.87)	0.001	0.71 (0.22; 0.84)	0.001	0.82 (0.43; 0.90)	0.121	0.14 (0.01; 0.34)
Fraction distance	0.001	0.78 (0.34; 0.87)	0.001	0.72 (0.23; 0.84)	0.001	0.83 (0.45; 0.90)	0.112	0.15 (0.06; 0.35)
VO2max	0.001	0.77 (0.32; 0.87)	0.001	0.72 (0.24; 0.84)	0.001	0.80 (0.38; 0.88)	0.160	0.12 (0.10; 0.32)

Discussion

Interval training, intermittent training and steady state training have proven to be effective methodologies for improving aerobic capacity, and therefore VO_2max. . There were no differences between the groups and time, so they all carried the same results. This means that both state training, interval training and intermittent training have been equally effective in improving the aerobic capacity of players. It was not the same with regard to BMI, the results of which were not statistically significant, although there were an improvement in physical condition. In detecting the anthropometric characteristics both pre and post training, only one player was overweight, while all the others fall within the normal weight range. Assessment

of body composition is central to player development, as there is a close correlation between strength, speed, explosiveness, and lean mass. However, it would be necessary to see the effects of long-term training and try to take care of the diet.

The results obtained from this study regarding the effectiveness of the three methodologies in youth football were consistent with those of two other studies (Cvetković, et al., 2018; Faude et al., 2014). In the first study, the authors concluded that intermittent training allowed significant improvements in multiple measures of muscle and cardiorespiratory fitness after 12 weeks of training in overweight and obese male children. In Faude's study (2014), however, the authors showed that four weeks of in-season endurance training had led to significant improvements in stamina. Significant effects were observed in individual anaerobic threshold, peak heart rate, and CMJ, with no significant intergroup interaction. In the study conducted by Rago et al., (2017) the collected data subjected to a statistical study showed improvements in the physical performance of different athletes thanks to the use of the periodization method integrated in high intensity intermittent training. Foster et al., (2015) finally compared high intensity interval training protocols with steady-state exercise and concluded that HIIT protocols were not superior to conventional training.

As far as interval training is concerned, the studies by Laursen & Jenkins (2002) are important. It appears that, for already trained athletes, improvements in endurance performance can only be achieved through high intensity interval training. Research examining changes in muscle enzyme activity in highly trained athletes following HIIT revealed no changes in oxidative or glycolytic enzyme activity, despite significant improvements in endurance performance. Instead, an increase in the buffering capacity of skeletal muscle may be a mechanism responsible for an improvement in endurance performance. Swedish physiologist Per Olof Astrand and his disciple Irma Ryhming (later Irma Astrand) are also mentioned as being responsible for founding the initial physiology of interval training. In 1967, Astrand and his Swedish colleague Bengt Saltin published data on the maximum oxygen consumption of several athletes using the interval training methodology, publishing the highest oxygen consumption value recorded so far in a runner: 82 ml / kg / min.

Finally, as regards the studies on steady state training we can refer to Venables and Jeukendrup (2008). The two researchers hypothesized that the steady state performed at a specific constant intensity such as to maximize the expenditure of lipids, could lead to a greater oxidation of fats and a greater improvement in insulin sensitivity compared to an Interval training program, on subjects who followed a equicaloric diet (i.e. with a balanced calorie intake). Specifically, it was found that fat oxidation was increased by 44% after Steady State but not after Interval training, while insulin sensitivity was increased by 27% after Steady State. These changes occurred despite no changes in body weight, BMI, waist / hip ratio (WHR), body fat percentage, and VO_2max were detected. The researchers concluded that Steady State Training can cause a higher rate of lipid oxidation by increasing the contribution of fat as an energy substrate during exercise and can significantly increase insulin sensitivity. In conclusion, all three types of training bring significant improvements in terms of VO_2max, but not significant in relation to BMI.

Conclusion

The results of this study showed us that 12 training weeks of intermittent training, steady state training and interval training had equally improved VO_2max in a soccer team, but not BMI. This study allowed us to recommend all three types of training methodologies to improve aerobic capacity. However, you would need to see the effects of long-term training to see significant improvements in BMI. This study demonstrated the equal effectiveness of the three most popular training methodologies in soccer. Coaches are encouraged to alternate these three training methodologies appropriately, in their team's annual athletic training program.

References

B, C., & S, C. (2014). Comparison of aerobic and anaerobic power between university men football and hockey players. *International Journal of Physical Education*, Fitness and Sports, 3, 108-112.

Barker, R. (2004). BTEC National Sport: Sports Development and Fitness Options. *Heinemann*, p. 144. ISBN 0-435-45509-5.

Belegišanin, B. (2017). Effects of high-intensity interval training on aerobic fitness in elite Serbian soccer players. *Exercise and Quality of Life*, 9. https://doi.org/10.31382/eqol.171202

Billat, L. V. (2001). Interval training for performance: a scientific and empirical practice. Special recommendations for middle- and long-distance running. Part I: aerobic interval training. *Sports medicine* (Auckland, N.Z.), 31(1), 13–31. https://doi.org/10.2165/00007256-200131010-00002

Calandro, A., Esposito, G., & Altavilla, G. (2020). Intermittent training and improvement of anthropometric parameters and aerobic capacity in youth football. *Journal of Human Sport and Exercise.* https://doi.org/10.14198/jhse.2020.15.Proc3.12

Castagna, C., Iellamo, F., Impellizzeri, F. M., & Manzi, V. (2014). Validity and reliability of the 45-15 test for aerobic fitness in young soccer

players. *International Journal of Sports Physiology and Performance*, 9(3), 525–531. https://doi.org/10.1123/ijspp.2012-0165

Ceruso, R., Esposito, G., & D'Elia, F. (2019). Analysis and evaluation of the qualitative aspects of the young players. *Journal of Physical Education and Sport*, 19, 1814-1819.

Coppola, C., Raiola, G. (2019). Interest in VO2 max capacity: Comparing Norwegian and Italian training, *Journal of Physical Education and Sport*, 19, art. no. 268, pp. 1825-1827.

Cvetković, N., Stojanović, E., Stojiljković, N., Nikolić, D., Scanlan, A. T., & Milanović, Z. (2018). Exercise training in overweight and obese children: Recreational football and high-intensity interval training provide similar benefits to physical fitness. *Scandinavian Journal of Medicine & Science in Sports*, 28, 18-32.

D'Isanto, T., Ponsano, N., Hosseini Varde'I, C., Izzo, R., Cejudo, A., & Raiola, G. (2020). The role of fatigue in football matches, performance model analysis and evaluation during quarters using live global positioning system technology at 50hz. *Sport Science*, 13 (1), 30-35.

Dvorak, J., Junge, A., Graf-Baumann, T., & Peterson, L. (2004). Football is the most popular sport worldwide. *The American journal of sports medicine,* 32, 3S-4S. https://doi.org/10.1177/0363546503262283

Esposito, G., Altavilla, G., & D'Elia, F. (2020). A method for identifying talent in youth football through the use of evaluation tests. *Sport Science* 13 1: 119-126.

Esposito G., Ceruso R., Valentini M., D'Isanto T. (2019). The use of enabling tests to provide a qualitative measurement of the sport skill level of small soccer players, *Journal of Human Sport and Exercise,* 14 (3proc) : S592-S601.

Faude, O., Steffen, A., Kellmann, M., & Meyer, T. (2014). The effect of short-term interval training during the competitive season on physical fitness and signs of fatigue: A crossover trial in high-level youth football players. *International Journal of Sports Physiology and Performance*, 9(6), 936-944.

Federici, A., Zumbo, F., Raiola, G. (2019). Use of chains as a means of intensifying the load in resistance training, *Journal of Physical Education and Sport*, 19, art. no. 68, pp. 466-472.

Foster, C., Farland, C., Guidotti, F., Harbin, M., Roberts, B., Schuette, J., Tuuri, A., Doberstein, S., & Porcari, J. (2015). The Effects of High Intensity Interval Training vs Steady State Training on Aerobic and Anaerobic Capacity. *Journal of Sports Science & Medicine*, 14, 747-755. https://doi.org/10.1249/01.mss.0000476771.63318.52

Francini, L., Rampinini, E., Bosio, A., Connolly, D., Carlomagno, D., & Castagna, C. (2019). Association Between Match Activity, Endurance Levels and Maturity in Youth Football Players. *International journal of sports medicine*, 40(09), 576-584.

Gaetano, R., & Rago, V. (2014). Preliminary study on effects of hiit-high intensity intermittent training in youth soccer players. *Journal of Physical Education & Sport*, 14 (2).

Izzo, R., Raiola, G., D'Isanto, T., Cejudo, A., & Giovannelli, M. (2020). Modelling an adequate profile for a more targeted work methodology, with dedicated technologies, for elite-level footballers: comparison between sub 17 vs sub 19, highlights and shadows. *Sport Science*, 1, 36-42.

Kalinowski, P., Bojkowski, Ł., & Śliwowski, R. (2019). Motor and psychological predispositions for playing football. *TRENDS in Sport Sciences*, 2 (26): 51-54. https://doi.org/10.23829/TSS.2019.26.2-2

Kalinowski, P., Sysiak, W., Jerszyński, D., & Gronek, P. (2020). Resistance training in football. *TRENDS in Sport Sciences*, 27 (1): 25-28. https://doi.org/10.23829/TSS.2020.27.1-4

Katushabe, E., & Kramer, M. (2020). Effects of Combined Power Band Resistance Training on Sprint Speed, Agility, Vertical Jump Height, and Strength in Collegiate Soccer Players. *International Journal of Exercise Science*, 13, 950.

Laursen, P. B., & Jenkins, D. G. (2002). The scientific basis for high-intensity interval training: optimising training programmes and maximising performance in highly trained endurance athletes. *Sports medicine* (Auckland, N.Z.), 32(1), 53–73. https://doi.org/10.2165/00007256-200232010-00003

Pastore, F., Di Domenico, F., Viscione, I., D'Elia, F.(2019). Assessment of aerobic resistance in the young soccer player. *Journal of Physical Education and Sport*, 19 (5), 1953 – 58. 10.7752/jpes.2019.s5290

Rago, V., Pizzuto, F., Raiola, G. (2017). Relationship between intermittent endurance capacity and match performance according to the playing position in sub-19 professional male football players: Preliminary results, *Journal of Physical Education and Sport*, 17 (2), art. no. 103, pp. 688-691.

Raiola, G., & Altavilla, G. (2020). Testing motor skills, general and special coordinative, in young soccer. *Journal of Human Sport and Exercise*, 15(2proc), S206-S212.

Rankovic, G., Mutavdzic, V., Toskic, D., Preljevic, A., Kocic, M., Nedin Rankovic, G., & Damjanovic, N. (2010). Aerobic capacity as an indicator in different kinds of sports. *Bosnian Journal of Basic Medical Sciences*, 10 (1), 44–48. https://doi.org/10.17305/bjbms.2010.2734

Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *J Sports Sci*, 18 (9), 669-683. https://doi.org/10.1080/02640410050120050

Venables, M. C., & Jeukendrup, A. E. (2008). Endurance training and obesity: effect on substrate metabolism and insulin sensitivity. *Medicine and science in sports and exercise,* 40(3), 495–502. https://doi.org/10.1249/MSS.0b013e31815f256f

WHO (World Health Organization). BMI-for-age (5-19 years). https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age

Wilmore JH and Costill DL (2005) Physiology of Sport and Exercise:3rd Edition. *Champ Human Kinetics.*

Živanić S, Životić-Vanović M, Mijić R, Dragojević R. (1999) Aerobna sposobnost i njena procena Astrandovim testom na bicikl-ergometru. Beograd: *Udruženje za medicinu sporta Srbije*;16. [in Serbian]

Primljen: 20. juli 2021. / Received: July 20, 2021
Prihvaćen: 11. oktobar 2021. / Accepted: Oktober 11, 2021

https://doi.org/10.7251/SSH2102205DJ
Original scientific paper

UDC: 796.011.1:159.947.5
Originalni naučni rad

Motivation for Recreational Exercise in Relation to Gender and Age Differences

Motivacija za rekreativno vježbanje u odnosu na spolne i dobne razlike

Damir Đedović, Rijad Novaković, Ekrem Čolakhodžić, Almir Popo

Faculty of Education, University "Džemal Bijedić", Mostar, Bosnia and Herzegovina

Correspondence:
Damir Đedović, Faculty of Education, University "Džemal Bijedić", Mostar, damir.djedovic@unmo.ba

Nastavnički fakultet, Univerzitet "Džemal Bijedić" u Mostaru, Bosna i Hercegovina

Korespondencija:
Damir Đedović, Nastavnički fakultet, Univerzitet "Džemal Bijedić" u Mostaru, damir.djedovic@unmo.ba

Abstract: *The aim of this research is to identify the motivational structure of recreational exercisers and to investigate differences in motivation with respect to gender, ie to determine the hierarchy of motives for which they choose recreational exercise. This research shows that the strongest motivation for recreational exercise is maintaining and improving health, and certainly relaxation. After them, the most important motivation is socializing and meeting new people, and improving and maintaining physical ability. The research also showed that there are very small differences in the motives for exercise in relation to the age of the respondents, and they are reflected in good looks and fun, while relaxation and relaxation and improvement and maintenance of physical ability are equally important for all ages.*

Keywords: *Recreational exercise, motivation, gender and age differences.*

Sažetak: *Cilj ovog istraživanja je identificirati motivacijsku strukturu rekreativnih vježbača i istražiti razlike u motivaciji s obzirom na spol, tj. utvrditi hijerarhiju motiva zbog kojih oni biraju rekreativno vježbanje. Ovo istraživanje pokazuje da je najsnažnija motivacija za rekreativno vježbanje održavanje i poboljšanje zdravlja, te svakako opuštanje i relaksacija. Posle njih, najvažnija motivacija jeste druženje i upoznavanje novih ljudi, i unapređenje i održavanje tjelesne sposobnosti. Sprovedeno istraživanje je pokazalo i to da postoje vrlo male razlike u motivima za vježbanje u odnosu na dob ispitanika, a one se ogledaju u dobrom izgledu i zabavi, dok je opuštanje i relaksacija i unapređenje i održavanje tjelesne sposobnosti jednako važno svim životnim dobima ispitanika.*

Ključne riječi: *Rekreativno vježbanje, motivacija, spolne i dobne razlike.*

Introduction

Inactivity and a sedentary lifestyle are considered one of the leading health risks of modern society. What are the drivers behind the tendency to exercise and an active lifestyle, that is, what prevents people from starting, even when they themselves are aware that it is necessary, useful, even necessary. The great changes that have taken place in the way of life of modern man have also affected physical activity, which is certainly declining. Motivational theories explain the background of human behavior. Planned behavior theory, self-efficacy theory, cognitive evaluation theory, and the transtheoretical model of behavior change are presented as a theoretical framework for explaining an inactive lifestyle (Fishbein & Eisen, 1975).

Subject and goal of research

The subject of this research is the motivation for recreational exercise in relation to gender and age dif-

Uvod

Neaktivnost i sjedilački način života smatra se jednim od vodećih zdravstvenih rizika savremenog društva. Koji su pokretači u pozadini sklonosti vježbanju i aktivnom životnom stilu, odnosno što je to što ljude sprečava da se pokrenu, čak i onda kada su sami svjesni da im je to nužno, korisno, čak i potrebno. Velike promjene koje su se dogodile u načinu života savremenog čovjeka uticale su i na tjelesnu aktivnost koja je svakako u opadanju. Motivacijske teorije objašnjavaju pozadinu ljudskog ponašanja. Teorija planiranog ponašanja, teorija samoefikasnosti, teorija kognitivne evaluacije i transteorijski model promjene ponašanja prezentovane su kao teorijski okvir za objašnjenje neaktivnog životnog stila (Fishbein i Ajzen, 1975).

Predmet i cilj istraživanja

Predmet ovog istraživanja je motivacija za rekreativno vježbanje u odnosu na spolne i dobne razlike. Cilj

ferences. The aim of this research is to identify the motivational structure of recreational exercisers and to investigate differences in motivation with respect to gender, ie. determine the hierarchy of motives for which they choose recreational exercise.

Methods

Sample of respondents

The sample consists of 200 adults living in Herzegovina (100 women and 100 men) who exercise only occasionally. The age range ranges from 16 to 60 years. The average age of the women covered by this study was 29 years, while the average age of the men was 35 years. The sample is very heterogeneous in terms of education, occupation and marital and parental status. At least once, and at most four times a week, they go to some form of organized or unorganized recreation, in the form of sports games (football, basketball, etc.) or running, aerobics, fitness, cycling or walking.

Sample variables

All respondents completed a questionnaire of motivational factors for recreational exercise by Campbel (2000), translated by V. Švaić (Table 1). The questionnaire contains 13 particles that were to be assessed on a Likert scale from 1 (not important to me) to 5 (very important). In addition, it contains 10 other variables, of which we were interested in two - age and gender.

Data processing methods

The basic methods for processing the results are determined by the characteristics and size of the sample, as well as the set hypotheses. Appropriate mathematical - statistical methods and procedures were used for input, processing and analysis of results. The statistical analyzes used in the paper are: descriptive statistics - basic central and dispersive parameters, and for testing hypotheses t-test and analysis of variance.

ovog istraživanja je identificirati motivacijsku strukturu rekreativnih vježbača i istražiti razlike u motivaciji s obzirom na spol, tj. utvrditi hijerarhiju motiva zbog kojih oni biraju rekreativno vježbanje.

Metod rada

Uzorak ispitanika

Uzorak ispitanika čini 200 odraslih osoba koje žive na području Hercegovine (100 žena i 100 muškaraca) koje samo povremeno vježbaju. Dobni se raspon kreće od 16 do 60 godina. Prosječna starost žena obuhvaćenih ovim istraživanjem bila je 29 godina, dok je prosječna starost muškaraca bila 35 godina. Uzorak je vrlo heterogen po školskoj spremi, zanimanju te bračnom i roditeljskom statusu. Oni najmanje jednom, a najviše četiri puta sedmično odlaze na neki oblik organizirane ili neorganizirane rekreacije, u obliku sportskih igara (nogomet, košarka i sl.) ili trčanja, aerobika, fitnesa, vožnje biciklom ili šetnje.

Uzorak varijabli

Svi su ispitanici ispunjavali upitnik faktora motivacije za rekreativno vježbanje autora Campbela (2000), u prevodu V. Švaića (tabla 1). Upitnik sadrži 13 čestica koje su trebale biti procijenjene na Likertovoj skali od 1 (nije mi važno) do 5 (vrlo važno). Osim toga, sadrži i još 10 varijabli, od kojih su nas interesirale dvije – dob i spol.

Metode obrade podataka

Osnovne metode za obradu rezultata određene su karakteristikom i veličinom uzorka, kao i postavljanim hipotezama. Za unos, obradu i analizu rezultata koristile su se prikladne matematičko – statističke metode i procedure. Statističke analize koje su korištene u radu su: deskriptivna statistika – osnovni centralni i disperzivni parametri, a za testiranje hipoteza t-test i analiza varijanse.

Research results and discussions

Rezultati istraživanja i diskusija

Table 1. *Results of the motivation factor questionnaire for recreational exercise (Campbel, 2000).*

Tabela 1. *Rezultati upitnika faktora motivacije za rekreativno vježbanje (Campbel, 2000).*

***Reasons* / Razlozi**	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	***Total* / Ukupno**	***Missing* / Izostalo**
Improving or maintaining physical fitness / Unapređenje ili održavanje tjelesne sposobnosti	1.5	6.0	14.0	31.0	47.0	99.5	.5
Maintaining vitality / Održavanje vitalnosti	1.0	6.0	16.0	43.5	33.5	100.0	
A sense of satisfaction / Osjećaj zadovoljstva	1.5	4.0	23.5	30.0	41.0	100.0	
Maintaining or improving health / Održavanje ili poboljšanje zdravlja	0	6.0	6.0	36.0	52.0	100.0	
Relaxation / Opuštanje i relaksacija	1.5	5.0	23.5	35.0	35.0	100.0	
Maintaining or reducing body weight / Održavanje ili smanjenje tjelesne težine	4.5	6.0	14.0	32.0	43.5	100.0	
Good look / Dobar izgled	1.5	4.5	18.0	37.5	38.5	100.0	
Fun / Zabava	3.5	7.5	21.0	29.0	39.0	100.0	
A sense of freedom. of independence / Osjećaj slobode, nezavisnosti	6.0	8.0	21.0	28.0	36.5	99.5	.5
Learning new knowledge and insights / Učenje novih znanja i spoznaja	5.0	9.0	22.0	37.0	26.5	99.5	.5
Getting out of the house / Izlazak iz kuće	5.0	11.5	27.5	30.5	25.5	100.0	
Socializing and meeting new people / Druženje i upoznavanje novih ljudi	5.0	12.0	19.5	38.0	25.5	100.0	
Adventure and excitement / Avantura i uzbuđenje	6.5	12.5	19.	30.5	31.5	100.0	

Table 2. *Analysis of differences in expressed attitudes of satisfaction in male and female respondents*

Tabela 2. *Analiza razlika izraženih stavova zadovoljstva kod muških i ženskih ispitanika*

***Gender* / Spol ispitanika**	***Improving or maintaining physical fitness* / Unapređenje ili održavanje tjelesne sposobnosti**					***Total* / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	0	3	11	37	49	100
Men / Muškarci	3	9	17	25	45	99
Total / Ukupno	3	12	28	62	94	199
Gender / Spol ispitanika	***Maintaining vitality* / Održavanje vitalnosti**					**Total / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	0	3	10	44	43	100
Men / Muškarci	2	9	22	43	24	100
Total / Ukupno	2	12	32	87	67	200

Gender / Spol ispitanika	*A sense of satisfaction* / Osjećaj zadovoljstva					*Total* / Ukupno
	I don't care / Nije mi važno	*Mostly I don't care* / Uglavnom mi nije važno	*I'm not sure* / Nisam siguran	*Important* / Važno	*Very important* / Vrlo važno	
Women / Žene	1	2	14	30	53	100
Men / Muškarci	2	6	33	30	29	100
Total / Ukupno	3	8	47	60	82	200
Gender / Spol ispitanika	*Maintaining or improving health* / Održavanje ili poboljšanje zdravlja					*Total* / Ukupno
	I don't care / Nije mi važno	*Mostly I don't care* / Uglavnom mi nije važno	*I'm not sure* / Nisam siguran	*Important* / Važno	*Very important* / Vrlo važno	
Women / Žene	-	1	3	30	66	100
Men / Muškarci	-	11	9	42	38	100
Total / Ukupno	-	12	12	72	104	200
Gender / Spol ispitanika	*Relaxation* / Opuštanje i relaksacija					*Total* / Ukupno
	I don't care / Nije mi važno	*Mostly I don't care* / Uglavnom mi nije važno	*I'm not sure* / Nisam siguran	*Important* / Važno	*Very important* / Vrlo važno	
Women / Žene	1	0	15	40	44	100
Men / Muškarci	2	10	32	30	26	100
Total / Ukupno	3	10	47	70	70	200
Gender / Spol ispitanika	*Maintaining or reducing body weight* / Održavanje ili smanjenje tjelesne težine					*Total* / Ukupno
	I don't care / Nije mi važno	*Mostly I don't care* / Uglavnom mi nije važno	*I'm not sure* / Nisam siguran	*Important* / Važno	*Very important* / Vrlo važno	
Women / Žene	3	5	9	37	46	100
Men / Muškarci	6	7	19	27	41	100
Total / Ukupno	9	12	28	64	87	200
Gender / Spol ispitanika	*Good look* / Dobar izgled					*Total* / Ukupno
	I don't care / Nije mi važno	*Mostly I don't care* / Uglavnom mi nije važno	*I'm not sure* / Nisam siguran	*Important* / Važno	*Very important* / Vrlo važno	
Women / Žene	0	1	16	37	46	100
Men / Muškarci	3	8	20	38	31	100
Total / Ukupno	3	9	36	75	77	200
Gender / Spol ispitanika	*Fun* / Zabava					*Total* / Ukupno
	I don't care / Nije mi važno	*Mostly I don't care* / Uglavnom mi nije važno	*I'm not sure* / Nisam siguran	*Important* / Važno	*Very important* / Vrlo važno	
Women / Žene	2	5	15	34	44	100
Men / Muškarci	5	10	27	24	34	100
Total / Ukupno	7	15	42	58	78	200

***Gender* / Spol ispitanika**	***Sense of freedom, of independence* / Osjećaj slobode, nezavisnosti**					***Total* / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	1	6	15	33	44	99
Men / Muškarci	11	10	27	23	29	100
Total / Ukupno	12	16	42	56	73	199
***Gender* / Spol ispitanika**	***Learning new knowledge and insights* / Učenje novih znanja i spoznaja**					***Total* / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	3	3	17	44	33	100
Men / Muškarci	7	15	27	30	20	99
Total / Ukupno	10	18	44	74	53	199
***Gender* / Spol ispitanika**	***Getting out of the house* / Izlazak iz kuće**					***Total* / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	7	9	23	35	26	100
Men / Muškarci	3	14	32	26	25	100
Total / Ukupno	10	23	55	61	51	200
***Gender* / Spol ispitanika**	***Socializing and meeting new people* / Druženje i upoznavanje novih ljudi**					***Total* / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	5	6	16	41	32	100
Men / Muškarci	5	18	23	35	19	100
Total / Ukupno	10	24	39	76	51	200
***Gender* / Spol ispitanika**	***Adventure and excitement* / Avantura i uzbuđenje**					***Total* / Ukupno**
	***I don't care* / Nije mi važno**	***Mostly I don't care* / Uglavnom mi nije važno**	***I'm not sure* / Nisam siguran**	***Important* / Važno**	***Very important* / Vrlo važno**	
Women / Žene	7	12	14	28	39	100
Men / Muškarci	6	13	24	33	24	100
Total / Ukupno	13	25	38	61	63	200

Table 3. *χ2test differences and their significance in male and female respondents in expressed attitudes towards physical activity*

Tabela 3. *χ^2test razlike i njihova značajnost kod muških i ženskih ispitanika u izraženim stavovima prema bavljenju fizičkom aktivnošću*

Variables / **Naziv varijable**	***Value /*** **Vrijednost χ^2**	***(Sig.)***
Improving or maintaining physical fitness / Unapređenje i održavanje tjelesne sposobnosti	9.774	**.044**
Maintaining vitality / Održavanje vitalnosti	14.900	**.005**
A sense of satisfaction / Osjećaj zadovoljstva	17.039	**.002**
Maintaining or improving health / Održavanje i poboljšanje zdravlja	20.872	**.000**
Relaxation / Opuštanje i relaksacija	22.539	**.000**
Maintaining or reducing body weight / Održavanje i smanjenje tjelesne težine	6.755	.149
Good look / Dobar izgled	11.824	**.019**
Fun / Zabava	9.387	.052
A sense of freedom. of independence / Osjećaj slobode i nezavisnosti	17.625	**.001**
Learning new knowledge and insights / Učenje novih znanja i spoznaja	17.705	**.001**
Getting out of the house / Izlazak iz kuće	5.507	.239
Socializing and meeting new people / Druženje i upoznavanje novih ljudi	11.044	**.026**
Adventure and excitement / Avantura i uzbuđenje	6.730	.151

Looking at the previous table, we can see that 9 (nine) out of 13 (thirteen) variables have a pronounced statistical significance in the differences when it comes to attitudes about physical activity. The variables that contribute the most to the difference are "Maintaining and improving health" and the variable "Relaxation and relaxation". It is assumed that this case occurred because male respondents have less worries and feelings about health status compared to female respondents to whom this item is significantly more important (Berger, Pargman & Weinberg, 2007). In contrast, the variables that contribute the least to the difference but are still within the limits of significance are the variables "Socializing and meeting new people" and the variable "Improving and maintaining physical ability". The variables in which the difference between male and female is the least prominent are "Leaving the house" and the variable "Adventure and excitement".

Uvidom u prethodnu tabelu možemo vidjeti da 9 (devet) od 13 (trinaest) varijabli ima izraženu statističku značajnost u razlikama kada su stavovi o bavljenju fizičkim aktivnostima u pitanju. Varijable koje najviše doprinose razlici su „Održavanje i poboljšanje zdravlja" i varijabla „Opuštanje i relaksacija". Pretpostavlja se da je do ovakvog slučaja došlo zbog toga što ispitanici muškog spola imaju manje brige i osjećaja za zdravstvenim statusom u odnosu na ispitanike ženskog spola kojima je ta stavka znatno bitnija (Berger, Pargman i Weinberg, 2007).

Nasuprot njima, odnosno varijable koje najmanje doprinose razlici ali su i dalje u granicama značajnosti su varijable „Druženje i upoznavanje novih ljudi" i varijabla „Unapređenje i održavanje tjelesne sposobnosti".

Varijable u kojima se najmanje ističe razlika između muškog i ženskog spola su „Izlazak iz kuće" i varijabla „Avantura i uzbuđenje".

Table 4. *χ2 differences and their significance with regard to the age of the respondents in the expressed attitudes towards physical activity*

Tabela 4. ***χ^2*** *razlike i njihova značajnost s obzirom na dob ispitanika u izraženim stavovima prema bavljenju fizičkom aktivnošću*

Variables / **Naziv varijable**	***Value /*** **Vrijednost χ^2**	***(Sig.)***
Improving or maintaining physical fitness / Unapređenje i održavanje tjelesne sposobnosti	136.007	.819
Maintaining vitality / Održavanje vitalnosti	161.674	.280
A sense of satisfaction / Osjećaj zadovoljstva	182.626	.046
Maintaining or improving health / Održavanje i poboljšanje zdravlja	125.572	.216
Relaxation / Opuštanje i relaksacija	157.974	.353

Maintaining or reducing body weight / Održavanje i smanjenje tjelesne težine	160.241	.308
Good look / Dobar izgled	226.215	.000
Fun / Zabava	220.617	.000
A sense of freedom. of independence / Osjećaj slobode i nezavisnosti	171.511	.133
Learning new knowledge and insights / Učenje novih znanja i spoznaja	189.112	.022
Getting out of the house / Izlazak iz kuće	170.948	.140
Socializing and meeting new people / Druženje i upoznavanje novih ljudi	197.033	.008
Adventure and excitement / Avantura i uzbuđenje	170.951	.139

Looking at the previous table, we can see that 5 (five) of the 13 (thirteen) variables have a pronounced statistical significance in the differences when it comes to attitudes about physical activity. The variables that contribute the most to the difference are "Good Look" and the "Fun" variable. It is assumed that this case occurred because it is much more important for respondents of younger age (-35 years) to achieve a good appearance through exercise, and to achieve some kind of fun, while for respondents of middle age (+35) it is much more important to maintain their health through exercise (Joint research center - European commission 2010).

In contrast, the variables that contribute the least to the difference but are still within the limits of significance are the variables "Learning new knowledge and insights" and the variable "Sense of satisfaction".

The variables in which the difference with regard to the age of the respondents is the least prominent are "Relaxation and relaxation" and the variable "Improvement and maintenance of physical ability".

Table 5. *χ2 differences and their significance with regard to the age of the respondents in the expressed attitudes towards physical activity in male respondents*

Uvidom u prethodnu tabelu možemo vidjeti da 5 (pet) od 13 (trinaest) varijabli ima izraženu statističku značajnost u razlikama kada su stavovi o bavljenju fizičkim aktivnostima u pitanju. Varijable koje najviše doprinose razlici su „Dobar izgled" i varijabla „Zabava". Pretpostavlja se da je do ovakvog slučaja došlo zbog toga što je ispitanicima mlađe starosne dobi (- 35 godina), mnogo bitnije da kroz vježbu postignu dobar izgled, te da postignu neku vrstu zabave, dok je ispitanicima srednje starosne dobi (+35) mnogo važnije da vježbanjem održavaju svoje zdravlje (Joint research centre - European commision 2010).

Nasuprot njima, odnosno varijable koje najmanje doprinose razlici ali su i dalje u granicama značajnosti su varijable „Učenje novih znanja i spoznaja" i varijabla „Osjećaj zadovoljstva".

Varijable u kojima se najmanje ističe razlika s obzirom na dob ispitanika su „Opuštanje i relaksacija" i varijabla „Unapređenje i održavanje tjelesne sposobnosti".

Tabela 5. *χ^2 razlike i njihova značajnost s obzirom na dob ispitanika u izraženim stavovima prema bavljenju fizičkom aktivnošću kod ispitanika muškog spola*

***Variables* / Naziv varijable**	***Value* / Vrijednost χ^2**	***(Sig.)***
Improving or maintaining physical fitness / Unapređenje i održavanje tjelesne sposobnosti	83.757	.743
Maintaining vitality / Održavanje vitalnosti	87.860	.631
A sense of satisfaction / Osjećaj zadovoljstva	119.786	.590
Maintaining or improving health / Održavanje i poboljšanje zdravlja	83.964	.738
Relaxation / Opuštanje i relaksacija	81.181	.804
Maintaining or reducing body weight / Održavanje i smanjenje tjelesne težine	94.966	.975
Good look / Dobar izgled	90.566	.552
Fun / Zabava	119.659	.593
A sense of freedom. of independence / Osjećaj slobode i nezavisnosti	117.523	.647
Learning new knowledge and insights / Učenje novih znanja i spoznaja	108.689	.835
Getting out of the house / Izlazak iz kuće	123.397	.498
Socializing and meeting new people / Druženje i upoznavanje novih ljudi	131.707	.301
Adventure and excitement / Avantura i uzbuđenje	123.256	.502

Looking at the previous table. we can see that there is no variable that has achieved a statistically significant difference in the expressed attitudes of male respondents with respect to their age. The variable that was closest to the statistically significant difference was "Socializing and meeting new people". while the variable "Maintaining and reducing body weight" contributed the least to the difference in these respondents with regard to age. It is assumed that this case occurred because it is much more important for male respondents of a younger age to meet and socialize with new people than for respondents of an older age. This is in any case only one of the possible roadmaps for authors who will be engaged in research of this type in the future.

Table 6. *χ2 differences and their significance with regard to the age of the respondents in the expressed attitudes towards physical activity in female respondents*

Uvidom u prethodnu tabelu možemo vidjeti da ne postoji niti jedna varijabla koja je ostvarila statistički značajnu razliku u izraženim stavovima kod ispitanika muškog spola obzirom na njihovu dob. Varijabla koja je bila najbliže statistički značajnoj razlici je „*Druženje i upoznavanje novih ljudi*", dok je varijabla „*Održavanje i smanjenje tjelesne težine*" najmanje doprinjela razlici kod ovih ispitanika obzirom na starosnu dob. Pretpostavlja se da je do ovakvog slučaja došlo zbog toga što je ispitanicima muškog spola mlađe starosne dobi mnogo važnije upoznavanje i druženje sa novim ljudima nego ispitanicima starije životne dobi. Ovo je u svakom slučaju samo jedan od mogućih putokaza autorima koji se budu bavili istraživanjima ovog tipa u budućnosti.

Tabela 6. *χ^2 razlike i njihova značajnost s obzirom na dob ispitanika u izraženim stavovima prema bavljenju fizičkom aktivnošću kod ispitanika ženskog spola*

***Variables* / Naziv varijable**	***Value* / Vrijednost χ^2**	***(Sig.)***
Improving or maintaining physical fitness / Unapređenje i održavanje tjelesne sposobnosti	131.640	.590
Maintaining vitality / Održavanje vitalnosti	121.321	.812
A sense of satisfaction / Osjećaj zadovoljstva	134.561	.519
Maintaining or improving health / Održavanje i poboljšanje zdravlja	123.749	.070
Relaxation / Opuštanje i relaksacija	119.529	.842
Maintaining or reducing body weight / Održavanje i smanjenje tjelesne težine	151.651	.170
Good look / Dobar izgled	151.820	.167
Fun / Zabava	180.173	**.007**
A sense of freedom. of independence / Osjećaj slobode i nezavisnosti	142.964	.324
Learning new knowledge and insights / Učenje novih znanja i spoznaja	146.853	.248
Getting out of the house / Izlazak iz kuće	128.727	.659
Socializing and meeting new people / Druženje i upoznavanje novih ljudi	152.139	.163
Adventure and excitement / Avantura i uzbuđenje	152.982	.152

Looking at the previous table. we can see that there is only 1 (one) variable that achieved a statistically significant difference in the expressed attitudes of female respondents with regard to their age. The only variable that made a statistically significant difference was "Fun". It is assumed that this case occurred because it is much more important for female respondents of a younger age to feel one form of entertainment through exercise and recreation.

The variable that was closest to the statistically significant difference was "Maintenance and improvement of health". while the variables "Relaxation and relaxation" and "Maintenance of vitality" contributed the least to the difference in these respondents with regard to age.

Uvidom u prethodnu tabelu možemo vidjeti da postoji samo 1 (jedna) varijabla koja je ostvarila statistički značajnu razliku u izraženim stavovima kod ispitanika ženskog spola obzirom na njihovu dob. Varijabla koja je jedina ostvarila statistički značajnu razliku je „Zabava". Pretpostavlja se da je do ovakvog slučaja došlo zbog toga što je ispitanicima ženskog spola mlađe životne dobi mnogo bitnije da kroz vježbu i rekreaciju osjete jedan vid zabave.

Varijabla koja je bila najbliže statistički značajnoj razlici je „Održavanje i poboljšanje zdravlja", dok su varijable „Opuštanje i relaksacija" i „Održavanje vitalnosti" najmanje doprinjele razlici kod ovih ispitanika obzirom na starosnu dob.

Conclusion

The development of sports recreation is inseparable from the development of technology and the general progress of modern society. The position of sports recreation is a significant link between a well-functioning individual with all his psychophysical potentials and society at all levels. The effects of sports recreation are measurable by socio-economic parameters. and in the notion of quality they take on a significant role in culture and lifestyle (Deci & Ryan, 1985). Regular and correct use of sports and recreational facilities. activities and programs guarantees a healthier. better and more meaningful life. Today's knowledge indicates that sports recreation generates a whole range of functions that are reflected in the development of society. The course of civilization should follow the quality of life of the creators of modern. developed society (Berger, Pargman & Weinberg, 2007). Based on the analysis of the results of this research. it seems justified to conclude that the active participation of middle-aged people in recreational physical activities contributes to the experience of better life satisfaction. Physical activity has a positive effect on the improvement and maintenance of functional abilities. and thus indirectly on the possibility of a longer independent life of the elderly. Active people are more often at a younger age. which is to be expected. because in middle and older age there is a weakening of functional abilities. But it is also causally consequential. because the preservation of functional abilities is possible through active recreational exercise. This research. as before. showed that people who are actively engaged in recreational exercise are more satisfied than those who do not (Ebben & Brudzynski, 2008). Also. this research shows that the strongest motivation for recreational exercise is maintaining and improving health. and certainly relaxation. After them. the most important motivation is socializing and meeting new people. and improving and maintaining physical ability. The research also showed that there are very small differences in the motives for exercise in relation to the age of the respondents. and they are reflected in good looks and fun. while relaxation and relaxation and improvement and maintenance of physical ability are equally important for all ages. There was no significant statistical difference in exercise motives in males compared to age. and the closest to a statistically significant difference was socializing and meeting new people. while maintaining and reducing body weight was equally important for all male ages. There is also no significant statistical difference in exercise motives when it comes to females. These findings should not be ignored in motiva-

Zaključak

Razvoj sportske rekreacije neodvojiv je od razvoja tehnologije i uopšte napretka savremenog društva. Pozicija sportske rekreacije predstavlja značajnu poveznicu kvalitetnog funkcionisana pojedinca sa svim svojim psihofizičkim potencijalima i društva na svim nivoima. Učinci sportske rekreacije mjerljivi su društveno-ekonomskim parametrima, a u poimanju kvalitete poprimaju značajnu ulogu u kulturi i stilu življenja (Deci i Ryan, 1985). Redovno i pravilno korištenje sportsko rekreativnih sadržaja, aktivnosti i programa daje jamstvo zdravijeg, kvalitetnijeg i sadržajnijeg života. Današnje spoznaje ukazuju da sportska rekreacija generira čitav niz funkcija koje se odražavaju na razvoj društva. Civilizacijski tok treba pratiti kvalitetu življenja samih stvaratelja savremenog, razvijenog društva (Berger, Pargman i Weinberg, 2007).

Na temelju analize rezultata ovog istraživanja čini se opravdanim zaključiti da aktivno učestvovanje osoba srednje životne dobi u rekreativnim tjelesnim aktivnostima doprinosi doživljaju boljeg zadovoljstva životom. Tjelesna aktivnost pozitivno utiče na poboljšanje i održavanje funkcionalnih sposobnosti, a time posredno i na mogućnost što dužeg samostalnog života starijih osoba. Češće su aktivne osobe u mlađoj starosnoj dobi, što je i za očekivati, jer u srednjoj i starijoj životnoj dobi dolazi do slabljenja funkcionalnih sposobnosti. Ali je i uzročno posljedično, jer je očuvanje funkcionalnih sposobnosti moguće kroz aktivno rekreativno vježbanje.

Ovo istraživanje je, kao i ranija, pokazalo da su zadovoljnije osobe koje se aktivno bave rekreativnim vježbanjem od onih koje to ne čine (Ebben i Brudzynski 2008).

Također, ovo istraživanje pokazuje da je najsnažnija motivacija za rekreativno vježbanje održavanje i poboljšanje zdravlja, te svakako opuštanje i relaksacija. Posle njih, najvažnija motivacija jeste druženje i upoznavanje novih ljudi, i unapređenje i održavanje tjelesne sposobnosti.

Sprovedeno istraživanje je pokazalo i to da postoje vrlo male razlike u motivima za vježbanje u odnosu na dob ispitanika, a one se ogledaju u dobrom izgledu i zabavi, dok je opuštanje i relaksacija i unapređenje i održavanje tjelesne sposobnosti jednako važno svim životnim dobima ispitanika.

Značajna statistička razlika u motivima za vježbanje kod muškog spola u odnosu na dob ne postoji, a najbliža statistički značajnoj razlici je bila druženje i upoznavanje novih ljudi, dok je održavanje i smanjenje tjelesne težine podjednako važno svim uzrastima muškog spola.

tional programs. Small gender and age differences open up opportunities for adaptation to certain groups. but in general. similar things are important to people when exercising. Continuous physical activity should be an indispensable measure of primary prevention of health protection of the elderly with the adoption of a healthy diet. avoidance of harmful habits (smoking. alcohol ...). maintenance of personal hygiene and cleanliness of the apartment. avoidance of harmful environmental influences. prevention of accidents and accidents. constant mental and work activities.

Također ne postoji značajna statistička razlika u motivima za vježbanje ni kada je ženski spol u pitanju.

Ove nalaze ne treba zanemariti u motivacijskim programima. Male spolne i dobne razlike otvaraju mogućnosti za prilagodbu određenim skupinama, ali generalno, ljudima su slične stvari važne pri vježbanju.

Stalna tjelesna aktivnost trebala bi biti neizostavna mjera primarne prevencije zaštite zdravlja starijih osoba uz prihvaćanje zdrave prehrane, izbjegavanje štetnih navika (pušenje, alkohol...), održavanje lične higijene i čistoće stana, izbjegavanje štetnih uticaja iz okoline, spriječavanje nezgoda i nesreća te održavanje stalne psihičke i radne aktivnosti.

References

Berger, B., Pargman, D., & Weinberg, R. (2007). *Foundations of Exercise Psychology*. Chapter 3, Exercise and quality of life. Inc, U.S. Fitness Information Technology. 40-64.

Campbell, W.K., Sedikides, C., & Harackiewicz, J.M. (2000). Competence valuation as a strategic intrinsic motivation process. *Personality and Social Psychology Bulletin*, 26 (7), 780-794.

Deci, E.L., & Ryan, R.M. (1985). Motivation and self determination in human behavior. *NY: Plenum Publish Co.*

Deci, E.L., & Ryan, R.M. (1995). Self-Determination Theory and the Facilitation of Intrinsic Motivation, *Social Development and Well-Being*. University of Rochester.

Ebben, W., Brudzynski L. (2008). Motivations and barriers to exercise among college students. *Journal of Exercise Physiology Online*. 11(5):1-10.

Fishbein, M., & Ajzen, I. (1975). Belief, Attitude, Intention, and Behavior: *An Introduction to Theory and Research*. Reading, MA: Addison-Wesley.

Primljen: 01. jun 2021. / Received: June 01, 2021
Prihvaćen: 31. avgust 2021. / Accepted: August 31, 2021

https://doi.org/10.7251/SSH2102215A
Original scientific paper

UDC: 159.947.5-057.875:796.011.1
Originalni naučni rad

Students 'Habits and Attitudes Towards the Contents of Sports Recreation

Navike i stavovi studenata prema sadržajima sportske rekreacije

Džafer Alić, Rijad Novaković, Damir Đedović

Faculty of Education "Džemal Bijedić University" in Mostar, Bosnia and Herzegovina

Correspondence:
Rijad Novaković, Faculty of Education "Džemal Bijedić University" in Mostar, Bosnia and Herzegovina, rijad.novakovic@unmo.ba

Nastavnički fakultet „Univerzitet" Džemal Bijedić" u Mostaru, Bosna i Hercegovina

Korespondencija:
Rijad Novaković, Nastavnički fakultet „Univerzitet" Džemal Bijedić" u Mostaru, Bosna i Hercegovina, rijad.novakovic@unmo.ba

Abstract: *Insufficient physical activity is the fourth leading risk factor for mortality. According to the World Health Organization (WHO, 2012), people who are insufficiently physically active have a 20% to 30% increased risk of all-cause mortality compared to those who engage in at least 30 minutes of moderate-intensity physical activity each day. Previous research has confirmed that regular physical activity and well-organized leisure time improves human health and affects the prevention of a number of diseases. The purpose of this paper was to show the habits and attitudes towards the contents of sports recreation through a survey conducted on a sample of students from the University "Džemal Bijedić" in Mostar. 331 students participated in the survey. Of the total number of respondents, 81% are active as athletes and recreational athletes. It is important to emphasize that out of the total number of respondents, 27.8% decide for activities in gyms and exercises on devices.*

Keywords: *sports recreation, students, free time.*

Sažetak: *Nedovoljna tjelesna aktivnost je četvrti vodeći faktor rizika za smrtnost. Prema podacima Svjetske zdravstvene organizacije (WHO, 2012), ljudi koji su nedovoljno fizički aktivni imaju 20% do 30% povećan rizik od smrtnosti od svih uzroka u usporedbi s onima koji učestvuju u najmanje 30 minuta tjelesne aktivnosti umjerenog intenziteta svaki dan. Dosadašnja istraživanja su potvrdila da redovna tjelesna aktivnost i kvalitetno organizovano slobodno vrijeme poboljšava ljudsko zdravlje i utiče na sprječavanje niz bolesti. Svrha ovoga rad bila je da se anketom, provednom na uzorku studenata Univerziteta "Džemal Bijedić" u Mostaru, prikažu navike i stavovi prema sadržajima sportske rekreacije. U anketiranju je učestvovalo 331 studenata. Od ukupnog broja ispitanika 81 % je aktivno kao sportisti i rekerativci. Bitno je i naglasiti da od ukupnog broja ispitanika, 27,8 % se odlučuje za aktivnosti u teretanama i vježbama na spravama.*

Ključne riječi: *Sportska rekreacija, studenti, slobodno vrijeme.*

Introduction

Sports recreation is a freely chosen activity that is carried out in free time. Sports recreation uses the contents of sports and physical exercise in order to meet the need for movement and physical activity (Hadžikadunić et al. 2002). For the student population, regular physical exercise is of great importance due to excessive learning and sitting. All contents of sports, as well as activities in nature are of great importance for the proper functioning of the organism, especially in moments of weaker physical engagement and great psychological load. In the accelerated pace of modern life, especially in the city, there is more and more free time, but it is less and less used for one's own needs (Andrijašević, 2000). Regular moderate physical activity has a positive effect on maintaining health and preventing various diseases, but also the prevention of some forms of tumors, diabetes and osteopo-

Uvod

Sportska rekreacija je slobodno odabrana aktivnost koja se provodi u slobodno vrijeme. Sportska rekreacija koristi sadržaje sporta i tjelesnog vježbanja u cilju zadovoljavanja potrebe za kretanjem i tjelesnom aktivnošću (Hadžikadunić i sar. 2002.). Za studentsku populaciju od velikog značaja je redovno tjelesno vježbanje zbog prekomjernog učenja i sjedenja. Svi sadržaji sporta, kao i aktivnosti u prirodi su od velikog značaja za pravilno funkcionisanje organizma, a posebno u momentima slabijeg kretnog angažmana i velikog psihološkog opterećenja. U ubrzanom tempu modernog života, posebno u gradu, sve je više slobodnog vremena, ali se ono sve manje koristi za vlastite potrebe (Andrijašević, 2000). Redovita umjerena tjelesna aktivnost pozitivno utječe na očuvanje zdravlja i prevenciju raznih bolesti, ali i prevenciju nekih oblika tumora, dijabetesa i osteoporoze

rosis in adults (Pate et al. 1995). Research by Ostojić et al. (2003) show that about 80% of the population is insufficiently physically active, and that in most developed countries over 50% of the population is overweight. According to Ghofrani and Golsanamlou, (2012), and Ünlü, et al. (2011), it is very important in this period to create quality conditions for exercise and sports, in which physical education should play a major role.

Methods of Work

Sample of respondents for the academic year 2020/21. year, consisted of a total of 331 students from different organizational units of the University "Džemal Bijedić" in Mostar (143 males and 188 females). The age of the respondents ranged from 18 to 36 years of age. Data that reflect the habits, attitudes and opinions of students towards sports recreation and sports and recreational activities that they spend in their free time, were collected through a questionnaire. The data is processed in the Microsoft Excel package. All respondents filled out a questionnaire containing 21 items with offered answers and questions with a score from 1 to 5. To collect data in this study, the survey method was used, which belongs to sociological methods, and which consists of a series of prepared questions. the student seeks an answer (Haralambos & Holborn, 2002). The basic value of the survey is to obtain a large amount of data from a large number of respondents in a relatively short time (Čolakhodžić, 2021). The free web package Google docs Editors and Google Forms (survey software) was used. The questionnaire was done in Google forms and the survey was conducted online.

Results and Discussion

Students from the Džemal Bijedić University in Mostar, distributed by organizational units, participated in this research (Table 1). Most respondents were from the Faculty of Economics (16.9%), and the least respondents from the Study Program of Interior Design (0.6%). Respondents play sports recreationally, 71.6% of them, while at the competitive level 9.4% of them play sports. 19% of respondents do not play sports. (Table 2). Based on the results, it can be concluded that out of the total number of students, 81% of them play sports in their free time. Breslauer, N. and Martinić, T. (2013) in their research came to the data that 70% of respondents engage in some sports and recreational activity. Ćurković (2009) states that 66% of students at the University of Zagreb do not participate in physical activities, and only 2% are

kod odraslih (Pate i sar. 1995.). Istraživanje Ostojića i sar. (2003) pokazuju da je oko 80% populacije nedovoljno fizički aktivno, te da u većini razvijenih zemalja preko 50% populacije ima višak kilograma. Prema Ghofrani i Golsanamlou, (2012), te Ünlü, i sar. (2011), vrlo je bitno u ovom periodu stvoriti kvalitetne uslove za vježbanje i bavljenje sportom, u čemu veliku ulogu treba da ima nastava fizičkog vaspitanja.

Metode rada

Uzorak ispitanika za akademsku 2020/21. godinu, sastojao se od ukupno 331 studenta različitih organizacionih jedinica Univerziteta „Džemal Bijedić" u Mostaru (143 muškog spola i 188 ženskog spola). Dob ispitanika je bila od 18 do 36 godina starosti. Podaci koji odražavaju navike, stavove i mišljenja studenata prema sportskoj rekreaciji i sportsko rekreativnim aktivnostima koje provode u slobodno vrijeme, prikupljani su postupkom anketnog upitnika. Podaci su obrađeni u Microsoft paketu Excelu. Svi su ispitanici ispunjavali upitnik koji je sadržavao 21 česticu sa ponuđenim odgovorima i pitanjima sa ocjenom od 1 do 5. Za prikupljanje podataka u ovom istraživanju je primijenjena metoda ankete koja pripada sociološkim metodama, a koja se sastoji se od niza pripremljenih pitanja na koja se od studenata traži odgovor (Haralambos & Holborn, 2002). Osnovna vrijednost ankete je dobijanje velikog broja podataka od velikog broja ispitanika za relativno kratko vrijeme (Čolakhodžić, 2021.)

Korišten je besplatni web paket Google docs Editors i Google Forms (softver za ankete). Upitnik je urađen u Google obrascima i ispitivanje je sprovedeno on line.

Rezultati i diskusija

U ovom istraživanju (Tabela 1.) učestvovali su studenti Univerziteta „Džemal Bijedić" u Mostaru raspoređeni po organizacionim jedinicama. Najviše ispitanika je bilo sa Ekonomskog fakulteta (16,9 %), a najmanje ispitanika sa Studijskog programa dizajna interijera (0,6 %).

Ispitanici se rekreativno bave sportom, njih 71,6 % , dok se na takmičarskom nivou njih 9,4 % bavi sportom. 19% ispitanika se ne bavi sportom. (Tabela 2.). Na osnovu rezultata može se zaključiti da se od ukupng broja studenata, njih 81% bavi sportom u slobodno vrijeme. Breslauer, N. i Martinić, T. (2013.) u svom istraživanju su došli do podatka da se 70% ispitanika bavi nekom sportsko rekreativnom aktivnošću. Ćurković (2009.), navodi podatak da 66% studenata zagrebačkog Sveučilišta ne participira u tjelesnim aktivnostima, a samo 2% se aktivno bavi sportom.

Podaci provedenog istraživanja slični su podacima

actively involved in sports. The data from the study are similar to those of foreign authors (Leslie et al., 1999; Pate et al., 1995), whose results indicate that less than 50% of students in the United States and Australia engage in physical activity. In the further analysis of the obtained data (Table 3), the respondents mostly spend physical exercise in training with equipment, ie in the gym (27.8%), followed by team sports with the ball (23.9%). Respondents are the least involved in sports with racquet (0.6%), yoga (0.6%), athletics (0.9%), swimming (0.9%). It can be concluded that students mostly participate in the contents of recreational activities of individual character that they can design, to a lesser extent in organized programs (aerobics and fitness programs), while also a high percentage of team sports, which are close to male students. Tendencies of such distributions of activities were also obtained in the research of Andrijašević et al. (2005). In Table 4, the respondents stated the length of engaging in certain sports activities, so that out of the total number of respondents, 33.4% of them spend most of their lives playing sports, while 22.4% of respondents play sports for several years (1 year or more). Up to a year of playing sports, a total of 25.7% of respondents said they had just started playing sports - 7.3%, playing sports for 3-6 months - 12.4%, playing sports for 6-12 months-6 %). The total frequency of sports (Table 5) at the weekly level is 1 time per week - 15.7%, 2 to 3 times a week 43.8% of respondents go in for sports, and more than 4 times a week 23% of respondents go in for sports. The duration of training up to 30 minutes is 11.2% of respondents. 26.3% of respondents spend 60 minutes training, 31.1% of respondents spend 1 hour and 30 minutes exercising, while 15.4% of respondents spend 2 hours or more on their sports activities. (Table 6) In Table 7, respondents listed the reasons for playing sports or recreation, so that 25.4% of respondents cited maintaining and improving health as a reason to play sports, then love of sports (20.5%), a sense of satisfaction (14 , 8%). Respondents stated that it is least important for them to carry out sports activities due to the regulation of body weight. Feelings that prevail in respondents (Table 8) who conduct sports activities are different, but most indicate a sense of satisfaction during exercise (65.9%), followed by a sense of achievement (15.7%), euphoria (5.4%), while 3.9% of respondents have a lack of interest or even negative feelings (0.9%). One of the important factors in the implementation and selection of sports and recreational content is motivation (Table 9). Of the total number, 26% of respondents cited love of a particular sport as motivation. Also, the motive for physical exercise is the desire

istraživanja stranih autora (Leslie i sur., 1999.; Pate i sur., 1995.) čiji rezultati ukazuju da se u SAD-u i Australiji tjelesnim aktivnostima bavi manje od 50% studenata.

U daljoj analizi dobijenih podataka (Tabela 3.) ispitanici najviše provode tjelesno vježbanje u treningu sa spravama, odnosno u teretani (27,8 %), zatim slijede timski sportovi sa loptom (23,9 %). Najmanje se ispitanici bave sportovima sa reketom (0,6 %), jogom (0,6 %), atletikom (0,9 %), plivanje (0,9 %). Može se zaključiti da studenti najviše učestvuju u sadržajima rekreacijskih aktivnosti individualnog karaktera koje mogu sami osmišljavati, manjim dijelom u organizovanim programima (aerobika i *fitness* programi), dok također visok procent učešća čine ekipni sportovi, koji su bliski muškoj populaciji studenata. Tendencije takvih raspodjela aktivnosti dobivene su i u istraživanju Andrijašević i sur. (2005.).

U tabeli 4. ispitanici su naveli dužinu bavljenja određenom sportskom aktivnošću, tako da se od ukupnog broja ispitanika njih 33,4 % se većinu svog života bave sportom, dok se 22,4 % ispitanika bavi sportom nekoliko godina (1 godinu i više). Do godinu dana bavljenja sportom izjasnilo se ukupno 25,7 % ispitanika (tek sam se počeo baviti sportom - 7,3 %, bavim se sportom od 3-6 mjeseci - 12,4 %, bavim se sportom od 6-12 mjeseci-6%).

Ukupna učestalost bavljenja sportom (Tabela 5.) na sedmičnom nivou iznosi za 1 put sedmično- 15,7 %, 2 do 3 puta sedmično se bavi sportom 43,8 % ispitanika, a više od 4 puta sedmično 23 % ispitanika se bavi sportom.

Trajanje treninga do 30 minuta iznosi za 11,2 % ispitanika. Trening od 60 minuta provodi 26,3 % ispitanika, a 31,1 % ispitanika provede 1 sat i 30 minuta vježbajući, dok 15,4 % ispitanika za svoje sportske aktivnosti odvoji 2 sata i više. (Tabela 6.)

U tabeli 7. ispitanici su naveli razloge zbog kojih se bave sportom ili rekreacijom, tako da je 25,4 % ispitanika navelo očuvanje i unapređenje zdravlja kao razlog za bavljenje sportom, zatim ljubav prema sportu (20,5 %), osjećaj zadovoljstva (14,8 %). Ispitanici su naveli da im je najmanje bitno provoditi sportsku aktivnost zbog regulisanja tjelesne težine.

Osjećaji koji vladaju u ispitanicima (tabela 8.) koji provode sportske aktivnosti su različiti, ali najviše navode osjećaj zadovoljstva tokom vježbanja (65,9 %), zatim osjećaj postignuća (15,7 %), euforije (5,4 %), dok se kod 3,9 % ispitanika javlja nezainteresiranost ili čak negativni osjećaji (0,9 %).

Jedan od bitnih faktora u provođenju i odabiru sportsko-rekreativnih sadržaja je i motivacija (Tabela 9.). Od ukupnog broja, 26% ispitanika je kao motivaciju na-

to change and improve health (14.8%). Physical appearance is also a motivation for 10% of respondents, while friends have the least influence on motivation (2.7%).

Regarding the impact of sports and recreational activities on the quality of life of the student population (Table 10), 95.2% of them confirmed that sports and recreation have a positive effect on the quality of life, while 1.2% of respondents believe the opposite. Regarding the impact of sports recreation on health (Table 11), 68% of them believe that sports recreation has a lot of impact on health, while 23.3% of respondents believe that it has a lot of impact. In Table 11. 52.3% of respondents found that a lot of sports recreation affects the appearance, and 35% of them said that it has a lot of influence. As an important factor in sports recreation is its impact on affirmation in society (Table 11). 32% of respondents stated that they have a lot of influence on affirmation in society, while 28.1% stated a lot. While 4.5% of respondents believe that sports recreation does not affect the affirmation in society. Prot and Radić (2010) state that the attitude towards physical exercise and sports is an important factor in the preference and choice of sports, and these attitudes can be decisive mediators on which the effectiveness of teaching depends. In Table 11. 33.5% of respondents believe that a lot of sports recreation affects attractiveness, while 30.8% think that a lot affects attractiveness. Sports recreation is also considered a part of entertainment and leisure (Table 11), so 43.2% of respondents stated that sports recreation has a great impact on entertainment, and 26.6% of respondents believe that it has a lot of impact. Social interaction and socializing (Table 11) is an important factor in sports recreation, which was confirmed by 43.8% of respondents as having a lot of influence, while 25.7% of respondents believe that it has a lot of influence on socializing. Active vacation, free time and other life activities are correlated with the contents of sports recreation. As many as 56.8% of respondents (Table 11) believe that sports recreation has a great impact on rest from other life activities, while 22.7% believe that it has a lot of impact. Sports recreation has a great impact on the quality of life was confirmed by 67.4% of respondents and as much as it affects 23.3% of respondents (Table 11) Of the total number of respondents, 72.5% stated that it is very important to engage in sports recreation, while 20.2% believe that engaging in sports recreation is very important.

velo ljubav prema određenom sportu. Također, motiv za tjelesno vježbanje je i želja za promjenim i poboljšanje zdravlja (14,8 %). Kao motivacija za 10 % ispitanika je i fizički izgled, dok najmanji uticaj na motivaciju imaju prijatelji (2,7 %).

O uticaju sportsko-rekreativnih aktivnosti na kvalitet života studentske populacije (Tabela 10.), njih 95,2 % je potvrdilo da sportska-rekreacija pozitivno utiču na kvalitet života, dok 1,2 % ispitanika smatra suprotno.

O uticaju sportske rekreacije na zdravlje (Tabela 11.) njih 68 % smatra da jako mnogo sportska rekreacija utiče na zdravlje, dok 23,3% ispitanika smatra da mnogo utiče.

U tabeli 11. 52,3 % ispitanika je utvrdilo da jako mnogo sportska rekreacija utiče na izgled, a njih 35 % je navleo da mnogo utiče.

Kao bitan faktor sportske rekreacije je i njen uticaj na afirmaciju u društvu (Tabela 11.). Da mnogo utiče na afirmaciju u društvu, navelo je 32 % ispitanika, dok 28,1 % je navleo jako mnogo. Dok 4,5 % ispitanika smatra da sportska rekreacija nikako ne utiče na afirmaciju u društvu. Prot i Radić (2010) navode da je stav prema fizičkom vježbanju i sportu bitan činilac preferencije i izbora sporta i ti stavovi mogu biti odlučujući medijatori od kojih zavisi učinkovitost nastave.

U tabeli 11. 33,5 % ispitanika smatra da jako mnogo sportska rekreacija utiče na privlačnost, dok 30,8 % smatra da mnogo utiče na privlačnost.

Sportska rekreacija se smatra i dijelom zabave i razonode (Tabela 11.), tako da 43,2 % ispitanika su naveli da sportska rekreacija jako mnogo utiče na zabavu, a 26,6 % ispitanika smatra da mnogo utiče.

Socijalna interakcija i druženje (Tabela 11.) je bitan faktor sportske rekreacije, što je i potvrdilo 43,8 % ispitanika kao jako mnogo utiče, dok 25,7 % ispitanika smatra da mnogo utiče na druženje.

Aktivan odmor, slobodno vrijeme i ostale životne aktivnosti su u korelaciji sa sadržajima sportske rekreacije. Čak 56,8 % ispitanika (Tabela 11.) smatra da sportska rekreacija jako mnogo utiče na odmor od ostalih životnih aktivnosti , dok 22,7 % smatra da mnogo utiče.

Sportska rekreacija jako mnogo utiče na kvalitet života je potvrdilo 67,4 % ispitanika i kao mnogo utiče 23,3% ispitanika (Tabela 11.)

Od ukupnog broja ispitanika, 72,5 % je navelo da je jako važno baviti se sportskom rekreacijom, dok 20,2 % smatra je mnogo važno bavljenje sportskom rekreacijom.

Table 1. *Percentage of students by organizational units*

Organizational unit	% of students from total number of respondents
Faculty of Economics	16.9 %
Law School	10.3%
Civil Engineering	10%
Faculty of Mechanical Engineering	22.4
Faculty of Information Technology	1%
Faculty of Education	10.9%
Faculty of Agromediterranean	1.5%
Faculty of Humanities	9.1%
Tourism study program	4.8%
Interior design study program	0.6%
Health study program	13.3

Tabela 1. *Procenat studenata prema organizacionim jedinicama*

Organizaciona jedinica	% studenata od ukupnog broja ispitanika
Ekonomski fakultet	16,9 %
Pravni fakultet	10,3%
Građevinski fakultet	10%
Mašinski fakultet	22,4
Fakultet informacionih tehnologija	1%
Nastavnički fakultet	10,9%
Agromediteranski fakultet	1,5%
Fakultet humanističkih nauka	9,1%
Studijski program turizma	4,8%
Studijski program dizajn interijera	0,6%
Studijski program zdravstva	13,3

Table 2. *Do you do sports competitively or recreationally?*

Competitive	9.4 %
Recreational	71.6 %
I don't play sports	19 %

Tabela 2. *Bavite li se sportom takmičarski ili rekreativno?*

Takmičarski	9,4 %
Rekreativno	71,6 %
Ne bavim se sportom	19 %

Table 3. *What activity do you do?*

Team sports with the ball	23.9 %
Cycling	5.1 %
Athletics	0.9 %
Aerobics	3.6 %
Gym	27.8 %
Racket sports	0.6 %
Jogging	7.6 %
Mountain climbing	3.3 %
Swimming	0.9 %
Yoga	0.6 %
Dance	2.1 %
Martial arts	3 %
I do not do sports / recreation	15.4 %
Other	5.1 %

Tabela 3. *Kojom se aktivnošću bavite?*

Timski sportovi s loptom	23,9 %
Biciklizam	5,1 %
Atletika	0,9 %
Aerobik	3,6 %
Teretana	27,8 %
Sportovi s reketom	0,6 %
Trčanje	7,6 %
Planinarenje	3,3 %
Plivanje	0,9 %
Yoga	0,6 %
Ples	2,1 %
Borilački sportovi	3 %
Ne bavim se sportom/rekreacijom	15,4 %
Ostalo	5,1 %

Table 4. *How long have you been involved in a particular sporting activity?*

I'm just getting started	7.3 %
From 3-6 months	12.4 %
From 6-12 months	6 %
Several years	22.4 %
Most of my life	34.1 %
I don't play sports	17.8 %

Table 5. *How many times a week do you do sports?*

1 X per week	15.7 %
2 - 3 X per week	43.8 %
More than 4 X per week	23 %
I don't do sports	17.5 %

Table 6. *On average, how much time do you spend on one training / sports activity?*

30 minutes	11.2 %
1 hour	26.3 %
1 and a half hours	31.1 %
2 hours and more	15.4 %
I don't train	16 %

Table 7. *State the reason why you do sports?*

Out of love for sports	20.5 %
For the preservation and improvement of health	25.4 %
Because of his physical appearance	11.5 %
Due to improved fitness	7.6 %
To achieve the desired body weight	5.7 %
Because of the feeling of satisfaction	14.8 %
Other	14.5 %

Table 8. *What feelings does sports activity evoke in you?*

Satisfaction	65.9 %
Attainment	15.7 %
Euphoria	5.4 %
Negative feelings	0.9 %
Disinterest	3.9 %
Other	8.2 %

Tabela 4. *Koliko dugo se bavite određenom sportskom aktivnošću?*

Tek sam počeo/la	7,3 %
Od 3-6 mjeseci	12,4 %
Od 6-12 mjeseci	6 %
Nekoliko godina	22,4 %
Većinu svog života	34,1 %
Ne bavim se	17,8 %

Tabela 5. *Koliko puta sedmično se bavite sportskom aktivnošću?*

1 X sedmično	15,7 %
2 - 3 X sedmično	43,8 %
Više od 4 X sedmično	23 %
Ne bavim se sportskom aktivnošću	17,5 %

Tabela 6. *Koliko vremena prosječno izdvojite za jedan trening / sportsku aktivnost?*

30 minuta	11,2 %
1 sat	26,3 %
1 i pol sat	31,1 %
2 sata i više	15,4 %
Ne treniram uopšte	16 %

Tabela 7. *Navedite razlog iz kojeg se bavite sportskom aktivnošću?*

Iz ljubavi prema sportu	20,5 %
Zbog očuvanja i unapređenja zdravlja	25,4 %
Zbog fizičkog izgleda	11,5 %
Zbog poboljšanja kondicije	7,6 %
Zbog postizanja željene tjelesne težine	5,7 %
Zbog osjećaja zadovoljstva	14,8 %
Ostalo	14,5 %

Tabela 8. *Koje osjećaje sportska aktivnost izaziva u Vama?*

Zadovoljstvo	65,9 %
Postignuće	15,7 %
Euforija	5,4 %
Negativni osjećaji	0,9 %
Nezainteresiranost	3,9 %
Ostalo	8,2 %

Table 9. *What motivated you to engage in a particular sporting activity?*

Friend (s)	2.7 %
The desire for change	14.8 %
Improving health	14.8 %
Achieving the desired body weight	7.6 %
Achieving the desired physical appearance	10 %
Desire to improve fitness	7.3 %
Love of a particular sport	26 %
Other	16.9 %

Tabela 9. *Šta vas je motivisalo da se bavite sa određenom sportskom aktivnošću?*

Prijatelj/i	2,7 %
Želja za promjenom	14,8 %
Poboljšanje zdravlja	14,8 %
Postizanje željene tjelesne težine	7,6 %
Postizanje željenog fizičkog izgleda	10 %
Želja za poboljšanjem kondicije	7,3 %
Ljubav prema određenom sportu	26 %
Ostalo	16,9 %

Table 10. *Do you think that sports activity has a positive effect on the quality of life of students?*

Yes	95.2 %
Not	1.2 %
I do not know	3.6 %

Tabela 10. *Smatrate li da sportska aktivnost pozitivno utječe na kvalitet života studenata?*

Da	95,2 %
Ne	1,2 %
Ne znam	3,6 %

Table 11. *Values of statements on the impact of sports and recreation on some segments of life (1-not at all 2, 3, 4, 5-very much)*

Tabela 11. *Vrijednosti tvrdnji ua uticaj sporta i rekeracije na neke segmente života (1-nimalo 2, 3, 4, 5- jako mnogo)*

	1	2	3	4	5
To what extent do you believe that sports and recreation affect health? / U kojoj mjeri smatrate da sport i rekreacija utječu na zdravlje?	1.2 %	0.9 %	6.6 %	23.3 %	68%
To what extent do you think sports and recreation affect appearance? / U kojoj mjeri smatrate da sport i rekreacija utječu na izgled?	0.6 %	0.6%	11.5 %	35 %	52.3 %
To what extent do you believe that sports and recreation affect affirmation in society? / U kojoj mjeri smatrate da sport i rekreacija utječu na afirmaciju u društvu?	4.5 %	7.6 %	27.8 %	32 %	28.1 %
To what extent do you think sports and recreation affect attractiveness? / U kojoj mjeri smatrate da sport i rekreacija utječu na privlačnost?	2.4 %	4.5 %	28.7 %	30.8 %	33.5 %
To what extent do you think sports and recreation affect entertainment? / U kojoj mjeri smatrate da sport i rekreacija utječu na zabavu?	2.7 %	6.9 %	20.5 %	26.6 %	43.2 %
To what extent do you think that sports and recreation affect socializing? / U kojoj mjeri smatrate da sport i rekreacija utječu na druženje? / U kojoj mjeri smatrate da sport i rekreacija utječu na odmor od ostalih aktivnosti (učenje, društvene mreže, ostale obaveze)?	3.6 %	5.4 %	21.5 %	25.7 %	43.8 %
To what extent do you think that sports and recreation affect the break from other activities (learning. social networks. other obligations)?	3 %	3.6 %	13.9 %	22.7 %	56.8 %
To what extent do you think that sports and recreation affect the quality of life? / U kojoj mjeri smatrate da sport i rekreacija utječu na kvalitet života?	0.9 %	0.3 %	8.2 %	23.3 %	67.4 %
Rate the importance of playing sports / recreation? / Ocijenite važnost bavljenja sportom/rekreacijom?	1.5 %	0.3 %	5.4 %	20.2 %	72.5 %

Conclusion

One of the ways to spend free time are sports recreation activities. A physically active lifestyle reduces the risks of many chronic diseases, relieves stress, depression and anxiety, improves only confidence, mood and

Zaključak

Jedan od načina provođenja slobodnog vremena su aktivnosti sportske rekreacije. Tjelesno aktivan način života smanjuje rizike za nastanak mnogih hroničnih oboljenjam, ublažava stanje stresa , depresije i anksioznosti,

life satisfaction. Analyzing the results of the questionnaire, we can conclude that the students of the University "Džemal Bijedić" mostly have positive attitudes towards sports and recreational activities in their free time, and also actively participate in sports and recreational activities, as many as 81%, as active athletes and recreationists . It is important to emphasize that out of the total number of respondents, 27.8% decide for activities in gyms and exercises on devices. What is disappointing is the organized teaching process in the field of physical and health education and sports activities at the University "Džemal Bijedić", where of all the organizational units, only the Faculty of Teacher Education and Law have classes in the field of sports. The results of the research show a further need for actions aimed at strengthening a positive attitude towards sports activities, which should play an important role in the future curriculum in all study groups.

poboljšava samo pouzdanje, raspoloženje i zadovoljstvo životom. Analizirajući dobijene rezultate anketnog upitnika, možemo zaključiti da studenti Univerziteta „Džemal Bijedić" u večini imaju pozitivne stavove prema sportsko-rekreativnim aktivnostima u slobodno vrijeme, a također i aktivno sudjeluju u sportsko-rekreativnim aktivnostima, čak njih 81 %, kao aktivni sportisti i rekerativci. Bitno je i naglasiti da od ukupnog broja ispitanika , 27,8 % se odlučuje za aktivnosti u teretanama i vježbama na spravama. Ono što je razočaravajuće, jeste organizovan nastavni proces iz oblasti tjelesnog i zdravstvenog odgoja i sportskih aktivnosti na Univerzitetu „Džemal Bijedić, , gdje od svih organizacionih jedinica samo Nastavnički i Pravni fakultet imaju nastavu iz oblasti sporta. Rezultati istraživanja pokazuju daljnju potrebu za akcijama usmjerenim na jačanje pozitivnog stava prema sportskim aktivnostima koji bi trebali zauzeti bitnu ulogu u budućem nastavnom planu na svim studijskim grupama.

References

Andrijašević M. (2000): Slobodno vrijeme i igra, M. Andrijašević (ur.), Zbornik radova 9. Zagrebački sajam sporta i nautike, Zagreb, 2000, (pp. 7- 15), *Zagrebački športski savez, Zagrebački velesajam, Fakultet za fizičku kulturu*. [in Croatian]

Andrijašević, M., Paušić, J., Bavčević, T., & Ciliga, D. (2005.). Participation in leisure activities and self – perception of health in the students of University of Split. *Kinesiology*, 37,1, 21-31.

Breslauer, N. i Martinić, T. (2013). Stavovi studenata prema sportsko-rekreacijskim aktivnostima. *Zbornik radova Međimurskog veleučilišta u Čakovcu*, 4 (2), 43-47. Preuzeto s https://hrcak.srce.hr/113473. [in Croatian]

Čolakhodžić E. (2021). *Metodologija i tehnologija naučnoistraživačkog rada*. Mostar: Univerzitet „Džemal Bijedić" u Mostaru. [in Croatian]

Ćurković, S., Bagarić, I., Straža, O., i Šuker, D. (2009.). Angažiranost studenata u sportsko- rekreativnim izvannastavnim aktivnostima tjelesne i zdravstvene kulture. U B. Neljak (ur.), *Zbornik radova 18. Ljetne škole kineziologa Republike Hrvatske. Zagreb: Hrvatski kineziološki savez*, str. 400-403. [in Croatian]

Ghofrani, M., & Golsanamlou, M. (2012). Students perception of physical education courses and its relationship with their participation in sport activities. *Sport Scientific & Practical Aspects*, 9(1), 21–31.

Hadžikadunić M., Demir M., Haseta M., Pašalić E. (2002). *Sportska rekreacija*. Fakultet za fizičku kulturu. Sarajevo. [in Bosnian]

Haralambos, M., & Holborn, M. (2002). *Sociologija-teme i perspektive*. Zagreb: Golden marketing. [in Croatian]

Leslie, E., Owen, N., Salmon, J.,Bauman, A., Sallis, JF., & Kai Lo, S. (1999.). Insufficiently Active Australian College Students: Perceived Personal, Social, and Environmental Influences. *Preventive Medicine* 28 /on line/. na web stranici:

Ostojić, S., Mazić, S., & Dikić, N. (2003). *Telesne masti i zdravlje*. Beograd: Udruženje za medicinu sporta Srbije. [in Serbian]

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., ... & Wilmore, J. H. (1995). Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Jama*, *273*(5), 402-407.

Prot, F., & Radić, K. (2010). Stav studentica i studenata Kineziološkog fakulteta prema borilačkim sportovima. U: Findak, V. (ured.), 19. *Ljetna škola kineziologa Republike Hrvatske „Individualizacija rada u područjima edukacije, sporta, sportske rekreacije i kineziterapije"* (str. 172–176). Zagreb: Hrvatski kineziološki savez. [in Croatian]

Ünlü, H., Karahan, M., Aydos, L., & Öner M. (2011). A comparative study: The attitudes of Turkish and foreign male students to the physical education lesson. *Croatian Journal of Education*, 13(1), 169–187.

http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6WPG-45FJX06 711&_cdi=6990&_user=3875467&_pii=S0091743598903759&_orig=search&_cover Date=01%2F31%2F1999&_sk=999719998&view=c&wchp=dGLzVzbzSkzV&md5=5048177fbc72207b35c3a363b54ad919&ie=/sdarticle.pdf. Pristupljeno 25. novembar 2021.

WHO (2012).*https://apps.who.int/gb/NCDs/pdf/A_NCD_2-en.pdf.* Pristupljeno 25. novembar 2021.

Primljen: 12. novembar 2021. / Received: November 12, 2021
Prihvaćen: 19. novembar 2021. / Accepted: November 19, 2021

https://doi.org/10.7251/SSH2102223L
Original scientific paper

UDC: 796.41-055.26:796.011.1
Originalni naučni rad

Influence of Physical Activity on Microcirculatory Changes in Healthy Pregnant Women

Uticaj fizičke aktivnosti na mikrocirkulatorne promjene kod zdravih trudnica

Vesna Ljubojević[1], Vlatka Bojanić[2], Saša Skočić Smoljanović[1]

[1]Faculty of Medicine University of Banja Luka, University Clinical Centre Banja Luka, Republic of Srpska, Bosnia and Herzegovina
[2]Pregnancy center "Radosnica", Banja Luka, Republic of Srpska, Bosnia and Herzegovina

Correspondence:
Vesna Ljubojević, Faculty of Medicine University of Banja Luka, University Clinical Centre Banja Luka
ljubojevic.v@gmail.com

[1]Medicinski fakultet Univerziteta u Banjoj Luci, Univerzitetski klinički centar Banja Luka, Republika Srpska, Bosna i Hercegovina
[2]Škola za trudnice "Radosnica", Banja Luka, Republika Srpska, Bosna i Hercegovina

Korespondencija:
Vesna Ljubojević, Medicinski fakultet Univerziteta u Banjoj Luci, Univerzitetski klinički centar Banja Luka
ljubojevic.v@gmail.com

Abstract: *In pregnancy physical activity is considered as a preventive measure for diseases of the cardiovascular system. In studies, the data on microvascular adaptation in pregnancy are scarce. The prenatal program included 35 pregnant women who exercised and 35 women who did not. The shape of the capillaries of the nail skin fold was analyzed with capillaroscopy. At the beginning of the study, the shape of the capillary was normal in all pregnant women. After 8 weeks in 40.91% of pregnant women who exercised and in 47.06% of pregnant women who did not exercise, the shape of the capillary loop was abnormal with bending of the limbs, tortuosity of the limbs, and crossing of the limbs. After the 8th week of the prenatal program, no significant difference in the shape of the capillary loop of the nail skin fold was found between pregnant women who performed prenatal exercises and pregnant women who did not.*
Keywords: *activity, physical, microcirculation, capillaroscopy, morphology, pregnancy.*

Sažetak: *Kod trudnica fizička aktivnost se navodi kao preventivna mjera oboljenja kardiovaskularnog sistema. U studijama podaci o mikrovaskularnoj adaptaciji u trudnoći su oskudni. U prenatalnom programu bilo je uključeno 35 trudica koje su vježbale i 35 koje nisu. Oblik kapilara kožnog nabora nokta je analiziran sa kapilaroskopijom. Na početku studije oblik kapilara je bio normalan kod svih trudnica. Nakon 8 nedelja kod 40.91 % trudnica koje su vježbale i kod 47.06 % trudnica koje nisu vježbale, oblik kapilarnih petlji je bio abnormalan sa savijanjem krakova, tortuozitetom krakova i ukrštanjem krakova. Nakon 8. nedelja prenatalnog programa između trudnica koje su izvodile prenatalne vježbe i trudnica koje nisu nije utvrđena značajna razlika u obliku kapilarnih petlji kožnog nabora nokta.*
Ključne riječi: *fizička aktivnost, mikrocirkulacija, kapilaroskopija, morfologija, trudnoća.*

Introduction

Physical activity is an important part of public health. Regular physical activity before the pregnancy, during the pregnancy, and after the delivery and its impact on health is emphasized in various studies (Deliens et al., 2019; Santos et al., 2016). Leading American, Canadian, Danish, Norwegian, Australian, and United Kingdom's guidelines for exercising in pregnancy recommend aerobic activity with moderate intensity, that is an activity that activates large muscle groups and spends energy sources for which release oxygen is required, and in the duration of 15 to 30 minutes, from three to four times a week (Filipec, 2019; da Silva et al., 2017).

Uvod

Fizička aktivnost („physical activity") je važan dio javnog zdravlja. Redovna fizička aktivnost prije trudnoće, u trudnoći i nakon porođaja i njen uticaj na zdravlje naglašava se u brojnim studijama (Deliens et al., 2019; Santos et al., 2016). Vodeće američke, kanadske, danske, norveške i australijske smjernice, te smjernice Ujedinjenog Kraljevstva za vježbanje u trudnoći preporučuju aerobnu aktivnost umjerenim intenzitetom, tj. aktivnost u kojoj se izvode ritmični pokreti, laganog do srednjeg intenziteta, pri kojima se aktiviraju velike mišićne grupe i troše izvori energije za čije oslobođenje je potreban kiseonik, a u trajanju od 15 do 30 min, od tri do četiri puta sedmično (Filipec, 2019; . da Silva et al., 2017).

Physical activity in pregnancy has numerous advantages. In pregnant women who did prenatal exercises, lower body weight gain was noted in pregnancy (Vargas-Terrones et al., 2019). Also, in pregnant women who exercised during pregnancy, physical activity is cited as a preventive measure for hypertension (Barakat et al., 2016). Physical inactivity and excessive weight gain during pregnancy increase the risk of gestational diabetes, pregnancy-induced hypertension (*pregnancy induced-hypertension*, PIH) (Poston et al., 2016; Szumilewicz et al., 2017), diseases of the cardiovascular system, musculoskeletal disorders, and numerous types of tumors (Deliens et al., 2019; Stutzman et al., 2010).

In pregnancy, the circulatory system is largely adapted to adequately supply the needs of the mother and fetus (Thevissen and Gyselaers, 2017). Blood volume, heart rate (*heart rate*, HR), stroke volume (*stroke volume*, SV), and cardiac output (*cardiac output,* CO) normally increase during pregnancy, while peripheral vascular resistance decreases (American College of Obstetricians and Gynecologists, 2015) from the first to the second trimester (Vasapollo et al., 2018).

Monitoring of microcirculatory changes can be viewed as a method that helps us to record the changes that precede the onset of clinical disease. Capillaroscopy is a non-invasive and effective method for direct visualization and analysis of microcirculation, that is capillaries of the nail skin fold. It is used for the recognition of qualitative, morphological patterns of microangiopathy (Thevissen and Gyselaers, 2017). The data on microcirculatory adaptation in pregnancy are scarce, mainly due to technical limitations. The aim of the study was to determine the shape of the capillary loop in pregnancy with capillaroscopy of the skin fold of the nail and the influence of the prenatal exercise program on microcirculatory changes.

Methods

Seventy pregnant women participated in the study (n = 70) from the western part of Bosnia and Herzegovina. One cycle of psychophysical preparation for childbirth lasted 8 weeks, as long as the subjects were followed. Subjects joined the program during the second and third trimesters, that is at the earliest in the 20th week of gestation and the latest in the 32nd week of gestation. The study was approved by the Ethics Committee of the Faculty of Medicine in Banja Luka.

Criteria for inclusion in the study are normal pregnancy confirmed by a gynecologist, age of pregnant women from 20 to 40 years, duration of pregnancy from

Fizička aktivnost u trudnoći ima brojne prednosti. Kod trudnica koje su izvodile prenatalne vježbe zabilježen je niži tjelesni prirast u trudnoći (Vargas-Terrones et al., 2019). Također, kod trudnica koje su vježbale u trudnoći, fizička aktivnost se navodi kao preventivna mjera hipertenzije (Barakat et al., 2016). Fizička neaktivnost i prekomjerno debljanje tokom trudnoće povećavaju rizik za gestacijski dijabetes, trudnoćom izazvanu hipertenziju (engl. *pregnancy induced hypertension*, PIH) (Poston et al., 2016; Szumilewicz et al., 2017), oboljenja kardiovaskularnog sistema, mišićno-koštanih poremećaja, te brojnih vrsta tumora (Deliens et al., 2019; Stutzman et al., 2010).

U trudnoći se cirkulatorni sistem u velikoj mjeri adaptira kako bi dovoljno opskrbio potrebe majke i ploda (Thevissen and Gyselaers, 2017). Volumen krvi, frekvencija otkucaja srca (eng. heart rate, HR), udarni volumen (eng. stroke volume, SV) i minutni volumen srca (eng. cardiac output, CO) normalno se povećavaju tokom trudnoće, dok se periferni vaskularni otpor smanjuje (American College of Obstetricians and Gynecologists, 2015) od prvog do drugog tromjesečja (Vasapollo et al., 2018).

Praćenje mikrocirkulatornih promjena možemo posmatrati kao metod koji nam pomažu da zabilježimo promjene koje prethode početku kliničke bolesti. Kapilaroskopija je neinvazivna i efikasna metoda za direktnu vizualizaciju i analizu mikrocirkulacije, odnosno kapilara nokatnog kožnog nabora. Koristi se za prepoznavanje kvalitativnih, morfoloških obrazaca mikroangiopatije (Thevissen and Gyselaers, 2017). U studijama podaci o mikrocirkulatornoj adaptaciji u trudnoći su oskudni, uglavnom zbog tehničkih ograničenja (Thevissen and Gyselaers, 2017). Cilj istraživanja je bio da se utvrdi oblik kapilarne petlje u trudnoći sa kapilaroskopijom kožnog nabora nokta i uticaj programa prenatalnih vježbi na mikrocirkulatorne promjene.

Metode

U studiji je učestvovalo sedamdeset trudnica (n= 70) iz zapadnog dijela Bosne i Hercegovine. Jedan ciklus psihofizičke pripreme za porođaj trajao je 8 nedjelja, koliko su ispitanice bile praćene. Ispitanice su se pridružile programu tokom drugog i trećeg tromjesečja, odnosno najranije u 20.nedjelji gestacije i najkasnije u 32.nedjelji gestacije. Studiju je odobrio Etički odbor Medicinskog fakulteta Banja Luka.

Kriterijumi za uključenje u studiju su: uredna trudnoća koju je potvrdio ginekolog, starost trudnica od 20 do 40 godina, trajanje trudnoće od 20. do 32. nedjelje

20 to 32 weeks of pregnancy, BMI before pregnancy <25 kg / m2, singleton pregnancy.

Criteria for exclusion from the study are bleeding in the second or third trimester, premature birth in the current pregnancy, rupture of the amniotic sac, pregnancy-induced hypertension, intrauterine fetal growth restriction (*intrauterine growth restriction* – IUGR) in the current pregnancy, anemia, and exclusion from the study at the pregnant woman's own request.

Within the prenatal program, theoretical classes on childbirth and prenatal exercises took place. After the gynecological examination and the confirmed normal pregnancy, the gynecologist included the pregnant women in the program. Subjects were divided into two groups: control and experimental. The control group consisted of pregnant women who spent 60 minutes three times a week in the theoretical part, where they received advice from gynecologists and other doctors on pregnancy, childbirth, nutrition, breastfeeding, etc. The experimental group consisted of pregnant women who exercised three times a week for 45 minutes and participated in the theoretical part of the prenatal program. Prenatal exercises were led by the leader for physical activities in pregnancy, according to the exercise program made according to the recommendations of the American College of Obstetricians and Gynecologists (American College of Obstetricians and Gynecologists, 2015) and guidelines CAPWH (Croatian Association of Physiotherapists for Women's Health) (Vojvodić-Schuster, 2004).

Prenatal training was presented with: exercises for muscle strength, exercises to strengthen the muscles of the abdominal wall, exercises to strengthen the muscles of the legs, exercises to strengthen the gluteal muscles, exercises to increase pelvic mobility, exercises to improve circulation and muscle stretching exercises. The training began and ended with breathing and relaxation techniques for about 10 min. Warm-up consists of moderate walking for about 5 min, followed by strength and stretching exercises for about 30 min. Pregnant women performed exercises in a standing, sitting, kneeling, and lateral position, with or without props (balls, straps, weights, etc.).

Capillaroscopy with a stereomicroscope and digital camera enabled the assessment of capillary shape, as well as the classification and evaluation of capillary abnormalities of the skin fold of the nail (Thevissen and Gyselaers, 2017). In the study, the capillaroscopy method was performed three times, in three time periods, in both groups of subjects: at the beginning of exercise, after the 4th week, and at the end of the completed exercise

trudnoće, BMI prije trudnoće <25 kg/m^2, jednoplodna trudnoća.

Kriterijumi za isključenje iz studije su: krvarenje u drugom ili trećem tromjesečju, prijevremeni porođaj u aktuelnoj trudnoći, ruptura plodovih ovojaka, trudnoćom izazvana hipertenzija, intrauterini zastoj rasta ploda (engl. *intrauterine growth restriction* – IUGR) u aktuelnoj trudnoći, anemija, te isključenje iz studije na vlastiti zahtjev trudnice.

U okviru prenatalnog programa odvijala se teorijska nastava o porođaju i prenatalne vježbe. Nakon obavljenog ginekološkog pregleda te potvrđene uredne trudnoće, ginekolog je uključio trudnice u program. Ispitanice su podijeljene u dvije grupe: kontrolnu i eksperimentalnu. Kontrolnu grupu činile su trudnice koje su tri puta sedmično provodile po 60 min na teorijskom dijelu, gdje su dobijale savjete od ginekologa i drugih ljekara o trudnoći, porođaju, ishrani, dojenju i drugo. Eksperimentalnu grupu činile su trudnice koje su vježbale tri puta sedmično po 45 min i učestvovale u teorijskom dijelu prenatalnog programa. Prenatalne vježbe vodila je voditeljica za fizičke aktivnosti u trudnoći, prema programu vježbanja koji je urađen po preporukama Američkog koledža opstetričara i ginekologa (American College of Obstetricians and Gynecologists, 2015) i smjernicama HUFZŽ (Hrvatska udruga fizioterapeuta za zdravlje žena) (Vojvodić-Schuster, 2004).

Prenatalni trening predstavljen je sa: vježbama snage mišića, vježbama za jačanje mišića trbušnog zida, vježbama za jačanje mišića nogu, vježbama za jačanje glutealnih mišića, zatim vježbama za povećanje mobilnosti karlice, vježbama za poboljšanje cirkulacije, te vježbama istezanja mišića. Vježbe mišića karličnog dna uz tehnike disanja i opuštanja su sastavni dio prenatalnog programa. Trening se započinjao i završavao tehnikama disanja i opuštanja oko 10 min. Zagrijavanje se sastoji od umjerenog hodanja oko 5 min, zatim slijede vježbe snage i istezanja oko 30 min. Trudnice su izvodile vježbe u stojećem, sjedećem, klečećem i bočnom položaju, sa ili bez rekvizita (lopte, trake, utezi i sl.).

Kapilaroskopija sa stereomikroskopom i digitalnom kamerom je omogućila ocjenu oblika kapilara, kao i klasifikaciju i ocjenjivanje abnormalnosti kapilara kožnog nabora nokta (Thevissen and Gyselaers, 2017). U istraživanju, metoda kapilaroskopije se provodila tri puta, u tri vremenska perioda, u obe grupe ispitanika: na početku vježbanja, nakon 4. nedjelje i na kraju završenog programa vježbanja. Analizirane su kapilare kožnog nabora četvrtog prst lijeve ruke. Dobijene digitalne slike kapilara nokatnog nabora su omogućile određivanje oblika

program. The capillaries of the skin fold of the fourth finger of the left hand were analyzed. The obtained digital images of the nail fold capillaries enabled the determination of the capillary shape. The usual capillary shape has the appearance of a hairpin or similar to the letter "U" upside down (Thevissen and Gyselaers, 2017). Any deviation from this form was registered and described. In the processing of the obtained data, descriptive statistics were performed and a chi-square test was applied, using the SPSS 20 program.

Results

The prenatal program included 90 pregnant women, of whom 70 pregnant women successfully completed the program (77.8%), while 20 pregnant women (22.2%) left the program (Table 1).

Table 1. *Pregnant women who attended the prenatal program and those who left the study.*

kapilara. Uobičajeni oblik kapilara ima izgled ukosnice ili slično slovu "U" naopako (Thevissen and Gyselaers, 2017). Svako odstupanje od ovog oblika se registrovalo i opisalo. U obradi dobijenih podataka urađena je deskriptivna statistika i primjenjen je hi-kvadrat testa, koristeći program SPSS 20.

Rezultati

U prenatalnom programu bilo je uključeno 90 trudnica, od kojih je program uspješno završilo 70 trudnica (77.8%), dok je 20 trudnica (22.2%) napustilo program (tabela 1).

Tabela 1. *Trudnice koje su pohađale prenatalni program i one koje su napustile studiju.*

Reason for exclusion from the study / **Razlog isključenja iz studije**	***Experimental group /*** **Eksperimentalna grupa**	***Control group /*** **Kontrolna grupa**
Miscarriage / Spontani pobačaj	-	2
Premature birth / Prijevremeni porođaj	1	1
Pregnancy-induced hypertension / Trudnoćom izazvana hipertenzija	-	2
Leaving the study at their own request / Napuštanje studije na vlastiti zahtjev	2	3
Failure to meet the minimum number of visits to the program / Nezadovoljavanje minimalanog broja dolazaka na program	2	2
Due to loss of contact after the study and incomplete data / Zbog gubitka kontakta nakon studije i nepotpunih podataka	2	3

Twenty pregnant women left the study for the following reasons: miscarriage (2 pregnant women from the control group), premature birth (1 from the control group, 1 from the experimental group), pregnancy-induced hypertension (2 pregnant women from the control group), leaving the study at their own request (3 pregnant women from the control group, 2 pregnant women from the experimental group), failure to meet the minimum number of visits to the program (2 pregnant women from the control group, 2 pregnant women from the experimental group), and due to loss of contact after the study and incomplete data (3 pregnant women from the control group, 2 pregnant women from the experimental group). Thus, 70 pregnant women participated in a study examining the impact of prenatal exercise on the vascular parameters of pregnant women. There were a total of 35 pregnant women in the experimental group (n = 35) while there were 35 pregnant women in the control group (n = 35). The experimental and control groups were equal

Dvadeset trudnica je napustilo studiju zbog sljedećih razloga: spontani pobačaj (2 trudnice iz kontrolne grupe), prijevremeni porođaj (1 iz kontrolne, 1 iz eksperimentalne grupe), trudnoćom izazvana hipertenzija (2 trudnice iz kontrolne grupe), napuštanje studije na vlastiti zahtjev (3 trudnice iz kontrolne, 2 trudnice iz eksperimentalne grupe), nezadovoljavanja minimalanog broja dolazaka na program (2 trudnice iz kontrolne grupe, 2 trudnice iz eksperimentalne grupe), te zbog gubitka kontakta nakon studije i nepotpunih podataka (3 trudnice iz kontrolne grupe, 2 trudnice iz eksperimentalne grupe) . Na taj način, u studiji ispitivanja uticaja prenatalnog vježbanja na vaskularne parametre trudnica učestvovalo je 70 trudnica. U eksperimentalnoj grupi ukupno je bilo 35 trudnica (n=35) dok je u kontrolnoj grupi bilo 35 trudnica (n = 35). Eksperimentalna i kontrolna grupa su bile ujednačene u odnosu na starosnu dob trudnica i gestacijsku dob trudnica.

Sa kombinacijom stereomikroskopa koji je spojen

in relation to the age of the pregnant women and the gestational age of the pregnant women.

With a combination of a stereomicroscope connected to a digital video camera, capillary loops of the skin fold of pregnant women 's nails were recorded. Digital video capillaroscopy performed digital images of capillary loops of the fourth finger of the left hand: in pregnant women who performed prenatal exercises and in pregnant women who did not perform prenatal exercises. Capillary loops are visible in the skin fold of the nail, which is arranged in rows. In the distal row, the capillary loops of the hairpin shape and the arms of the capillary loop are clearly differentiated (Figure 1).

sa digitalnom videokamerom snimane su kapilarne petlje kožnog nabora nokta trudnica. Digitalnom videokapilaroskopijom urađene su digitalne slike kapilarnih petlji četvrtog prsta lijeve ruke: kod trudnica koje su izvodile prenatalne vježbe i kod trudnica koje nisu izvodile prenatalne vježbe. U kožnom naboru nokta vidljive su kapilarne petlje koje su poredane u redove. U distalnom redu jasno se diferenciraju kapilarne petlje oblika ukosnice i krakovi kapilarne petlje (Slika 1).

Figure 1. *Capillary loops of the skin fold of the nail*

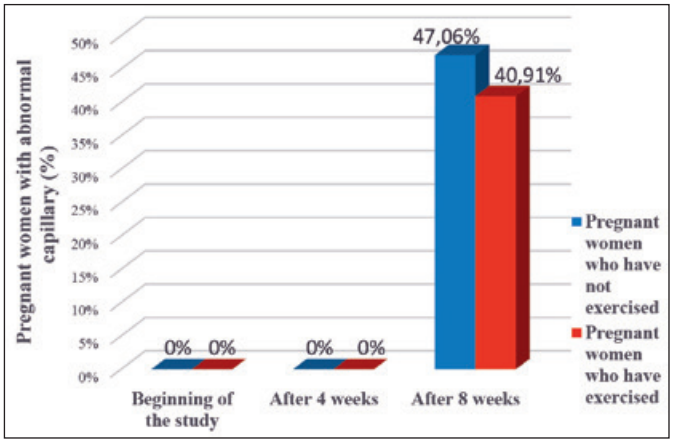
Slika 1. *Kapilarne petlje kožnog nabora nokta*

At the beginning of the study, the capillary shape of the skin fold of the nail was neat, normal, that is in the form of a hairpin, in all pregnant women. The arms of the capillary loop were straight, without bending, tortuosity, and intersection (Figure 1).

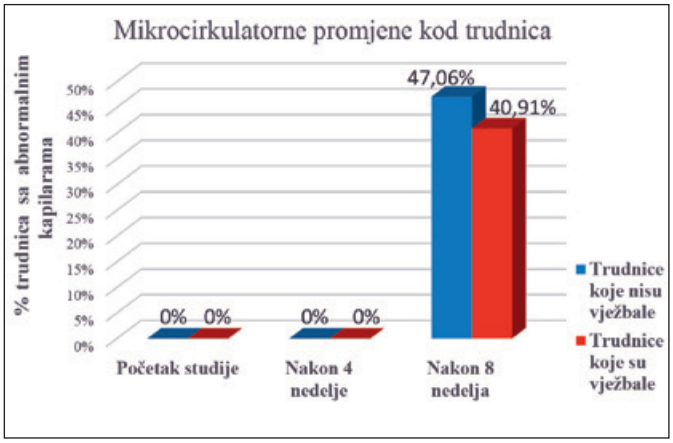
In the second time of measuring the capillaries of the skin fold of the nail, that is after 4 weeks of study, the form did not change in the experimental and control groups (Graph 1).

Na početku studije oblik kapilara kožnog nabora nokta je bio uredan, normalan, tj. u obliku ukosnice, kod svih trudnica. Kraci kapilarne petlje su bili ravni, bez savijanja, tortuoziteta i međusobnog ukrštanja (slika 1).

U drugom vremenu mjerenja kapilara kožnog nabora nokta, tj. nakon 4 nedjelje studije, oblik se nije mijenjao u eksperimentalnoj i kontrolnoj grupi (grafikon 1).



Graph 1. *The shape of the capillary loops of the skin fold of the nail of pregnant women who have exercised and who have not*



Grafikon 1. *Oblik kapilarnih petlji kožnog nabora nokta trudnica koje su vježbale i koje nisu*

At the end of the study, after 8 weeks, in 40.91% of pregnant women who were involved in prenatal exercise and in 47.06% of pregnant women who were not involved in the prenatal exercise, the shape of the capillary loops changed. The presence of capillary loops of altered, abnormal shape with bending of the arms, tortuosity of the arms, and crossing of the arms was determined (Figure 2).

Na kraju studije, nakon 8 nedelja, kod 40.91 % trudnica koje su bile uključene u izvođenje prenatalnih vježbi i kod 47.06 % trudnica koje nisu bile uključene u izvođenje prenatalnih vježbi, oblik kapilarnih petlji se izmijenio. Utvrđeno je prisutvo kapilarnih petlji izmijenjenog, abnormalog oblika sa savijanjem krakova, tortuozitetom krakova i ukrštanjem krakova (slika 2).

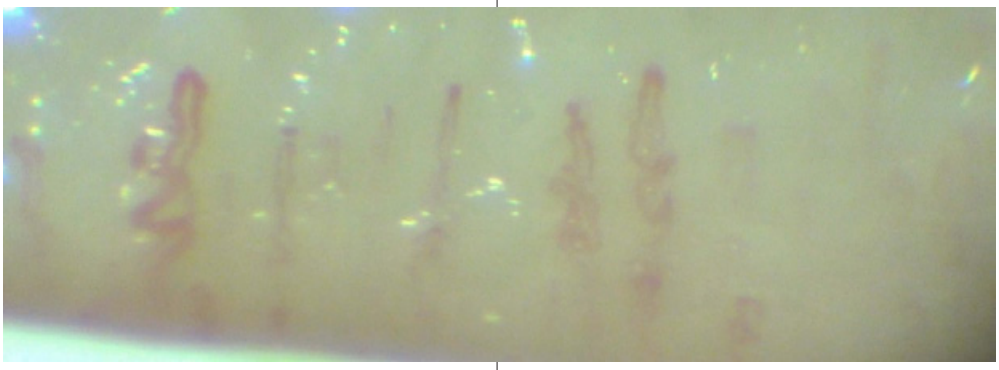


Figure 2. *Tortuosity and crossing of the arms of capillary loops*

Slika 2. *Tortuozitet i ukrštanje krakova kapilarnih petlji*

After 8 weeks of the prenatal program, the percentage of pregnant women who exercised with abnormal capillaries of 40.91% was not statistically significantly lower compared to 47.06% of pregnant women with abnormal capillaries who did not exercise (p> 0.05).

Nakon 8 nedelja prenatalnog programa postotak trudnica koje su vježbale sa abnormalnim kapilarama od 40,91 % nije bio statistički značajno manji u odnosu na 47,06 % trudnica sa abnormalnim kapilarama koje nisu vježbale (p>0.05).

Discussion

The study used capillaroscopy to analyze the shape of the capillary loop of the skin fold of the nail in pregnant women who performed prenatal exercises and in pregnant women who did not perform prenatal exercises. At the beginning of the study in all pregnant women, gestational age from 20 to 32 weeks, the capillary loops of the skin fold of the nail were of normal shape, that is in the form of a hairpin. The arms of the capillary loops were straight, without bending, tortuosity and intersection. Also, after the 4th week of the study, the shape did not change, it remained normal in pregnant women of the experimental and control groups. After 8 weeks, in 40.91% of pregnant women who were involved in performing prenatal exercises and in 47.06% of pregnant women who were not involved in performing prenatal exercises, the shape of the capillary loops changed. The presence of capillary loops of altered, abnormal shape with bending of arms, tortuosity of arms, and crossing of arms was determined.

No study was found in the literature that analyzed the shape of capillary loops in the second and third trimesters of pregnancy and the percentage of capillaries

Diskusija

U studiji je pomoću kapilaroskopije analiziran oblik kapilarne petlje kožnog nabora nokta kod trudnica koje su izvodile prenatalne vježbe i kod trudnica koje nisu izvodile prenatalne vježbe. Na početku studije kod svih trudnica, gestacijske starosti od 20. do 32. nedelje, kapilarne petlje kožnog nabora nokta su bile normalnog oblika tj. u obliku ukosnice. Kraci kapilarnih petlji su bili ravni, bez savijanja, tortuoziteta i međusobnog ukrštanja. Takođe,nakon 4. nedjelje studije, oblik se nije mijenjao, ostao je normalan kod trudnica eksperimentalne i kontrolne grupe. Nakon 8 nedelja, kod 40.91 % trudnica koje su bile uključene u izvođenje prenatalnih vježbi i kod 47.06 % trudnica koje nisu bile uključene u izvođenje prenatalnih vježbi, oblik kapilarnih petlji se izmijenio. Utvrđeno je prisutvo kapilarnih petlji izmijenjenog, abnormalog oblika sa savijanjem krakova, tortuozitetom krakova i ukrštanjem krakova.

U literaturi nije nađena studiju koja je analizirala oblik kapilarnih petlji u drugom i trećem trimestru trudnoće i procenat kapilara abnormalnog oblika. Kapilaroskopija kožnog nabora nokta se koristi za procjenu morfologije kapilara dermalnih papila nokatnog kožnog

of abnormal shape. Capillaroscopy of the skin fold of the nail is used to assess the morphology of the capillaries of the dermal papillae of the nail skin fold, which facilitates the recognition of qualitative, morphological patterns of microangiopathy (Thevissen, 2017). Elongated capillaries are commonly found in hypertension and arteriosclerosis, while shorter capillaries often indicate heart failure and diabetes (Thevissen, 2017). Structural rarefaction of capillaries, which is recorded by reduced capillary density, has been demonstrated in individuals with hypertension compared to individuals who are not hypertensive (Thevissen, 2017). Patients with diabetes have altered capillary morphology with unchanged capillary density (Thevissen, 2017). In the study of Nama et al. (2012) the number of capillary loops of the nail fold, that is the density of capillaries in pregnant women in all three trimesters was analyzed. A statistically significant decrease in the number of capillary loops from the 34th to the 38th gestational week was found. Compared with the first analysis of capillary loops in the period from the 11th to the 16th week of gestation, the earliest statistically significant decrease in the average density of capillary loops was found in the period from the 34th to the 38th week of gestation.

The study analyzed the influence of prenatal exercises on the microcirculation of pregnant women, which was analyzed with capillaroscopy of the skin fold of the nail. After the 8th week of the prenatal program, the percentage of pregnant women who exercised with abnormal capillaries of 40.91% was not statistically significantly lower compared to 47.06% of pregnant women who did not exercise with abnormal capillaries ($p > 0.05$).

No study has been found in the literature examining the effect of prenatal exercise on the microcirculatory adaptation of pregnant women. In pregnancy, there is an adaptation of the macrocirculation and microcirculation of the pregnant woman. In studies, data on microcirculatory adaptation are scarce, mainly due to technical limitations (Thevissen, 2017). Microcirculation disorders are associated with most risk factors for cardiovascular disease. In patients with hypertension and in patients with the initial stage (prehypertension) capillary remodeling and change in capillary shape are manifested (Gurfinkel, 2015). The study by Haakstad et al. (2016) was analyzed the impact of prenatal exercise on blood pressure. They found that in pregnant women who exercised, systolic blood pressure values were lower compared to pregnant women who did not exercise. To improve the cardiovascular health of pregnant women, physical activity in the form of prenatal exercises is a desirable way of life.

nabora, što olakšava prepoznavanje kvalitativnih, morfoloških obrazaca mikroangiopatije (Thevissen, 2017). Izduženi kapilari obično se susreću kod hipertenzije i arterioskleroze, dok kraći kapilari često ukazuju na srčanu insuficijenciju i dijabetes (Thevissen, 2017). Strukturno prorjeđivanje kapilara, koje se evidentira smanjenom gustinom kapilara, dokazano je kod osoba s hipertenzijom u poređenju sa pojedincima koji nisu hipertenzivni (Thevissen, 2017). Kod pacijenata sa šećernom bolešću se javlja izmijenjena kapilarna morfologija sa nepromijenjenom gustinom kapilara (Thevissen, 2017). U studiji Nama i sar. (2012) je analiziran broj kapilarnih petlji kožnog nabora nokta, odnosno gustina kapilara kod trudnica u sva tri trimestra. Utvrđeno je statistički značajno smanjenje broja kapilaranih petlji od 34. do 38. gestacijske nedelje. U poređenju sa prvom analizom kapilarnih petlji u periodu od 11. do 16. gestacijske nedelje, najranije statistički značajno smanjenje u prosječnoj gustini kapilarnih petlji se utvrdilo u period od 34. do 38. nedelje gestacije.

U studiji se analizirao uticaj prenatalnih vježbi na mikrocirkulaciju trudnica koja se analizirala sa kapilaroskopijom kožnog nabora nokta. Nakon 8. nedelja prenatalnog programa postotak trudnica koje su vježbale sa abnormalnim kapilarama od 40,91 % nije bio statistički značajno manji u odnosu na 47,06 % trudnica koje nisu vježbale sa abnormalnim kapilarama ($p>0.05$).

U literaturi nije nađena studija koja je ispitivala uticaj prenatalnim vježbi na mikrocirkulatornu adaptaciju trudnica. U trudnoći dolazi do adaptacije makrocirkulacije i mikrocirkulacije trudnice. U studijama podaci o mikrocirkulatornoj adaptaciji su oskudni, uglavnom zbog tehničkih ograničenja (Thevissen, 2017). Poremećaji mikrocirkulacije povezani su sa većinom faktora rizika kardiovaskularnih oboljenja. Kod pacijenata sa hipertenzijom i kod pacijenata sa početnim stadijumom, prehipertenzijom, manifestuje se kapilarno remodelovanje i promjena oblika kapilara (Gurfinkel, 2015). U studiji Haakstad i sar. (2016) je analiziran uticaj prenatalnih vježbi na krvni pritisak. Utvrdili su da kod trudnica koje su vježbale su vrijednosti sistolnog krvnog pritiska niže u odnosu na trudnice koje nisu vježbale. Za poboljšanje kardiovaskularnog zdravlja trudnica fizičku aktivnost u obliku prenatalnih vježbi je poželjan način života.

Conclusion

The method of videocapillaroscopy of the skin fold of pregnant women 's nails enables the determination of microcirculatory changes in pregnancy. The shape of the capillary loops changed both in pregnant women who performed prenatal exercises and in those who did not. In pregnant women in the third trimester of pregnancy who attended the prenatal program, the presence of abnormal capillary loops with bending of the arms, tortuosity of the arms, and crossing of the arms was determined after 8 weeks of follow-up. After the 8th week of the prenatal program, no significant difference in the shape of the capillary loop of the skin fold of the nail was found between pregnant women who performed prenatal exercises and pregnant women who did not perform prenatal exercises.

Zaključak

Metoda videokapilaroskopije kožnog nabora nokta trudnica omogućava da se utvrde mikrocirkulatorne promjene u trudnoći. Oblik kapilarnih petlji se izmijenio i kod trudnica koje su izvodile prenatalne vježbe i kod onih koje nisu. Kod trudnica u trećem trimestru trudnoće koje su pohađale prenatalni program je utvrđeno, nakon 8 sedmica praćenja, prisutvo kapilarnih petlji abnormalog oblika sa savijanjem krakova, tortuozitetom krakova i ukrštanjem krakova. Nakon 8. nedelja prenatalnog programa između trudnica koje su izvodile prenatalne vježbe i trudnica koje nisu izvodile prenatalne vježbe nije utvrđena značajna razlika u obliku kapilarne petlje kožnog nabora nokta.

References

American College of Obstetricians and Gynecologists. (2015). Physical activity and exercise during pregnancy and the postpartum period. Committee Opinion No. 650.*Obstet Gynecol*, 126(6), e135-142.

Barakat, R., Pelaez, M., Cordero, Y., Perales, M., Lopez, C., Coteron, J., Mottola, M.F. (2016). Exercise during pregnancy protects against hypertension and macrosomia: randomized clinical trial. *American journal of obstetrics and gynecology*, 214(5), 505-507.

da Silva, S. G., Hallal, P. C., Domingues, M. R., Bertoldi, A. D., da Silveira, M. F., Bassani, D., & Evenson, K. (2017). A randomized controlled trial of exercise during pregnancy on maternal and neonatal outcomes: results from the PAMELA study. *The International Journal of Behavioral Nutrition and Physical Activity*, 14(1), 1-11.

Deliens, T., Versele, V., Eynde, H.V., Clarys, P., Devlieger, R., Bogaerts, A., … & Aerenhouts, D. (2019). Body weight, body composition and energy balance related behaviour during the transition to parenthood: study protocol of a multi-centre observational follow-up study (TRANSPARENTS). *BMC public health*, 19(1), 1-9.

Filipec, M. (2019). *Utjecaj terapijskoga vježbanja na smanjenje sakroilijakalne disfunkcije u trudnoći [The influence of exercise on reduction of sacroiliac dysfunction in pregnancy]* Doctoral dissertation. Zagreb: Sveučilište u Zagrebu Medicinski fakultet. [in Croatian]

Gurfinkel, Y. I., Sasonko, M. L., Kuznetzov, M. I., & Priezzhev, A. V. (2015). Importance of image processing in digital optical capillaroscopy for early diagnostics of arterial hypertension. *In 2015 International Conference on BioPhotonics (BioPhotonics)* (pp. 1-4). IEEE.

Haakstad, L. A., Edvardsen, E., & Bø, K. (2016). Effect of regular exercise on blood pressure in normotensive pregnant women. A randomized controlled trial. *Hypertension in pregnancy*, 35(2), 170-180.

Nama, V., Antonios, T. F., Onwude, J., & Manyonda, I. T. (2012). Capillary remodelling in normal pregnancy: Can it mediate the progressive but reversible rise in blood pressure? Novel insights into cardiovascular adaptation in pregnancy. *Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health*, 2(4), 380-386.

Poston, L., Caleyachetty, R., Cnattingius, S., Corvalán, C., Uauy, R., Herring, S., & Gillman, M. W. (2016). Preconceptional and maternal obesity: epidemiology and health consequences. *The lancet Diabetes & endocrinology*, 4(12), 1025-1036.

Santos, C. M. D., Santos, W. M. D., Gallarreta, F. M. P., Pigatto, C., Portela, L. O. C., & Morais, E. N. D. (2016). Effect of maternal exercises on biophysical fetal and maternal parameters: a transversal study. *Einstein (São Paulo)*, 14(4), 455-460.

Stutzman, S. S., Brown, C. A., Hains, S. M., Godwin, M., Smith, G. N., Parlow, J. L., & Kisilevsky, B. S. (2010). The effects of exercise conditioning in normal and overweight pregnant women on blood pressure and heart rate variability. *Biological research for nursing*, 12(2), 137-148.

Szumilewicz, A., Worska, A., Piernicka, M., Kuchta, A., Kortas, J., Jastrzębski, Z., Radzimiński, Ł., Jaworska, J., Micielska, K., Ziemann, E. (2017). The exercise-induced irisin is associated with improved levels of glucose homeostasis markers in pregnant women participating in 8-week prenatal group fitness program: a pilot study. *BioMed Research International*, 17, 1-10.

Thevissen, K, & Gyselaers, W. (2017). Capillaroscopy in pregnancy. *Expert review of medical devices*, 14(12), 961-967.

Vargas-Terrones, M., Nagpal, T. S., Barakat, R. (2019). Impact of exercise during pregnancy on gestational weight gain and birth weight: an overview. *Brazilian journal of physical therapy*, 23(2), 164-169.

Vasapollo B, Lo Presti D, Gagliardi G, Farsetti D, Tiralongo G. M., Pisani I, Novelli GP, Valensise, H. (2018). Restricted physical activity in pregnancy reduces maternal vascular resistance and improves fetal growth. *Ultrasound in Obstetrics & Gynecology*, 51(5), 672-6.

Vojvodić-Schuster, S. (2004). Vježbe za trudnice: cjeloviti program vježbanja kroz tromjesečja i priprema za porođaj. *Zagreb: Biovega*. [in Croatian]

Primljen: 05. jun 2021. / Received: Juny 05, 2021
Prihvaćen: 31. avgust 2021. / Accepted: August 31, 2021

https://doi.org/10.7251/SSH2102231N
UDC: 796.015:616.12-036.886
Review paper
Pregledni rad

The Influence of Professional Sport on Changes in the Athlete's Cardiovascular System After the end of Career

Tanja Nikolić[1], Sanja Zbućnović[2], Darijan Ujsasi[2], Zoran Milić[3]
[1]Student of Faculty of Sport and Physical Eeducation, Novi Sad, Serbia
[2]Student of doctoral studies, Faculty of Sport and Physical Education, Novi Sad, Serbia
[3]Educons University, Novi Sad, Serbia

Correspondence:
Zoran Milić,
Educons University, Novi Sad, Serbia, zoranmilic@yahoo.com

Abstract: *The benefits of sports activities on almost all physiological systems are immense and of wide spectrum. However, a large number of recent studies deals with the consequences of long-term professional engagement in sports activities and present opposite results. The review was based on the assumption that intense physical activity to which top athletes are exposed brings with it changes in the cardiovascular system. The methodological procedure has included a review of previous research through the Google Scholar, PubMed, Scopus and Web of Science search engines over the past twenty years. Athletes who have played endurance sports have lower blood pressure values compared to athletes who have played strength sports, as well as compared to the non-athlete population. Athletes who have been involved in strength sports have more pronounced left ventricular values. As a general conclusion, it can be pointed out that intense physical activity contributes to changes in the cardiovascular system, but further monitoring of the athlete's condition is needed after a professional career, in order to obtain even clearer results, because sport is performed at an extremely intensive level, higher than 50-60 years ago.*
Keywords: *professional sports, cardiovascular system, sports impact.*

Introduction

Athletes are exposed to enormous physiological and psychological efforts during the training process. A very important, if not key aspect that determines cardiovascular adaptation, is the load (intensity, volume, but also the type of sport, the presence of strength and endurance training) to which the athlete is exposed during his/her professional life. In this regard, moderate-intensity physical activity is recommended for the prevention and treatment of cardiovascular diseases (Khanji et al, 2018). The beneficial effects of physical training are primarily the result of peripheral adaptations. In trained skeletal muscles, the capillary network, the content of oxidative enzymes, the concentration of myoglobin and the number and size of mitochondria increase (De Bacquer, De Backek & Kornitzer, 2000). These changes increase skeletal muscle perfusion and oxygen extraction by up to 20%. Reduced arterial vascular resistance and better redistribution of minute volume also contribute to the beneficial effects of physical training. Training of higher intensity, especially in younger people, leads to central (cardiac) adaptations. Myocardial oxygenation and systolic function are improved during exercise. Limm et al. (2012) indicate great health benefits that increase linearly with the degree of that activity. If only intensive physical activity is observed, it is important to point out the results of the author (Schnohr et al., 2006; Shortreed, Peeters & Forbes, 2013), showing linear relationship with a reduced incidence of cardiovascular disease. This mainly refers to better efficiency of the heart and improvement of endothelial function and metabolic profile (Hoch et al., 2011), as well as a reduced chance of hypertension (O'Keefe et al., 2012). On the other hand, if the skeletal system is observed, physical activity can affect the process of osteoporosis (Meczekalski et al., 2014).

However, intense physical activity can also be seen in a negative context. Study (Joy et al, 2014) points out that intense physical activity with restrictive diets can affect health where low energy intake is associated with amenorrhea and osteoporosis, with possible occurrence of endothelial dysfunction (Joy et al., 2014).

The degree and types of changes in the cardiac system correlate with age, gender of the athlete, as well as the type of sport in which the athlete is engaged (De Innocentiis, 2018). Individual studies (Krol, 2016) indicate the influ-

ence of the type of contraction on the morphological changes of the cardiovascular system, i.e. that in sports where the static component is dominant, enlargement of the left atrium occurs more often.

In endurance sports, some studies (D'Andrea et al., 2010) show a tendency to enlargement of both left and right atria. When it comes to active athletes, some of the most common changes in the cardiovascular system caused by sports are sinus bradycardia, sinus arrhythmia, ectopic atrial rhythm (Dresner, 2013; Pagourelias et al., 2013), in other words, training in younger athletes leads to morphological changes in the heart (Ruegsegger & Booth, 2017).

Professional sport carries with it far greater physiological demands due to the ultimate motive that clearly draws the line between amateurism and professionalism. Accordingly, it is assumed that the morphological changes of the cardiovascular system in retired athletes are indispensable. The aim of this paper is to critically review and analyze studies dealing with mentioned cardiovascular changes in former athletes.

Method

The methodological procedure included the grouping of primary and secondary sources, domestic and foreign scientific literature, professional papers and electronic journals. The search for relevant scientific studies involved the use of primarily Internet databases *Kobson, Web of Science, Google Scholar and Pubmed.* Journals in the field of sports sciences and sports medicine were searched. Internet domain searches were limited to studies conducted in the last 25 years, and the following keywords were used: changes, cardiovascular system, former athletes, effects, consequences.

Table 1. *Cardiovascular changes in former professional athletes and non-athletes*

Author	Monitoring of the cardiovascular system	Respondents	Endurance sports	Strength sports	Control group
Mengelkochet al. (1997)	blood pressure	N=30	123/79		144/82
	resting electrocardiogram (ECG)		No abnormality detected		No abnormality detected
	total serum cholesterol (mg/dl)		187.5±29.9		149±.7±70
	plasma glucose (mg/dl)		102.2±5.3		103.5±2.1
Pluim et al. (2000)	Left ventricular mass (g)	N=1451	237.36	247.15	177.75
Stuhr, Gerdts&Nordrehaug (2000)	The thickness of the anterior and posterior wall of the left ventricle	N=20 former divers N=20 non-athlete respondents	/	No difference were observed compared to the control group	Diastolic functional parameters were the same as in divers
Hernelahti et al. (2002)	Hypertension	N=69 former athletes N=319 non-athletes	Lowest frequency of hypertension in the 10-year follow-up period (23.6%)	Incidence of hypertension in 10-year follow-up - 33%	Incidence of hypertension in the population - 32%
Parssinen& Seppala (2002)	Ischemic heart disease, hypertension	/	Lower risk of ischemic heart disease	Lower risk of ischemic heart disease, higher obesity in later life	The higher the risk of developing ischemic heart disease, the higher the frequency of hypertension

Hagmar et al. (2006)	Echocardiographic results	N=20 former professional female athletes, 10 medal winners (17 runners, 1 swimmer and 1 cross country competitor) 56±3.5 years and 19 female non-athletes	Larger diameter of the left ventricle (2.9±0.3 cm/m^2)		Smaller diameter of the left ventricle (2.6±0.2 cm/m^2)
Lynch et al. (2007)	Cholesterol levels (mM)	N=16 professional footballers N=16	LDL=3.10±0.48 HDL=1.30±0.23 HDL$_2$=0.21±12		LDL=3.04±0.61 HDL=0.95±0.19 HDL$_2$=0.05±0.04
Luthi et al. (2007)	Systolic velocity of mitral and tricuspid annulus	134 Swiss cyclists	Reduced		Enlarged
Johansson et al (2015)	Hypertension (%)	N=49 endurance-type athletes N=50 strength-type athletes N=49 control group	22	/	18
	Age		74.9±5.3	73.7±5.0	74.2±5.0
	BMI (kg/m^2)		24.8±3.4	27.6±3.8	25.9±3.4
	Diabetics (%)		6.1	6	14.3
	High blood pressure (%)		57.1	72	79.6
	Heart rate (freq./min)		66.3±10.8	63.8±10.2	65.6±11.4
	Left ventricular mass (g/m)		128.6±28	137.3±56.3	128.4±31.3
	Carotids (mm)		0.93±0.18	0.97±0.97	0.91±0.17
	Level of physical activity obtained by MET min.		20.4±16.4	15.2±12.5	9.9±9.3
Laine et al (2014)	Type 2 diabetes	N=392 former athletes N=207 non-athletes	Lower risk of diabetes	Lower risk of glucose tolerance	Higher incidence of type 2 diabetes
Laine et al (2015)	Hypertension	N=3434, 2037 former professional male athletes	Lowest blood pressure	With drugs lower value than in the control group	The highest values of blood pressure with the use of drugs
Sanchis-Gomar et al. (2016)	Indexed left ventricular mass in relation to the body surface (g/m^2)	N=53 former athletes, 42 cyclists, 11 runners N=33 control group of non-athletes	115.2±23.1 87±9	/	94.8±21 88±7
Åsmul et al. (2017)	Incidence of angina pectoris	N=768 former divers		Increased incidence of cardiovascular disease	
Zadvorev et al. (2018)	Hemodynamic changes	N=155 endurance-type athletes N=102 non-athletes	Higher frequency of hemodynamically significant asystolic pauses		Lower frequency of permanent pacemakers

Kim et al. (2019)	Systolic pressure, left ventricular thickness	N=126 American football players	Left ventricular hypertrophy, increased systolic blood pressure	/	/
Ermolao et al. (2019)	Condition of the cardiovascular system	N=525 respondents	/	/	Over 100 cardiovascular changes, arterial hypertension, complex arrhythmia were detected
Melekoğlu et al. (2019)	Condition of the cardiovascular system	N=60 former professional footballers	12 respondents have intraventricular conduction arrest		Poorer lipid composition results, LDL elevated
Moris et al. (2019)	Cardiometabolic disease	N=3745 former American football players	1/4 reported post-career cardiovascular problems	/	/

Discussion

The aim of the study was to analyze changes in the cardiovascular system (CVS) in former athletes. Based on the results of the research, changes in the cardiovascular system can be expected after retirement of professional athletes. In most of the analyzed studies, the changes were characterized as positive, especially in endurance sports. Former athletes who were exposed to training activities where the dominant component of endurance was a priority were less likely to develop hypertension (Johansson et al., 2015; Laine et al., 2014). Studies (Fogelholm, Caprio & Sarna, 1994; Parssinen& Seppala, 2002), although not included in the table, indicate the positive effects of intense exercise on the cardiovascular system. Given the fact that intense physical activity has a positive effect on CVS, the study (Garatechea, 2014) showed that athletes have a longer life expectancy compared to the standard population. Also, the same study shows the importance of intensive physical activity in the prevention of CV diseases. Although in a slightly smaller sample, study (Teramoto, 2010) highlights the impact of intense physical activity on the mortality rate.

Sanchis-Gomar et al. (2016) indicate morphological changes in muscle structure where endurance as a motor ability was dominant during a sports career. Long-term training efforts that are sometimes of very high intensity, primarily endurance sports (cycling), can affect the difference in the indexed left ventricular mass in relation to body surface area (g/m^2). Study (Prakken et al., 2011) indicates the influence of highly demanding training activities on the larger cross-section of the heart cavities compared to non-athletes. Changes in the heart muscle after sports career in American football players were related to fatal outcomes, i.e. myocardial infarction (Lincoln, 2018).

Changes in the heart muscle, which were later fatal for former American football players, were the main causes of myocardial infarction and deaths (Lincoln isar., 2018). After retirement, top athletes continued to engage in recreational sports, more than respondents who did not engage in professional sports during their lifetime (Laine et al., 2013). One such study was also Laine et al. (2015) which indicated that the former career of an elite-top athlete may be associated with a lower prevalence of hypertension in later life (these were athletes who were engaged in endurance-type, general strength-type and mixed sports). The amount of current physical activity and free time was inversely proportional to the prevalence (frequency) of hypertension in later life.

Zadvorev et al. (2018) observed the frequency of cardiac arrhythmias and blood flow conduction in professional athletes after the end of their careers and compared them with the standard population. The results indicated that the group of former athletes had a higher frequency of hemodynamically significant asystolic pauses ($p=0.044$), SA node blocks ($p=0.02$) and required the implantation of permanent pacemakers. The same study indicates a higher frequency of arrhythmias in athletes who have had longer careers in high-load sports as well as the association of cardiac muscle hypertrophy with the length of sports career (Zadvorev et al., 2018). Åsmul et al. (2017) on the sample of divers found a higher incidence of high blood pressure, i.e. they came to the conclusion that professional diving can have negative consequences for the cardiovascular system, while on the other hand when it comes to the general frequency of health problems Morris et al. (2019) found in a large sample that 27% of former American football players showed higher frequency than the regular population.

Based on the presented research results, it can be assumed that in the future, after a sports career, professional athletes will have positive attitudes about life, which will stem from sports habits, but also positive changes in the cardiovascular system. The changes and habits acquired through the engagement in sports will provide them with a healthier continuation of life and may provide them with a longer life if they adhere to all the recommendations received from experts. It is essential to undergo regular medical examinations, wellness exams in adequate health care institutions and monitor health condition. Of course, it can be seen from the results of research that there are certain changes in the cardiovascular system that have left negative consequences in the form of the need for greater interventions on the heart, the introduction of pacemakers (Ermolao et al., 2019). But the changes are partly individual or hereditary, so in further research of this type, the anamnesis of the athlete and genetic preconditions should be analyzed in more detail and taken into account.

It would be good to increase the number of studies that can follow former athletes in later life, a longitudinal study, which would include several factors that can affect the state of this system in later life. Cardiovascular screening of former professional athletes also has a number of objective difficulties. History taking and physical examination have little specificity for detecting diseases of the cardiovascular system that can lead to sudden death caused by a heart attack, or they can cause ventricular tachyarrhythmia, coronary artery abnormalities, and coronary heart disease that generally have a negative physical result.

Conclusion

Professional sports definitely have negative aspects related to changes in the cardiovascular system. A large number of studies indicate the benefits of long-term engagement in sports, but it should be emphasized that sports where strength and endurance are key components can lead to consequences for the cardiovascular system after the end of a sports career. These consequences are mostly related to the left ventricular hypertrophy, as well as to various types of arrhythmias. The recommendation for further research includes the observations related to the correlation of training volume and changes in the cardiovascular system, as well as the connection between early involvement in professional sports and the mentioned changes. It can be assumed that professional sports will at some point affect cardiovascular changes in later life, but one should keep in mind the way and lifestyle as well as the social environment in which the person (former athlete) will continue to live and work. All of these factors can affect the condition and lifespan of former athletes and the condition of the cardiovascular system.

References

Åsmul, K., Irgens, Å., Grønning, M., &Møllerløkken, A. (2017). Diving and long-term cardiovascular health. *Occupational Medicine, 67*(5), 371–376.

D'Andrea, A., Riegler, L., Cocchia, R., Scarafile, R., Salerno, G., Gravino, R., … Calabrò, R. (2010). Left atrial volume index in highly trained athletes. *American Heart Journal, 159*(6), 1155–1161.

De Bacquer, D., De Backer, G., & Kornitzer, M. (2000). Prevalences of ECG findings in large population based samples of men and women. *Heart*, *84*(6), 625-633.

De Innocentiis, C., Ricci, F., Khanji, M. Y., Aung, N., Tana, C., Verrengia, E., … Gallina, S. (2018). Athlete's Heart: Diagnostic Challenges and Future Perspectives. *Sport Med*icine, *48*(11), 2463–2477.

Drezner, J. A., Ackerman, M. J., Anderson, J., Ashley, E., Asplund, C. A., Baggish, A. L., … Wilson, M. G. (2013). Electrocardiographic interpretation in athletes: *The „Seattle Criteria". British Journla of Sports Medicine, 47*(3), 122-124.

Ermolao, A., Gasperetti, A., Rigon, A., Patti, A., Battista, F., Frigo, A. C., … Neunhaeuserer, D. (2019). Comparison of cardiovascular screening guidelines for middle-aged/older adults. *Scandinavian Journal of Medicine & Science in Sports, 29*(9), 1375-1382.

Fogelholm, M., Kaprio, J., & Sarna, S. (1994). Healthy lifestyles of former Finnish world class athletes. *Medicine and Science in Sports Exercise, 26*(2), 224-229

Garatachea, N., Santos-Lozano, A., Sanchis-Gomar, F., Fiuza-Luces, C., Pareja-Galeano, H., Emanuele, E., & Lucia, A. (2014). Elite athletes live longer than the general population: a meta-analysis. In *Mayo Clinic Proceedings*, *89*(9), 1195-1200.

Hagmar, M., Hirschberg, A. L., Lindholm, C., Schenck-Gustafsson, K., & Eriksson, M. J. Ath-lete's heart in postmenopausal former elite endurance female athletes. *Clinical Journal of Sport Medicine*, *15*(4), 257–262.

Hernelahti, M., Kujala, U. M., Kaprio, J., & Sarna, S. (2002). Long-term vigorous training in young adulthood and later physical activity as predictors of hypertension in middle- aged and older men. *International Journal of Sports Medicine, 23*(3) ,178–182.

Hoch, A. Z., Papanek, P., Azabo, A., Widlansky, M. E., Schimke, J. E., &Gutterman, D. D. (2011). Association between the female triad athlete and endothelial dysfunction indancers. *Clinical Journal of Sports Medicine*, 21, 119–125.

Johansson, J. K., Kujala, U. M., Sarna, S., Karanko, H., Puukka, P. J., &Jula, A. M. (2015). Cardiovascular health in former elite male athletes. *Scandinavian Journal of Medicine & Science in Sports, 26*(5), 535–543.

Joy, E., De Souza, M. J., Nattiv, A., Misra, M., Williams, N. I., Mallinson, R. J., … Borgen, J. S. (2014). Female Athlete Triad Coalition Consensus Statement on Treatment and Return to Play of the Female Athlete Triad. *Current Sports Medicine Reports, 13(*4), 219–232.

Khanji, M. Y., van Waardhuizen, C. N., Bicalho, V. V., Ferket, B. S., Hunink, M. M., & Petersen, S. E. (2018). Lifestyle advice and interventions for cardiovascular risk reduction: a systematic review of guidelines. *International Journal of Cardiology*, *263*, 142-151.

Kim, J. H., Hollowed, C., Liu, C., Al-Badri, A., Alkhoder, A., Dommisse, M., … Baggish, A. L. (2019). Weight Gain, Hypertension, and the Emergence of a Maladaptive Cardiovascular Phenotype Among US Football Players. *JAMA Cardiology, 4*(12), 1221-1229.

Król, W., Jędrzejewska, I., Konopka, M., Burkhard-Jagodzińska, K., Klusiewicz, A., Pokrywka, A., … Braksator, W. (2016). Left Atrial Enlargement in Young High-Level Endurance Athletes – Another Sign of Athlete's Heart? *Journal of Human Kinetics, 53*(1), 81–90.

Laine, M. K., Eriksson, J. G., Kujala, U. M., Wasenius, N. S., Kaprio, J., Bäckmand H. M, Peltonen, M., Mertsalmi, T., & Sarna, S. (2014). A former career as a male elite athlete: does it protect against type 2 diabetes in later life? *Diabetologia*, *57*(2), 270–274.

Laine, M. K., Kujala, U. M., Eriksson, J. G., Wasenius, N. S., Kaprio, J., Bäckmand, H. M., Peltonen, M., Heinonen, O., Jula, A., & Sarna, S. (2015). Former male elite athletes and risk of hypertension in later life. *Journal of Hypertension, 33*(8), 1549–1554.

Lim, S. S., Vos, T., Flaxman, A. D., Danaei, G., Shibuya, K., Adair-Rohani, H., … Andrews, K. G. (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet, 380*(9859), 2224–2260.

Lincoln, A. E., Vogel, R. A., Allen, T. W., Dunn, R. E., Alexander, K., Kaufman, N. D., & Tucker, A. M. (2018). Risk and Causes of Death among Former National Football League Players (1986–2012). *Medicine & Science in Sports & Exercise, 50*(3), 486–493

Luthi, P., Zuber, M., Ritter, M., Oechslin, E., Jenni, R., Seifert, B., Baldesberger, S., Attenhoferjost, C. (2008). Echocardiographic findings in former professional cyclists after long-term deconditioning of more than 30years. *European Journal of Echocardiography, 9*(2), 261-267.

Lynch, N. A., Ryan, A. S., Evans, J., Katzel, L. I., & Goldberg, A. P. (2007). Older Elite Football Players Have Reduced Cardiac and Osteoporosis Risk Factors. *Medicine & Science in Sports & Exercise, 39*(7), 1124–1130.

Meczekalski, B., Katulski, K., Czyzyk, A., & Podfigurna-Stopa, A. (2014). Health in older women athletes. *Maturitas, 79*(4), 357–361

Melekoğlu, T., Sezgin, E., Işın, A., & Türk, A. (2019). The Effects of a Physically Active Lifestyle on the Health of Former Professional Football Players*. Sports, 7*(4), 75.

Mengelkoch, L. J., Pollock, M. L., Limacher, M. C., Graves, J. E., Shireman, R. B., Riley, W. J.,... Leon, A. S. (1997). Effects of Age, Physical Training, and Physical Fitness on Coronary Heart Disease Risk Factors in Older Track Athletes at Twenty-Year Follow-up. *Journal of the American Geriatrics Society, 45*(12), 1446–1453.

Morris, T. P., McCracken, C., Baggish, A., Weisskopf, M., Zafonte, R., Taylor, H. A., … Pascual-Leone, A. (2019). Multisystem afflictions in former National Football League players. *American Journal of Industrial Medicine, 62*(8), 655-662.

O'Keefe, J. H., Patil, H. R., Lavie, C. J., Magalski, A., Vogel, R. A., &McCullogh, P. A. (2012). Potential adverse cardiovascular effects from excessive endurance exercise. *Mayo Clinic Proceedings, 87*(6), 587–595.

Pagourelias, E. D., Kouidi, E., Efthimiadis, G. K., Deligiannis, A., Geleris, P., & Vassilikos, V. (2013). Right atrial and ventricular adaptations to training in male Caucasian athletes: an echocardiographic study. *Journal of American Soietyc Echocardiography*, *26*(11), 1344–1352.

Parssinen, M., & Seppala, T. (2002). Steroid Use and Long-Term Health Risks in Former Athletes. *Sports Medicine, 32*(2), 83–94.

Pluim, B. M., Zwinderman, All., van der Larse, A., & van der Wall, E. (2000). The athlete's heart: a meta analysis of cardiac structure and function. *Circulation*, *100*(3), 336-344

Prakken, N. H. J., Teske, A. J., Cramer, M. J., Mosterd, A., Bosker, A. C., Mali, W. P., … Velthuis, B. K. (2011). Head-to-head comparison between echocardiography and cardiac MRI in the evaluation of the athlete's heart. *British Journal of Sports Medicine, 46*(5), 348–354.

Ruegsegger, G. N., & Booth, F. W. (2017). Health Benefits of Exercise. *Cold Spring Harbor Perspectives in Medicine, 8*(7), a029694.

Sanchis-Gomar, F., López-Ramón, M., Alis, R., Garatachea, N., Pareja-Galeano, H., Santos-Lozano, A.,… Lucia, A. (2016). No evidence of adverse cardiac remodeling in former elite endurance athletes. *International Journal of Cardiology,* 222, 171–177.

Schnohr, P., Lange, P., Scharling, H., & Jensen, J. S. (2006). Long-term physical activity in leisure time and mortality from coronary heart disease, stroke, respiratory diseases, and cancer. The Copenhagen City Heart Study. *European Journal of Cardiovascular Prevention Rehabilitation, 13*(2), 173–179.

Stuhr, L. E., Gerdts, E., &Nordrehaug, J. E. (2000). Doppler-echocardiographic findings in professional divers. *Undersea Hyperbaric Medicine, 27*(3), 131-135.

Teramoto, M., & Bungum, T. J. (2010). Mortality and longevity of elite athletes*. Journal of Science and Medicine in Sport, 13*(4), 410–416.

Zadvorev, S. F., Krysiuk, O. B., Obrezan, A. G., &, Yakovlev, A. A.(2018). The influence of personal history of athletic activity on clinical course of cardiovascular diseases in former athletes. *Advences in Gerontology, 31*(4), 531-537.

Primljen: 11. oktobar 2021. / Received: Oktober 11, 2021
Prihvaćen: 18. novembar 2021. / Accepted: November 18, 2021

https://doi.org/10.7251/SSH2102237S
UDC: 796.011.1:796.015.572
Short notice
Kratko saopštenje

Influence of Programmed Exercise on Body Composition Indicators of Recreational Exercisers

Uticaj programiranog vežbanja na pokazatelje telesne kompozicije rekreativnih vežbača

Omer Špirtović[1], Senad Bajrić[2], Rašid Hadžić[3]

[1]State of University in Novi Pazar, Department for Biochemical and Medical Sciences, Novi Pazar, Serbia
[2]Pan-European University Apeiron, Faculty of Sports Sciences, Banja Luka, BiH
[3]University of Montenegro, Faculty of Sports and Physical Education, Nikšić, Montenegro

Correspondence:
Senad Bajrić, Pan-European University Apeiron, Faculty of health sciences, Banja Luka, BiH
senad.o.bajric@apeiron-edu.eu

[1]Državni univerzitet u Novom Pazaru, Departman za biomedicinske nauke, Novi Pazar, Srbija
[2]Panevropski univerzitet Apeiron, Fakultet sportskih nauka, Banja Luka, Bosna i Hercegovina
[3]Univerzitet Crne Gore, Fakultet za sport i fizičko vaspitanje, Nikšić, Crna Gora

Korespondencija:
Senad Bajrić, Panevropski univerzitet Apeiron, Fakultet sportskih nauka, Banja Luka, Bosna i Hercegovina,
senad.o.bajric@apeiron-edu.eu

Abstract: *This research was conducted in order to determine whether and what to extent the three-month fitness program affect changjes in body composition on a sample of 42 exercisers, recreational athletes, ages between 21 and 35. The measurement was performed using a Tanita scale, model BC-543, and the following variables were applied: body weight, muscle mass and percentage of fat.*

After the initial measurement, a three-month fitness exercise program was applied, and then the final measurement in order to determine the achieved effects of training. Trainings were performed three times a week and were adjusted to each recreational athlete in proportion to the age and current state of training.

In the process of statistical data processing, descriptive and comparative statistics procedures were used. The basic statistical parameters for each subject were calculated individually and it was determined that there are statistically significant differences between the initial and final measurements.

Keywords: *body composition, recreational athletes, exercisers, fitness exercise programs.*

Sažetak: *Na uzorku od 42 vežbača, rekreativaca, starosti od 21 do 35 godina, izvršeno je istraživanje sa ciljem da se utvrdi da li i u kojoj meri tromesečni fitness program vežbanja utiče na promene u njihovoj telesnoj kompoziciji. Merenje je izvršeno uz pomoć Tanita vage, model BC-543, a primenjene su sledeće varijable: masa tela, mišićna masa i procenat masti.*

Nakon inicijalnog merenja primenjen je tromesečni fitness program vežbanja, a onda i finalno merenje kako bi se utvrdili postignuti efekti treninga. Treninzi su obavljani tri puta nedeljno i bili su prilagođeni svakom rekreativcu srazmerno godinama starosti i trenutnom stanju treniranosti.

U postupku statističke obrade podataka, koristili su se postupci deskriptivne i komparativne statistike. Izračunati su osnovni ststistički parametri za svakog ispitanika pojedinačno i utvrđeno je da postoje statistički značajne razlike između inicijalnog i finalnog merenja.

Ključne riječi: *telesna kompozicija, rekreativci, vežbači, fitness programi vežbanja.*

Introduction

Analyzing the quality of human health, it can be said that in addition to his genetics, it is largely conditioned by his way of life, and that the cause of various diseases is related to excessive and inadequate nutrition and insufficient physical activity.

The current living and working conditions, which are primarily conditioned by the scientific - technological revolution, mechanization and automation, directly lead

Uvod

Analizirajući kvalitet zdravlja čoveka, može se reći da je ono pored njegove genetike, umnogome uslovljeno i načinom njegovog življenja, te da je uzrok raznih bolesti vezan kako za preobilnu i neadekvatnu ishranu tako i nedovoljnu fizičku aktivnost.

Sadašnji uslovi života i rada koji su pre svega uslovljeni naučno - tehnološkom revolucijom, mehanizacijom i automatizacijom, direktno dovode do nedovoljne kretne

to insufficient motor activity, ie reduced physical activity, which often has a negative effect on the organism. For these reasons, it is necessary to choose an adequate recreational program content, which can primarily act preventively, but also effectively contribute to the alleviation and elimination of certain diseases, such as damage and diseases of the locomotor system, cardiovascular and respiratory system, nervous system and obesity (Acimovic, Spirtovic 2012).

Kinesiological activities must be carried out regularly, but care should be taken to ensure that the loads are appropriate for age, health and current physical fitness. Increased function, in the conditions of muscular work, accelerates numerous physiological processes and the development of organs, which work with less load in everyday life, thus reducing the risk of certain diseases. Exercise of programmed physical activities leads to various changes in morphological characteristics, especially on muscle tissue (Lohman, 1992; Malousaris et al. 2008).

Physical exercise in the broadest sense, and especially fitness activities are the right measure for human health, because each individual, in relation to their individual potentials, can choose the type of activity, time and place of physical activity, under the professional control of trainers and doctors. With programmed exercise, the muscular system becomes more elastic, stronger, more endurable. The work of the muscular system releases energy, and especially fats are burned easier and more efficiently (Nićin, 2003). According to Prskal (2004), appropriate physical exercise is an effective and irreplaceable means of improving and protecting health, especially in modern social and environmental conditions.

In many medical branches, as well as in the field of sports physiology, the assessment of body composition occupies an important place in the assessment of health risks. By studying the body composition of an individual, one can gain an impression of a lifestyle that includes both good and bad habits and reflects on the structure of the body, giving it a personal characteristic. (Maksimović, 2008). Determining the composition of body composition is a common method not only in medical disciplines but also in sports sciences. This increases the interest in new methods and modern procedures in determining the composition of body composition. The focus is most often on determining the amount of fat component, due to the analysis of health status and assessment of the existence of possible health risk (Ostojić, 2005).

Similar research has been done by many authors Reilly and Dorosty, 1999; Tsimeas et al., 2005; Ozdirenc et al., 2005; Relly, 2007; Petrić and Novak, 2007; Aberle

aktivnosti čoveka, odnosno smanjene fizičke aktivnosti, koja često negativno utiče na organizam. Iz tih razloga potrebno je odabrati adekvatan rekreativni programski sadržaj, koji pre svega može preventivno delovati, ali i efikasno doprineti ublažavanju i uklanjanju određenih obolenja, kao što su oštećenje i obolenje lokomotornog aparata, kardiovaskularnog i respiratornog sistema, nervnog sistema i gojaznosti (Aćimović, Špirtović 2012.).

Kineziološke aktivnosti moraju se sprovoditi redovno ali treba voditi računa da opterećenja budu primerena uzrastu, zdravstvenom stanju i trenutnoj fizičkoj pripremljenosti. Pojačanom funkcijom, u uslovima mišićnog rada, dolazi do pospešivanja brojnih fizioloških procesa i razvijanja organa, koji u svakodnevnom životu rade sa manjim opterećenjem, pa se na taj način smanjuje rizik od određenih bolesti. Upražnjavanjem programiranih fizičkih aktivnosti dolazi do raznih promena u morfološkim karakteristikama, posebno na mišićnom tkivu (Lohman, 1992; Malousaris i sar. 2008).

Telesno vežbanje u najširem smislu, a posebno fitness aktivnosti su upravo prava mera za čovekovo zdravlje, jer svaki pojedinac, u odnosu na svoje individualne potencijale, može da bira vrstu aktivnosti, vreme i mesto obavljanja telesnih aktivnosti, a pod stručnom kontrolom trenera i lekara. Programiranim vežbanjem mišićni sistem postaje elastičniji, snažniji, izdržljiviji. Radom mišićnog sistema oslobađa se energija, a posebno se masnoće sagorevaju lakše i efikasnije (Nićin, 2003.). Prema Prskalu (2004), primjereno tjelesno vježbanje je učinkovito i nezamjenjivo sredstvo unapređenja i zaštite zdravlja, posebno u savremenim društvenim uslovima i uslovima okoline.

U brojnim medicinskim granama, kao i u oblasti fiziologije sporta, procena telesne kompozicije zauzima važno mesto u proceni zdravstvenih rizika. Proučavajući telesnu kompoziciju pojedinca može se steći utisak o životnom stilu koji uključuje i dobre i loše navike, a odražava se na strukturu tela dajući njegovo lično obilježje. (Maksimović, 2008). Određivanje sastava telesne kompozicije česta je metoda ne samo u okvirima medicinskih disciplina već i u sportskim naukama. S toga se povećava interesovanje za nove metode i savremene postupke u određivanju sastava telesne kompozicije. Fokus je usmeren najčešće ka određivanju količine masne komponente, zbog analize zdravstvenog statusa i procene postojanja eventualnog zdravstvenog rizika (Ostojić, 2005).

Sličnim istraživanjima su se bavili mnogi autori Reilly i Dorosty, 1999; Tsimeas i sar., 2005; Ozdirenc i sar., 2005; Relly, 2007; Petrić i Novak, 2007; Aberle i sar., 2009; Horvat i sar., 2009; Tinazci i Emiroglu, 2009;

et al., 2009; Horvat et al., 2009; Tinazci and Emiroglu, 2009; Cetinić et al., 2011; Vasić et al., 2012; Momčilović V. and Momčilović Z., 2018; Vuckovic et al., 2019.

The aim of this study was to determine whether and to what extent a three-month fitness exercise program affects changes in the body composition of exercisers.

Material And Methods

The research was conducted on a sample of 42 exercisers, recreational athletes, aged between 21 and 35 years. Measurements were performed in the fitness center with the help of Tanita scales, model BC-543. The following variables were applied:

- body weight (AMAST),
- muscle mass (TSMMA) and
- fat percentage (TSUTM).

After the initial measurement, a three-month fitness exercise program was applied, and then the final measurement in order to determine the achieved effects of training. The training program was the same for all respondents and based on the initial condition, the intensity and scope of work were determined. Respondents were educated with performing basic exercises. The first month of training was with less load and simpler exercises so that the subjects could pass without stronger muscle inflammation, which could be the reason for giving up further exercise, and then, in order to achieve the effect of exercise, the load was gradually increased and practiced more complexly exercises. Trainings were performed three times a week, a total of 36 trainings and were adjusted to each recreational athlete in proportion to age and current state of physical fitness. Each training lasted 60 minutes and consisted of an introductory-preparatory, main and final part of the training. In the introductory-preparatory part of the training for warming up and stretching, were used cyclic trainers and shaping exercises which were lasting 10 minutes. The main part of the training lasted 45 minutes and it included the planned contents of exercises for strengthening the muscles of the arms and shoulder girdle, abdominal and back muscles, as well as leg muscles. In the first phase of the main part of the training, the trainees worked on trainers and props, while the second part was intended to work on aerobic endurance through walking and running of moderate intensity. In the final part of the training, exercises for relaxing the muscles and stretching were performed for 5 minutes.

Descriptive statistics and comparative statistics procedures were used to process the obtained data. Using descriptive statistics, the basic statistical parameters were calculated for each respondent individually.

Cetinić i sar., 2011; Vasić i sar., 2012; Momčilović V. i Momčilović Z., 2018; Vučković i sar., 2019.

Cilj ovog rada bio je da se utvrdi da li i u kojoj meri tromesečni fitness program vežbanja utiče na promene u telesnoj kompoziciji vežbača.

Materijal I Metode

Istraživanje je sprovedeno na uzorku od 42 vežbača, rekreativaca, starosne dobi između 21 i 35 godina. Merenja su vršena u fitness centru uz pomoć Tanita vage, model BC-543. Primenjene su sledeće varijable:

- masa tela (AMAST),
- mišićna masa (TSMMA) i
- procenat masti (TSUTM).

Nakon inicijalnog merenja primenjen je tromesečni fitness program vežbanja, a onda i finalno merenje kako bi se utvrdili postignuti efekti treninga. Program treninga je bio isti za sve ispitanike a na osnovu početnog stanja se odredjivao intenzitet i obim rada. Ispitanici su bili edukovani sa izvođenjem osnovnih vežbi. Prvi mesec treninzi su bili sa manjim opterećenjem i jednostavnijim vežbama kako bi ispitanici prošli bez jače upale mišića, što je mogao biti razlog odustajanja od daljeg vežbanja, a zatim, da bi se postigao efekat vežbanja, opterećenje se postepeno povećavalo i upražnjavale su se i složenije vežbe. Treninzi su obavljani tri puta nedeljno, ukupno 36 treninga i bili su prilagođeni svakom rekreativcu srazmerno godinama starosti i trenutnom stanju fizičke spremnosti. Svaki trening je trajao 60 minuta i sastojao se od uvodnog- pripremnog, glavnog i završnog dela treninga. U uvodno-pripremnom delu treninga za zagrevanja i razgibavanja koristili su se ciklični trenažeri i vežbe oblikovanja u trajanju od 10 minuta. Glavni deo treninga je trajao 45 minuta i u njemu su se odvijali planirani sadržaji vežbi za jačanje mišića ruku i ramenog pojasa, trbušnih i leđnih mišića, kao i mišića nogu. U prvoj fazi glavnog dela treninga vežbači su radili na trenažerima i sa rekvizitima, dok je drugi deo bio namenjen radu na aerobnoj izdržljivosti kroz hodanje i trčanje umerenog intenziteta. U završnom delu treninga u trajanju od 5 minuta su se provodile vežbe za opuštanje muskulature i istezanje.

Za obradu dobijenih podataka, koristili su se postupci deskriptivne statistike i komparativne statistike. Primenom deskriptivne statistike izračunati su osnovni statistički parametri za svakog ispitanika pojedinačno.

The Results

Results of descriptive analysis

Table 1. *Initial measurement of respondents*

	MAX	MIN	VW	Mean	SD	V (%)	SKEW	KURT
Body mass / Telesna masa	1o4	68	36	82	11.99	14.86	.519	-.793
Muscle mass / Mišićna masa	71	45	26	61	9.26	15.41	1.299	.790
Fat percentage / Procenat masti	45	27	18	35	7.42	21.98	-.073	-.250

Legend: MAX-maximum *result, MIN-minimum result, VW-variation width, SD-standard deviation, V-coefficient of variability, SKEW-curvature of distribution, KURT-flatness of distribution.*

As can be seen in Table 1, during the first measurement, before the start of the training process, the average weight of the subjects was 82 kg, the average muscle mass of the subjects was 61 kg, while the proportion of adipose tissue was on average 35 kg. Analyzing the dispersion parameters of the variables, it is clear that based on the standard deviation, the group of subjects is the most homogeneous in the percentage of fat (sd = 7.42), followed by muscle mass (sd = 9.26), and the most inhomogeneous in the variable body mass (sd = 11.99). Based on the coefficient of variability, the results vary the least in body mass (14.86%), slightly more in muscle mass (15.41%), and most in the percentage of fat (21,98%).

Skewness analysis clearly shows that the variable body mass has a symmetrical distribution, the variable adipose tissue has a negative moderate asymmetry while muscle mass (skew = 1.299) has a pronounced asymmetry.

According to the results of flatness - kurtosis there is no variable that shows the normal flatness of the results. We can only speak of greater flatness than normal in all variables where kurtosis ranges from -0.793 in the case of the body mass variable to a value of 0.790 in the case of the muscle mass variable.

Rezultati

Rezultati deskriptivne analize

Tabela 1. *Inicijalno merenje ispitanika*

Legenda: MAX-maksimalan *rezultat, MIN-minimalan rezultat, VŠ-varijaciona širina, Mean-srednja vrednost, SD-standardna devijacija, V(%)-koeficijent varijabilnosti, SKEW-zakrivljenost distribucije, KURT-spljoštenost distribucije.*

Kao što se vidi na tabeli 1, tokom prvog merenja, pre početka trenažnog procesa, prosečna masa ispitanika je iznosila 82 kg, prosek mišićne mase ispitanika iznosio 61 kg, dok je udeo masnog tkiva u proseku bio 35 kg. Analizirajući disperzione parametre varijabli, jasno se zapaža, da je na osnovu standardne devijacije grupa ispitanika najhomogenija u procentu masti (SD=7,42), zatim sledi mišićna masa (SD=9,26), a da su najnehomogeniji u varijabli telesna masa (SD=11,99). Na osnovu koeficijenta varijabilnosti rezultati najmanje variraju kod telesne mase (14,86%), nešto više kod mišićne mase (15,41%), a najviše kod procenta masti (21,98%).

Analiza Skewness-a, jasno pokazuje da varijabla telesna masa ima simetričnu distribuciju, varijabla masno tkivo ima negativno umerenu asimetriju dok mišićna masa (SKEW= 1,299) ima izrazitu asimetriju.

Prema rezultatima spljoštenosti – kurtosis ne postoji varijabla koja pokazuje normalnu spljoštenost rezultata. Možemo govoriti samo za veću spljoštenost od normalne u svim varijablama gdje se kurtosis kreće od -0,793 u slučaju varijable telesna masa pa do vrednosti od 0,790 u slučaju varijable mišićna masa.

Table 2. *Final measurement of respondents*

	MAX	MIN	VW	Mean	SD	V (%)	SKEW	KURT
Body mass / Telesna masa	100	65	35	78	11,23	14,41	.708	-.690
Muscle mass / Mišićna masa	74	46	28	63	8,49	13,63	1.107	.208
Fat percentage / Procenat masti	42	15	27	28	8,37	29,80	-.243	.284

Legend: MAX-maximum *result, MIN-minimum result, VW-variation width, SD-standard deviation, V-coefficient of variability, SKEW-curvature of distribution, KURT-flatness of distribution.*

Tabela 2. *Finalno merenje ispitanika*

Legenda: MAX-maksimalan *rezultat, MIN.minimalan rezultat, VŠ(%)-varijaciona širina, Mean-srednja vrednost, SD-standardna devijacija, V-koeficijent varijabilnosti, SKEW-zakrivljenost distribucije, KURT-spljoštenost distribucije.*

After the training process, which lasted for three months, the average body weight of the examinees was 78 kg, the average muscle mass was 63 kg, and the share of adipose tissue was on average 28 kg. Based on the standard deviation, the group of subjects is the most homogeneous in the percentage of fat (sd = 8.37), followed by muscle mass (sd = 8.49), and the most inhomogeneous are in the variable body weight (sd = 11.23). Based on the coefficient of variability, the results vary the least in muscle mass (13.63%), slightly more in body mass (14.41%), and most in the percentage of fat (29.80%).

In the Skewness analysis part, it is clear that the body mass variable has a symmetrical distribution, the adipose tissue variable has a negative moderate asymmetry and the muscle mass variable (skew = 1,107) has a pronounced asymmetry.

According to the results of flatness - kurtosis, there is no variable that shows the normal flatness of the results. We can only speak of greater flatness than normal in all variables where kurtosis ranges from -0.690 in the case of the variable body weight to a value of 0.284 in the case of the variable percentage of fat.

Results of comparative analysis

Table 3. *Determination of differences between initial and final T-test measurements at the significance level of 99% (p <0.01)*

Paired Samples Test

	Paired Differences					t	df	Sig (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 weight - weight 2 / Pair 1 težina - težina 2	3.91000	1.76545	.38178	3.74139	5.11515	10.898	19	.000
Pair 2 muscles - muscles 2 / Pair 2 mišići - mišići 2	-2.11000	2.12544	.51128	-3.106324	-.913498	-3.120	19	.001
Pair 3 fat - fat 2 / Pair 3 mast - mast 2	6.22000	2.63631	.54337	5.11401	6.958463	11.244	19	.000

Legend: Mean-mean, *Std. Deviation-standard deviation, Std. Error Mean-standard error of the arithmetic mean, Confidence interval of the Difference-confidence interval, t-value of the test, Sig (2-tailed) -significance level.*

From Table 3, where the results of the t-test are shown, it can be clearly concluded that there are statistically significant differences in all variables, with an achieved level of statistical significance less than 0.01, ie. with a statistical inference error of less than 1%.

Nakon trenažnog procesa, koji je trajao tri meseca, prosečna telesna masa ispitanika iznosila je 78 kg, prosečna mišićna masa 63 kg, a udeo masnog tkiva u proseku je iznosio 28 kg. Na osnovu standardne devijacije grupa ispitanika najhomogenija je u procentu masti (SD=8,37), zatim sledi mišićna masa (SD=8,49), a najnehomogeniji su u varijabli telesna masa (SD=11,23). Na osnovu koeficijenta varijabilnosti rezultati najmanje variraju kod mišićne mase (13,63%), nešto više kod telesne mase (14,41%), a najviše kod procenta masti (29,80%).

U delu analize Skewness-a, jasno je uočljivo da varijabla telesna masa ima simetričnu distribuciju, varijabla masno tkivo ima negativno umerenu asimetriju, a varijabla mišićna masa (skew= 1,107) ima izrazitu asimetriju.

Prema rezultatima spljoštenosti – kurtosis, ne postoji varijabla koja pokazuje normalnu spljoštenost rezultata. Možemo govoriti samo za veću spljoštenost od normalne u svim varijablama gdje se kurtosis kreće od -0,690 u slučaju varijable tjelesna masa pa do vrijednosti od 0,284 u slučaju varijable procenat masti.

Rezultati komparativne analize

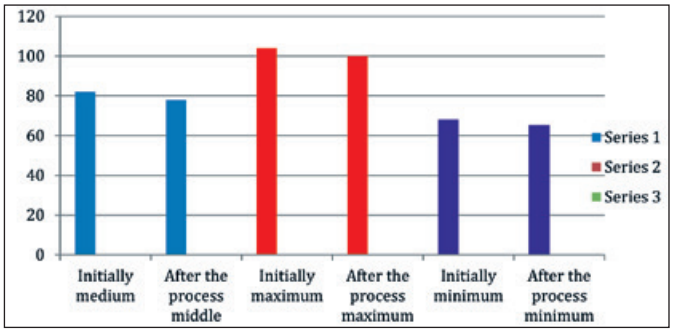
Tabela 3. *Utvrđivanje razlika između inicijalnog i finalnog merenja T-testom na nivou značajnosti od 99% (p<0,01)*

Paired Samples Test

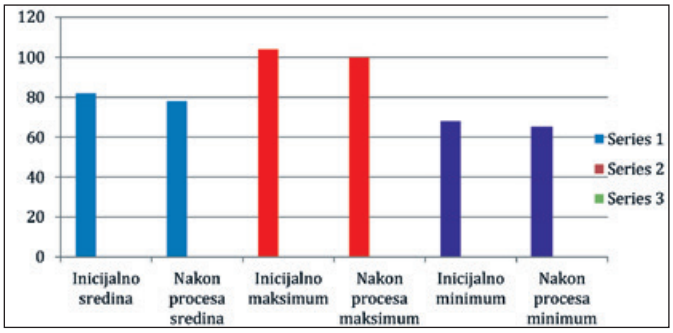
	Paired Differences					t	df	Sig (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 weight - weight 2 / Pair 1 težina - težina 2	3.91000	1.76545	.38178	3.74139	5.11515	10.898	19	.000
Pair 2 muscles - muscles 2 / Pair 2 mišići - mišići 2	-2.11000	2.12544	.51128	-3.106324	-.913498	-3.120	19	.001
Pair 3 fat - fat 2 / Pair 3 mast - mast 2	6.22000	2.63631	.54337	5.11401	6.958463	11.244	19	.000

Legenda: Mean-srednja *vrednost, Std. Deviation-stardandna devijacija, Std. Error Mean-standardna greška aritmetičke sredine, Confidence interval of the Difference-interval pouzdanosti, t-vrednost testa, Sig (2-tailed)-nivo značajnosti.*

Iz tabele 3, gde su prikazani rezultati t-testa, se jasno može zaključiti da postoje statistički značajne razlike u svim varijablama, sa ostvarenim nivoom statističke značajnosti manjim od 0,01 tj. sa verovatnoćom greške pri statističkom zaključivanju manjom od 1%.



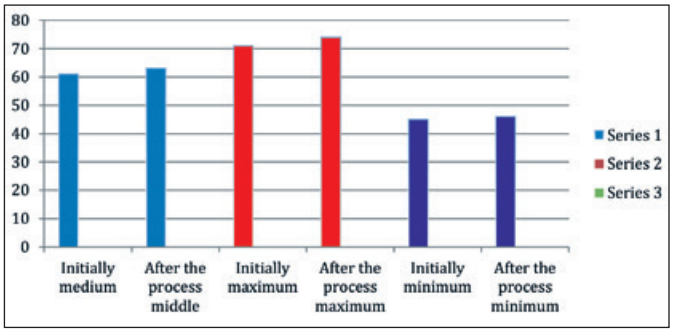
Graph 1. *Variable - body weight, before and after the training process*



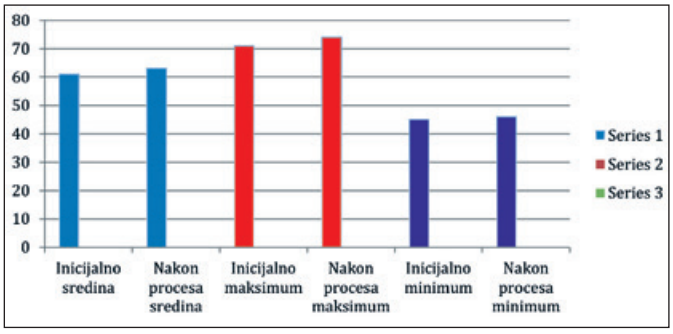
Slika 1. *Varijabla - telesna masa, pre i posle programiranog vežbanja*

The graph shows that the training process showed certain results in terms of body weight. Average weight decreased from 82 kg to 78 kg, minimum body weight was reduced from 68 kg to 65 kg. while the maximum value is reduced by 4 kg.

Iz slike 1. se vidi da je trenažni proces pokazao određene rezultate po pitanju telesne mase. Prosečna masa smanjena sa 82 kg na 78 kg, minimalna vrednost telesne mase je snižena sa 68 kg na 65 kg. dok je maksimalna vrednost snižena za 4 kg



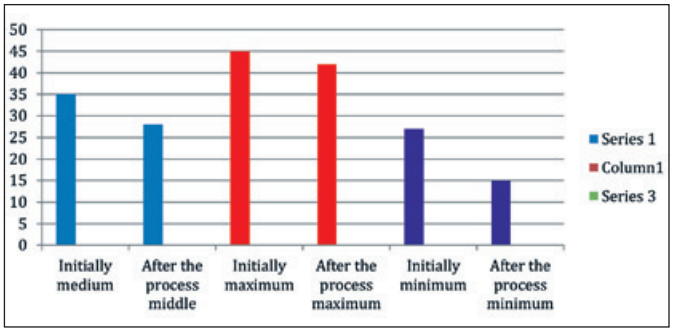
Graph 2. *Variable - muscle mass, before and after the training process*



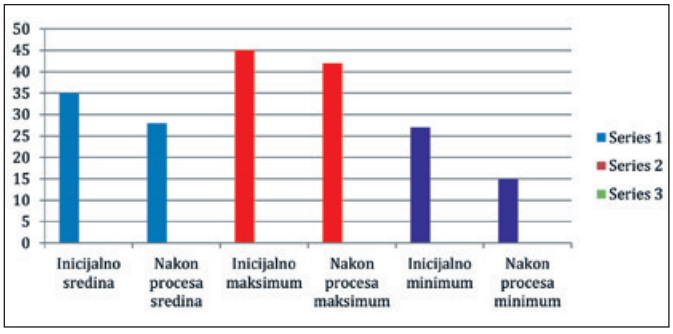
Slika 2. *Varijabla - mišićna masa, pre i posle programiranog vežbanja*

The average muscle mass was increased by 2 kg, the minimum value of muscle mass was increased from 45 kg to 46 kg. while the maximum value was increased from 71 kg to 74 kg.

Prosečna mišićna masa uvećana je za 2 kg, minimalna vrednost mišićne mase je uvećana sa 45 kg na 46 kg. dok je maksimalna vrednost uvećana sa 71 kg na 74 kg.



Graph 3. *Variable - adipose tissue, before and after the training process*



Slika 3. *Varijabla - masno tkivo, pre i posle programiranog vežbanja*

The graph shows that the programmed training process showed certain results in terms of adipose tissue. It is clear that the average value was reduced by 7 kg, the mini-

Iz slike 3. se vidi da je programirani trenažni proces pokazao određene rezultate i po pitanju masnog tkiva. Jasno se vidi da je prosečna vrednost smanjena za 7 kg,

mum value of adipose tissue was reduced by 12 kg, while the maximum value was reduced from 45 kg to 42 kg.

Discussion

Programmed exercise, in accordance with the needs of the individual, has a positive effect on weight loss and fat reduction in obese people, while the positive effect of training is seen in the improvement of muscle mass.

The results of the final measurement clearly show that the three-month fitness exercise program gave positive results on all three variables. It is visible that the trainees had a decrease in subcutaneous fat and an increase in muscle mass, which was exactly the goal of this training process and is a prerequisite for good health of the trainees.

Since the reduction of body fat is achieved, as in the fight against cellulite, adequate exercises that "affect" certain parts of the body, and which are the most vulnerable to fat deposits, the exercise program was designed so that strength exercises, which were performed in the main part of the training, were focused on those parts of the body where the formation of fatty subcutaneous tissue can occur to a greater extent. The work on the training was focused on removing fat deposits on the hips, waist, abdominal region, thighs, upper arms, which gave a positive result. The achieved positive effects show that programmed physical activities provide significant transformational effects when it comes to body composition, which could be observed in the works of other authors in whom this type of research was the subject of interest and who obtained similar results.

Research conducted by Hrgetić, Dadić, Milanović, Skoblar (2016) shows that after a three-month training process, statistically significant changes in the percentage of adipose tissue occurred in middle-aged women. Similar results were obtained in their research (Širić et al., 2005; Stojiljković et al., 2010; Obrovac, 2015).

Conclusion

The aim of this study was to determine whether and to what extent a three-month fitness exercise program affects changes in the body composition of exercisers.

The research was conducted on a sample of 42 exercisers, recreational athletes, aged 21 to 35 years. Measurements were performed by one meter using a Tanita scale, model BC-543, and the following variables were applied: body mass (AMAST), muscle mass (TSMMA) and fat percentage (TSUTM).

Based on the obtained results of this research, it can be concluded that programmed physical activities

minimalna vrednost masnog tkiva je snižena za 12 kg, dok je maksimalna vrednost snižena sa 45 kg na 42 kg.

Diskusija

Programirano vežbanje, u skladu sa potrebama pojedinca, pozitivno utiče na smanjenje telesne mase i redukciju masti kod gojaznih osoba, dok se pozitivan efekat treninga vidi u poboljšanju mišićne mase.

Rezultati finalnog merenja jasno pokazuju da je tromesečni fitness program vežbanja dao pozitivne rezultate na sve tri varijable. Vidljivo je da kod vežbača došlo do smanjenja masnog potkožnog tkiva i povećanja mišićne mase što je upravo i bio cilj ovog trenažnog procesa, a preduslov je za dobro zdravstveno stanje vežbača.

Obzirom da se redukovanje masnih naslaga na telu postiže, kao i kod borbe protiv celulita, adekvatnim vežbama koje "pogađaju" određene delove tela, a koje su najugroženije masnim naslagama, program vežbanja je bio koncipiran tako da su vežbe snage, koje su se izvodile u glavnom delu treninga, bile fokusirane upravo na te delove tela gde u većoj meri može doći do stvaranja masnog potkožnog tkiva. Rad na treningu je bio usmeren na skidanju masnih naslaga na bokovima, struku, trbušnoj regiji, butini, nadlaktici što je i dalo pozitivan rezultat. Ostvareni pozitivni efekti pokazuju kako programirane telesne aktivnosti osiguravaju značajne transformacijske učinke kada je u pitanju telesni sastav, što se moglo zapaziti i u radovima drugih autora kod kojih je ova vrsta istraživanja bila je predmet interesovanja i koji su dobili slične rezultate.

Istraživanja koje su sproveli Hrgetić, Dadić, Milanović, Skoblar (2016) pokazuju da su nakon provedenog trenažnog procesa u trajanju od tri meseca kod žena srednje životne dobi nastale statistički značajne promene u procentu masnog tkiva. Slične rezultate u svojim istraživanjima dobili su (Širićisar., 2005; Stojiljković i sar., 2010; Obrovac, 2015).

Zaključak

Cilj ovog rada bio je da se utvrdi da li i u kojoj meri tromesečni fitness program vežbanja utiče na promene u telesnoj kompoziciji vežbača.

Istraživanje je sprovedeno na uzorku od 42 vežbača, rekreativaca, starosti od 21 do 35 godina. Merenja je izvršio jedan merilac uz pomoć Tanita vage, model BC-543, a primenjene su sledeće varijable: masa tela (AMAST), mišićna masa (TSMMA) i procenat masti (TSUTM).

Na osnovu dobijenih rezultata ovog istraživanja može se zaključiti da programirane telesne aktivnosti mogu pozitivno uticati na promene u telesnom sastavu

can positively affect changes in body composition in recreational exercisers. By interpreting the comparative analysis between the initial and final measurement, it was determined that there are statistically significant differences in the body composition of recreational exercisers, ie that there is a difference in body mass, muscle mass and that there is a statistically significant difference in fat percentage after applying a three-month fitness program.

kod rekreativnih vežbača. Interpretacijom komparativne analize između inicijalnog i finalnog merenja utvrđeno je da postoje statistički značajne razlike u telesnoj kompoziciji vežbača rekreativaca, odnosno da postoji razlika u telesnoj masi, mišićnoj masi kao i da postoji statistička značajna razlika u procentu masnog tkiva nakon primene tromesečnog fitness programa vežbanja.

References:

Aberle, N., Blekić, M., Ivaniš, A. & Pavlović, I. (2009). The Comparison of Anthropometrical Parameters of the Four-Year-Old Children in the Urban and Rural Slavonia, Croatia, 1985 and 2005. Collegium Antropollogicum, 33 (2), 347-351.

Aćimović, D., Špirtović, O. (2012). *Teorija i metodika rekreacije.* Beograd. [in Serbian]

Cetinić, J.,Petrić,V., Vidaković Samardžija, D. (2011). Urbano ruralne razlike antropometrijskih obilježja, motoričkih i funkcionalnih sposobnosti te motoričkih dostignuća učenika rane školske dobi. *U Zbornik radova 20. Ljetna škola kineziologa R. Hrvatske, Poreč „Dijagnostika u područjima edukacije, sporta, sportske rekreacije i kineziterapije"(*233-238). Zagreb: Hrvatskikineziološki savez. [in Croatian]

Horvat, V., Mišigoj-Duraković, M., & Prskalo, I. (2009). Body Size and Body Composition Change Trends in Preschool Children over a Period of Five Years. Collegium Antropologicum, 33(1), 99-103.

Hrgetić, M., Dadić, M., Milanović, M., Skoblar, J. (2016). Utjecaj tromjesečnog fitness programa vježbanja na antropološki status žena srednje životne dobi. *Zbornik radova, Zagreb: Hrvatski kineziološki savez,* str. 354-357. [in Croatian]

Lihaman, T.G. (1992). Advances in Body Composition Assessment. Champaign: Human Kinetics.

Maksimović, N., Milošević, Z. (2008). *Stil života mladih Vojvodine*. Novi Sad: Fakultet sporta i fizičkog vaspitanja, Savez za školski sport i olimpijsko vaspitanje. [in Serbian]

Malousaris, G.G., Bergeles, N.K., Barzouka, K.G., Bayios, I.A.. Nassis, G.P. and Kaskolou, M.D. (2008). Somatotype, size and body composition of competitive female volleyball players. Journal of Science and Medicine in Sport. 11(3):337-344.

Momčilović V., Momčilović, Z. (2018). Motoričke sposobnosti učenika IV razreda osnovne

škole gradske i seoske sredine u Vranju. *U Zbornik radova 13. Konferencije, „Vaspitač u 21. vijeku"*(264-269). Aleksinac: Visoka škola za vaspitanje strukovnih studija. [in Serbian]

Nićin, Đ. (2003). *Fitness.* Univerzitet BK, Beograd. [in Serbian]

Obrovac, S. (2015). Analiza promjena u sastavu tijela i pojedinim motoričkim sposobnostima pod utjecajem šest tjednog programa vježbanja. Master's/Diplomski rad. Sveučilište u Zagrebu, Kineziološki fakultet. [in Croatian]

Ostojić, S. (2005). Savremeni trendovi u analizi telesne strukture sportista. *Sportska medicina,* 5 (1), 1-11. [in Serbian]

Ozdirenc, M., Ozcan, A., Akin, F., Gelecek, N. (2005). Physical fitness in rural children

compared with urban children in Turkey. Pediatrics International. Vol.47, 26-31.

Petric, V., Novak, D. (2007). Razlike u antropološkim obilježjima učenika urbanih i ruralnihnaselja. *Zbornik radova "Sport za sve u funkciji unapređenja kvalitete života*" 277-284 Zagreb. [in Croatian]

Prskalo, I. (2004). *Osnove kineziologije.* Petrinja: Visoka učiteljska škola u Petrinji. [in Croatian]

Reilly, J.J. & Dorosty, R.A. (1999). Epidemic of Obesity in UK Children. The Lancet, 354 (9193), 1874 – 1875.

Reilly, J.J. (2007). Childhood Obesity: An Overview. Children & Society, 21 (5), 390 – 396.

Stojiljković, S., Mandarić, S., Katarina, T., Mitić, D. (2010). Efekti primene „omnibus" aerobika na telesnu kompoziciju žena. *Fizička kultura,* 64(2), 59-67. [in Serbian]

Tinazci, C., & Emiroglu, O. (2009). Physical Fitness of Rural Children Compared With Urban Children in North Cyprus: A Normative Study. Journal of Physical Activity and Health, 6(1),88-92.

Tsimeas, P.D.,Tsiokanos, A.L.,Koutedakis, Y., Tsigilis, N., Kellis, S. (2005). Does living in urban or rural settings effect aspects of physical fitness in children? An allometric approach. British Journal of Sports medicine. Vol.39 , 671-674.

Vasić, Z., Vidović, S., Vulić, I., Šnjegota, D., Šuščević, D., Bojić, N., Baroš, I. (2012).

Komparativna analiza antropometrijskih parametara učenika osnovnih škola urbanog i ruralnog područja regije Doboj. *Glasnik Antropološkog društva Srbije,* 47, 163-172. [in Serbian]

Vučković, I., Ljubojević, A., Vukić, Ž., Pašić, G. (2019). Starosne i polne razlike u antropometrijskim karakteristikama i telesnoj kompoziciji osnovnoškolske dece. *Naučno-stručni časopis o antropološkim aspektima sporta, fizičkog vaspitanja i rekreacije,* str. 59-71. Banja Luka. [in Serbian]

Širić, V. i sar. (2005). Utjecaj programiranog tjelesnog vježbanja na postotak tjelesne masti, *Stručni časopis „Edukacija, rekreacija, sport",* str. 38-42. Rijeka. [in Croatian]

Primljen: 11. jun 2021. / Received: June 11, 2021
Prihvaćen: 03. decembar 2021. / Accepted: December 03, 2021

https://doi.org/10.7251/SSH2102245M
UDC: 796.332.093-053.2
Professional paper
Stručni rad

Women's Football Prospects in City of Zadar and Zadar County

Josip Miočić[1], Luka Androja[2], Sandra Kovačević[2]
[1]*Sports Association City of Zadar, Croatia*
[2]*Aspira University College, Split, Croatia*

Correspondence:
Josip Miočić, Sports Association City of Zadar, Croatia,
josip.miocic@szgz.hr

Abstract: *The research conducted is focused on status and prospects of women's football in the city of Zadar and Zadar County. Since football is the most famous sport in the world, and thus also in the mentioned area, it transcends the category of sport. The concept of sport is not unambiguous and it has no unique generally accepted definition. The aim of the research was to determine the satisfaction of the respondents with the status and popularity of women's football in the city of Zadar and Zadar County.The research used a method of survey and a suitable questionnaire in order to investigate satisfaction of respondents with social status of women's football in the city of Zadar and Zadar County. The respondents included 78 sports employees, coaches and players of women's football from the city of Zadar and Zadar County area. The aim of this research is to establish the level of satisfaction of the respondents with social status of women's football and the level of its popularity growth in the city of Zadar and Zadar County. Moreover, the aim is also to establish the level of socialization of such population achieved by participating in women's football. According to this research it is possible to confirm the hypothesis that participants are not completely satisfied with social status and the popularity growth of women's football in the city of Zadar and Zadar County and that the level of socialization is improved by participating in such activity.*
Keywords: *football, women, prospects, satisfaction, social status.*

Introduction

As numbers show, football is one of the most popular sports in the world and as such, in Croatia. Its popularity is defined and enabled by the possibility of participation for both male and female sportspeople (Grgić, 2018). According to the Croatian Football Association (HNS) data there are 124.064 registered football players while there are about 22 million in the world. Women's football in Croatia is insufficiently represented since there are 1264 registered female football players which is only 1% of overall number of registered football players (HNS, 2019). Thus, football is still considered as men's sport in Croatian society which is obvious because of: the amount of funds invested, the number of active players, clubs, leagues, media interest, number of stadiums, etc. (Softić, 2018). At the same time, women's football as such is still not properly developed because of the problem of gender stereotypes in our society. In their research with respondents from student population, Bosnar and Žugaj concluded that even educated population sees football as primarily men's sport (Bosnar, Žugaj 2009). However, "women's football is a sport in the world of women's sports that transcends the area of sports and becomes a serious dispute in many international councils and governing bodies" (FIFA, 2019). As confirmed in the last FIFA Women's World Cup in Lyon, France 2019, most of women's sports in the world are in the shadow of men's. However, football, as the most important of the less important things in the world, provides a chance to establish itself and achieve the "importance", i.e. equality. Of course, women's football is primarily a sport and secondarily a tool for achieving certain goals. So, terms "women and men" should not be taken for granted since in its core it is a game played by women and men. Thus, it is obvious that women's football is not sufficiently represented and recognized in the city of Zadar and Zadar County and as such is "fighting" for its existence. Thomas Bach, the president of International Olympic Committee (IOC), is promoting and insisting on principles of gender equality in Olympic Movement project and he also promotes proper terminology in football. Hence, there are questions: Are there prospects in women's football? Can women's football be just football and not a tool for fighting inequality? Are there ways to promote women's football and what are they?

Sport and Football

Sport is a matter of interest for different profile of scientists, sociologists, medics, economists, communicologists, etc. in modern society. Since the concept of sport is not unambiguous and it has no unique generally accepted definition, the paper states social component accepted by most sociologists that we "should ask what activities are defined as sport and why in a certain society" (Coakley, 2007). As a social institution, sport depends to a large extent on dominant culture, i.e. values and norms of a society it belongs to which is of great importance considering the context of this paper. According to the Sports Act in Croatia, sport is defined as "any physical and psychological activity that person does according to a set of rules, with aim to compete with an opponent or an opponent's team by applying a set system of scoring that defines a winner" (Sports Act). Sport is a part of social needs of all individuals, a universal mean of understanding and cooperation among people with aim of physical and spiritual upbringing, vitality and health, social relations and attitudes, defence readiness and quality of life, and it also represents the category of economy.

Today's football represents, without doubt, the most popular sport in Croatia and it has features of acyclic activity. It belongs to a dynamic group of sports in which two teams, 11 players each, compete against each other, establish the ball flow and try to achieve a score during the match. Stamina, speed, strength, coordination, accuracy and flexibility form the hierarchy of motor abilities (Dujmović, 2006). Even though football can be marked as "male" sport, there is a positive social attitude towards women's participation. Leskovar (2012) identified positive attitude towards women's football on a sample of both male and female students of high school. Rural areas in our country and Zadar County represent the most conservative parts of society. If a positive attitude towards women's football exists in such areas, we can conclude that it is time for institutions to do their part in order to develop it. Thus, the aim of this research is to establish the attitude towards women's football in rural area on a sample of people of different gender and age.

Women in Football

Equality in football should be one of the basic goals of contemporary sports, as set and conducted by FIFA. Since different efforts to promote equality are introduced by society, governing bodies, etc., prejudices have reduced in everyday life and in football, but they still exist. Thus, traditional values which consider football as an area dominated by masculine values are beginning to decrease (Coakley, 2007). According to Talleu, in a handbook "Gender equality in sports: access for girls and women to sport practices", it is still necessary to make an effort to achieve gender equality in football because there is still great unused potential in society. Sport can give positive contribution to society: doing sports promotes mutual respect, resourcefulness and understanding by connecting people of different gender, race, religion, age and economical background. Sports activities, if managed well, can be tools for fighting discrimination, prejudices and stereotypes (Talleu, 2011). One can question the state of women's football in countries where national teams did not qualify for world championships and in that way did not enter the international scene. Insufficiently developed sports infrastructure and insufficient funds as well as overall support is generally a serious problem of women's team sports in Croatia and especially football which position is considered as insufficiently recognised. However, women's football has recently achieved some progress in Croatia. Researches and strategies such as "Together for the future of football" from 2019 to 2024, Bosnar Kovačević in 2011, Herman in 2016, Medo in 2018, etc. all show a certain progress that also includes investment in infrastructure, competition system, coach education, number of clubs and, most importantly, the number of new young sportswomen. 1937, when the first women's football club "Bata" in Borovo was formed, is considered as the beginning of official women's football. Whereas today, according to HNS data, "from total of 118 316 registered players of football and futsal in Croatia, only 2106 are female, including younger age groups" which is worrying. But these data and the following should be taken with precaution because in last few years there has been an improvement in this area (Baršić, 2018). There are 1 732 football clubs registered in Croatian Football Association with only 38 women's clubs. Among judges, there are 2239 men and only 19 women (HNS, 2013). Such status can be explained in several ways: insufficient care, not enough interest within sports institutions responsible for development of football, gender stereotypes in society, negligence and resistance of overall society regarding this matter. Stereotypes possibly influence parents when choosing sports for girls and there is still a very conservative attitude regarding the choice of sports for girls, like for example: volleyball, basketball, swimming, etc. Gregurić research from 2018 is based on social aspect of sex and gender and it

confirmed that gender stereotypes can inhibit the development of women's football as well as all gender stereotypical activities. (Gregurić, 2018).

Women Football in Croatia

It should be stressed that since 2012 there has been a continuing growth of registered female players of football which is a result of various factors and processes done by public administration and overall society. "There are five centres of women's football in Croatia (Zagreb, Varaždin, Split, Osijek, Rijeka) which are equivalent to men's football" and they organise camps where educated coaches work with girls and promote football (HNS, 2019). This presents infrastructural grounds for development of women's football. It is obvious that the existence of such centres helps to form a system of competitions, women's sports clubs, quality matches and educated staff which is a key moment for further development of women's football. Currently, in Croatian official system of competitions, women's clubs compete in 1st HNLŽ (Croatian Football League for Women) and 2nd HNLŽ and in regional system of competing for youth. This trend is marked by achieved sports results of clubs as well as national teams on international competitions (participating in qualifications for Euro League - ŽNK Split, etc.), professionalization of players' status, possible creation and participation of Croatian clubs in regional league with aim of raising the quality. Countries which have well developed women's football (Austria, Hungary, Slovakia, etc.) and which have market interest would participate in the competition.

In the last few years there has been a vivid continuing growth of women's football in the city of Zadar and Zadar County. There has been an increase in number of active clubs (3 clubs) as well as the number of girls and women (around 190) who play football. This means that they are becoming increasingly important factor of women's football in this area. Along with volleyball, swimming, rhythmic gymnastics, basketball and several individual sports, women's football makes up a sum of sports which dominates in popularity in the city of Zadar and Zadar County (ŠZGZ, 2019). Considering social context, presence and role of modern technologies in lives of youth, all should be used to promote football.

Methods

In order to investigate the satisfaction of respondents with social status of women's football in the city of Zadar and Zadar County, method of survey was used and appropriate questionnaire was formed. The survey represents a quantitative form of research and it gathered data about different attitudes and opinions (satisfaction) of respondents which identified possible changes needed in order to improve social status of women's football. The questionnaire included four areas of research: social status of women's football in the city of Zadar and Zadar County, popularity of women's football in the city of Zadar and Zadar County, quality of women's football and women's football.

Respondents

The sample of respondents includes 78 sports employees, coaches and female players of women's football in the city of Zadar and Zadar County. Respondents actively participate in women's football and they are representative sample for this area of research. Total number includes 6 coaches, 3 presidents and secretaries of clubs and the rest (69) are players of Women's football club Donat, Futsal super Chiks and Football club Abeceda sporta. This paper analyses results of the questionnaire which was answered by 78 respondents, i.e. those who were training at the moment of research. Respondents filled in the questionnaire after training in appropriate facility. The questionnaire was first tested on a sample of 5 respondents and later was given to the other participants in this research. All profiles of respondents were included (coaches, players and sports employees). It consists of 11 questions organised in two parts: general and research. First part is related to general data, while the other part consists of questions which have the aim to answer suggested hypotheses of this paper. After conducting this survey, questionnaires in printed form were imported in a program LimeSurvey and then exported in specialized SPSS data analysing program.

Aims

The aim of this paper is to establish the satisfaction of respondents with social status of women's football in the city of Zadar and Zadar County as well as the level of popularity growth of women's football and also to directly identify the level of socialization of such population achieved by playing women's football. In accordance with the

aim, it is possible to generate hypothesis that participants are not satisfied with the status of women's football in the city of Zadar and Zadar County and that the level of socialization is improved because of their participation in women's football.

Results

After the survey was conducted, respondents' answers were analysed. Results showed that there were more female respondents (75%) than men (25%) and majority of respondents (80%) were those aged between 15 and 20. A group of questions related to the satisfaction with social status of women's football in the city of Zadar and Zadar County crystallised the answer that social status is unsatisfactory as seen in answers to the question (Table 1) *How satisfied are you with social status of women's football in the city of Zadar and Zadar County?* The majority of respondents (80%) are completely dissatisfied with the status of women's football, while 8 % are partly dissatisfied. Fewer respondents (9.4%) answered that they are neither satisfied nor dissatisfied. 2.6% respondents are partly satisfied; however no one is completely satisfied.

Table 1. *Question results - How satisfied are you with social status of women's football in the city of Zadar and Zadar County?*

Completely dissatisfied	Partly dissatisfied	Neither satisfied nor dissatisfied	Partly satisfied	Completely satisfied
80%	8%	9.4%	2.6%	-

There was a clear answer concerning growth and popularity of women's football (table 2) where 63% respondents answered the popularity is growing (as expected concerning the profile of respondents), 26,66% answered it neither grows nor it does not grow and 12,04% answered it does not grow.

Table 2. *Question results – Does popularity of women's football in the city of Zadar and Zadar County grow?*

It does not grow	Neither grows nor it does not grow	It grows
12.04%	26.66%	61.3%

Question *Does women's football have lower quality than men's football*? generated similar percentage of answers; 21,33% answered yes, neither yes nor no was answered by 33,33%, while 45,33% answered no.

Table 3. *Question results – Does women's football have lower quality than men's football?*

No	Neither yes nor no	Yes
45.33%	33.33%	21.33%

Question *Does participation in women's football influence your inclusion in society?* generated answers as follows: yes in 60%, neither no nor yes in 25,34% and no in 14,66%.

Table 4. *Question results – Does participation in women's football influence your inclusion in society?*

No	Neither no nor yes	Yes
14.66%	25.34%	60%

Good response from respondents is due to wish and motivation of sports employees, coaches and players of women's football to improve and open new prospects for women's football. This research and its results gained from 78 respondents opened new topics, questions that are necessary to deal with in the future: is women's football a tool for fighting for women's rights and appreciation of women's football in rural areas of referred county; since contemporary football is business, how fit is women's football for such aspect considering market interest in Croatia? This

research and its results which included 78 respondents opened several other topics that need to be discussed in the future.

Conclusion

Women's football in the world is far more developed than in Croatia, including the city of Zadar and Zadar County. As established by the results of this research, the reason is not only the negative attitude of the general population towards women's football, but also insufficient effort in the development of women's football by institutions. In order to follow the models of more developed countries in this area, especially in Europe, in the city of Zadar and Zadar County, the guidelines and goals of FIFA for the development of women's football should be adhered to.These include: improving the infrastructure needed for women's football, increasing the number of members in the football school, increasing the number of women's competitions, enrolling women in technical and management areas of football such as refereeing, training and administration, organizing seminars for coaches, referees and analyzing and monitoring women's technical development. football. With all of the above in mind, it is important to stress that infrastructure is also essential for men's football. Improving the conditions for women's football can gain prospects in men's football as well. This research found that respondents are not satisfied with the status and popularity of women's football in the city of Zadar and Zadar County and its quality. It has also been confirmed that playing football helps female footballers to integrate into societies of events. Moreover, women's football should not only be a tool for gender equality, but it is an exciting sport, perhaps currently less attractive than men's, but with perspectives and new ideas of improvement it can develop into a sport that can satisfy society in general in the same way as men football.

References

Baršić, M. (2018). Žene i nogomet u hrvatskom društvu: što futsal ima s tim? (Doctoral dissertation, University of Zagreb. Faculty of Kinesiology. Department of Kinesiological Anthropology and Methodology. Chair of Kinesiological Psychology, Sociology and Methodology.). Žene i nogomet u hrvatskom društvu: što futsal ima s tim? | Repository of Faculty of Kinesiology, University of Zagreb (unizg.hr) [in Croatian]

Bosnar K. and Žugaj, S. (2009). Gender typing of sports in Croatian university students. In. Doupona Topič, M. And Ličen, S. (Eds.): Sport, culture & society: an account of views and perspectives on social issues in a continent (and beyond), Ljubljana: University of Ljubljana, Faculty of Sport:161-164. Bosnar K. and Žugaj, S. (2009). Gender typing of sports in Croatian university students. In. Doupona Topič, M. And Ličen, S. (Eds.): Sport, culture & society: an account of views and perspectives on social issues in a continent (and beyond), Ljubljana: University of Ljubljana, Faculty of Sport:161-164. - Google pretraživanje

Coakley J. (2007). Sports in Society: Issues and Controversies. New York: McGraw-Hill Sports in Society: Issues and Controversies (mheducation.com)

Dujmović, P. (2006). Škola suvremenog nogometa. Zagreb: Zagrebački nogometni savez. (Book) https://bib.irb.hr/datoteka/954262.RAZVOJ_NOGOMETAA.pdf [in Croatian]

Gregurić, M. (2018). Spol i rod: sociološka analiza hrvatskog ženskog nogometa (Doctoral dissertation, University of Zagreb. Faculty of Kinesiology. Department of Kinesiological Anthropology and Methodology. Chair of Kinesiological Psychology, Sociology and Methodology.). 198148143.pdf (core.ac.uk) [in Croatian]

Grgić, S. (2018). A Brief History of Women's Football in Croatia/Yugoslavia during the Interwar Period. Časopis za suvremenu povijest, 50(3), 557-580. A Brief History of Women's Football in Croatia/Yugoslavia during the Interwar Period (srce.hr)

Hrvatski nogometni savez (2019) Službene web stranice. Skinuto s mreže 03.09.2019. s adrese: https://hns-cff.hr/ [in Croatian]

Leskovar, S. (2012). Stav prema ženskom nogometu kod srednjoškolaca (diplomski rad). Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu 67-Kovacevic.indd (hrks.hr) [in Croatian]

Fédération Internationale de Football Association (2019) Službene web stranice. Skinuto s mreže 03.09.2919. s adrese: https://www.fifa.com/womens-football/

Talleu C. (2011). Ravnopravnost spolova u športu: dostupnost športskih aktivnosti djevojčicama i ženama. Priručnici o dobroj praksi, br. 2. Vlada RH, Ured za ravnopravnost spolova, Zagreb. Ured za ravnopravnost spolova - Priručnik o dobroj praksi Vijeća Europe „Ravnopravnost spolova u športu – Dostupnost športskih aktivnosti djevojčicama i ženama“ (gov.hr) [in Croatian]

Softić, J. (2018). Nogomet u Istarskoj županiji (University of Pula. Faculty of Educational Sciences.). Nogomet u Istarskoj županiji | Digitalni repozitorij Sveučilišta Jurja Dobrile u Puli (unipu.hr)

Zakon o sportu. Narodne novine, br. 71/06, 150/08, 124/10, 124/11, 86/12, 94/13, 85/15, 96/16. Zakon o sportu - Zakon.hr [in Croatian]

Kosinac, Z. (2002). Kineziterapija sustava za kretanje, Split: Sveučilište u Splitu, 78-80. 2. [in Croatian]

Findak, V. (1999). Metodika tjelesne i zdravstvene kulture, Zagreb: Školska knjiga, 222. [in Croatian]

Primljen: 26. juli 2021. / Received: July 26, 2021
Prihvaćen: 17. septembar 2021. / Accepted: September 17, 2021

Instruction for authors submitting papers

TITLE OF PAPER (TWO LINES AT THE MOST)

First and last name of the first author[1], First and last name of the second author[2]

[1]Name of the Organization, [2]Name of the Organization

Abstract: Every paper must contain the abstract. You should bring basic idea with final results of research to abstract. Paper should be written according the guideline bellow. Abstract may contain up to 250 words.

Keywords: Maximum of five, key words or phrases, separated by commas.

The paper must contain clear introduction, problem statement, method of resolving the problem, results, conclusion, and references. It shoud not contain more than 8 pages of A4 format (21 x 29.7 cm) including figures, tables, references. Paper margins must be: top and bottom 2.5 cm, inside 2.5 cm and outside 2 cm. Pages are not ought to be numbered.

The paper title (use 12 point Times New Roman type of text; the title must be highlighted with Bold option) should be positioned in the middle of the first page, shifted two spaces, font size 10pt, below top margin. After the title, one should leave one space, font size10 pt. The paper must be sent to the Congress Programme Board in electronic form (DOC) via *Paper Submission Form*, or as an email attachment to *siz@apeiron-edu.eu*.

There should be a caption above the table, which says, for example „Table 1. Intercorrelation matrix". Below the figure, there should be the figure number and legend, for example "Figure 3: Work with preschoolers".

The Editorial Board accepts manuscripts written in English (American English or British English) and optionally in Slavic language.

Manuscripts may be rejected if written in poor English or Slavic language. The author is fully responsible for the style (formal, unbiased in any sense), language, and content of the paper. Yet, the Editorial Board has the right to comment on the form and language of the paper before it is accepted for publication. A good, standard command of grammar is expected in written English. Please, avoid non-standard abbreviations.

REFERENCE

It is necessary to cite all sources used for your paper. APA citation style is recommended.

Authors must write the Contact of the corresponding author with his/her full name, academic title, institution, address, e-mail address and phone number (optionally).

REVIEW PROCESS

Submissions to the journal will initially be evaluated by the Editorial Board using several criteria: the appropriateness of the topic and content for the journal; the editing (preparation of the manuscript) and format; and "general" merit. If these criteria are met, the submission will undergo a double-blind review process by at least two acknowledged and independent reviewers, with the review process taking up to 8 weeks.

Only the papers that receive positive reviews will be accepted. One of the crucial reasons for the review is to provide quotations and references of relevant literature. The Editorial Board has the right to comment on the form of the paper before it is accepted for publication. The Editorial Board is not obliged to publish papers in chronological sequence of their receipt or in the sequence in which they have been accepted for publication. No substantial part of the submission should have been published elsewhere. The adducing of the results in extracts, summaries, abstracts, dissertations and Master's theses, reviews and conference papers (up to three pages, containing abstracts, graphical presentations and references) are not considered as publishing. If the manuscript contains the results that have already been published, the author(s) must get the consent of the first publisher and quote the source clearly.

Uputstvo za autore

NASLOV RADA (NAJVIŠE DVA REDA)

Ime i prezime prvog autora[1], Ime i prezime drugog autora[2]

[1]Naziv organizacije, [2]Naziv organizacije

Sažetak: Svaki rad mora sadržati sažetak. Sažetak treba da sadrži osnovnu ideju sa konačnim rezultatima istraživanja. Rad treba pisati u skladu sa uputstvom u nastavku. Sažetak može sadržati do 250 riječi.

Ključne riječi: Najviše pet ključnih riječi ili fraza odvojenih zarezom.

Rad mora sadržati jasan uvod, naveden problem, način riješavanja problema, rezultate, zaključak i literaturu. Rad ne treba da sadrži više od 8 stranica formata A4 (21 x 29.7 cm), uključujući slike, tabele i literaturu. Margine moraju biti: gornja i donja 2,5 cm, unutrašnja 2,5 cm i spoljašnja 2 cm. Stranice ne treba da budu numerisane.

Naslov rada (koristite font Times New Roman 12; naslov mora biti označen opcijom Bold) treba da bude postavljen na sredini prve stranice, pomjeren za dva razmaka, veličina fonta 10 pt, ispod gornje margine. Nakon naslova treba ostaviti jedan razmak, veličina fonta 10 pt. Rad mora biti poslat Programskom odboru Kongresa u elektronskom obliku (PDF ili DOC) putem obrasca za podnošenje radova, ili kao prilog e-mail-u na siz@apeiron-edu.eu.

Trebalo bi da postoji natpis iznad tabele, koji navodi, na primjer, „Tabela 1. Interkorelaciona matrica“. Ispod slike treba da bude broj i legenda, na primjer “Slika 3: Rad sa predškolskim djecom”.

Uredništvo prihvata rukopise napisane na engleskom (američki ili britanski engleski) i opciono na nekom od slovenskih jezika.

Rukopisi mogu biti odbijeni ako su napisani na lošem engleskom ili slovenskom jeziku. Autor je u potpunosti odgovoran za stil (formalan, nepristrasan u bilo kom smislu), jezik i sadržaj rada. Ipak, Urednički odbor ima pravo da komentariše formu i jezik rada prije nego što bude prihvaćen za objavljivanje. Očekuje se dobra, standardna upotreba gramatike u pisanom engleskom jeziku. Izbjegavajte nestandardne skraćenice.

LITERATURA

Potrebno je navesti sve izvore koji se koriste za vaš rad. Preporučuje se APA stil citiranja. Autori moraju da navedu kontakt podatke autora sa njegovim/njenim punim imenom, akademskim nazivom, institucijom, adresom, e-mail adresom i brojem telefona (opciono).

PROCEDURA RECENZIJE

Radovi poslati časopisu će najprije biti ocijenjeni od strane Uredništva imajući u vidu nekoliko kriterijuma: prikladnost teme i sadržaja časopisa; uređivanje (priprema rukopisa) i format; i “opšta” valjanost. Ako su ovi kriteriji ispunjeni, rad će biti poslat na dvostruku anonimnu recenziju od strane najmanje dva priznata i nezavisna recenzenta, a proces recenzije može trajati do 8 sedmica.

Samo radovi koji dobiju pozitivne recenzije će biti prihvaćeni. Jedan od presudnih razloga recenzije je navođenje citata i referenci relevantne literature. Urednički odbor ima pravo da komentariše formu rada prije nego što on bude prihvaćen za objavljivanje. Redakcija nije obavezna da objavljuje radove po hronološkom redosledu njihovog prijema ili po redoslijedu po kom su prihvaćeni za objavljivanje. Nijedan značajan dio rada ne treba da bude objavljen negdje drugdje. Prikazivanje rezultata u izvodima, sažecima, kratkim pregledima, disertacijama i magistarskim tezama, recenzijama i radovima sa konferencija (do tri stranice, koje sadrže sažetke, grafičke prezentacije i literaturu) ne smatra se objavljivanjem. Ako rukopis sadrži rezultate koji su već objavljeni, autor(i) moraju dobiti pristanak prvog izdavača i jasno citirati izvor.

Ethics

Publication ethics, disclosure policy and malpractice statement

Publication and authorship

- All submitted articles are subject to strict peer-review process by at least two reviewers that are experts in the area of the particular paper.
- The factors that are taken into account in review are relevance, soundness, significance, originality, readability and language.
- The paper acceptance is constrained by such legal requirements as shall then be in force regarding libel, copyright infringement and plagiarism.
- For published articles, information on relevant potential conflicts of interest will be made available to the public.

Authors' responsibilities

- Authors must certify that their manuscripts are their original work.
- Authors must certify that the manuscript has not previously been published elsewhere.
- In case a submitted manuscript is a result of a research project, or its previous version has been presented at a conference in the form of an oral presentation (under the same or similar title), detailed information about the project, the conference, etc. shall be provided navesti gde se navode. A paper that has already been published in another journal cannot be reprinted in this journal.
- Authors must certify that the manuscript is not currently being considered for publication elsewhere.
- Authors must identify all sources used in the creation of their manuscript.
- It is the responsibility of each author to ensure that papers submitted in this journal are written with ethical standards in mind.

Reviewers' responsibilities

- Reviews should be conducted objectively, with no personal criticism of the author.
- Reviewers are required to provide written, competent and unbiased feedback in a timely manner on the scholarly merits and the scientific value of the manuscript.
- Reviewers should keep all information regarding articles confidential and treat them as privileged information.
- Reviewers must not have conflict of interest with respect to the research, the authors and/or the funding sources for the research. If such conflicts exist, the reviewers must report them to the Editor without delay.
- Any selected referee who feels unqualified to review the research reported in a manuscript or knows that its prompt review will be impossible should notify the Editor without delay.

Editors' responsibilities

- Editors have complete responsibility and authority to reject/accept an article.
- Editors are responsible for the contents and overall quality of the publication.
- Editors should always consider the needs of the authors and the readers when attempting to improve the publication.
- Editors should preserve the anonymity of reviewers.
- Editors should act if they suspect misconduct, whether a paper is published or unpublished, and make all attempts to persist in obtaining a resolution to the problem.
- Editors should not reject articles based on suspicions.

ETIKA

Etika objavljivanja, pravila objavljivanja i zloupotreba podataka

Objavljivanje i autorska prava

- Svi pristigli članci podliježu strogoj recenziji od strane barem dva recenzenta koji su stručnjaci iz oblasti naučnog rada.
- Faktori koji se uzimaju u obzir prilikom recenzije su relevantnost, ispravnost, značaj, originalnost, čitljivost i jezik.
- Prihvatanje rukopisa je ograničeno takvim zakonskim uslovima koje će se primijeniti u slučaju klevete, zloupotrebe autorskih prava i plagijata.
- Kod objavljenih članka, informacije o relevantnim potencijalnim sukobima interesa biće dostupne javnosti.

Odgovornosti autora

- Autori moraju da potvrde da je njihov rukopis njihovo autorsko djelo.
- Autori moraju da potvrde da njihov rukopis nije prethodno objavljen na nekom drugom mjestu.
- U slučaju da je poslati rukopis rezultat naučnoistraživačkog projekta ili da je, u prethodnoj verziji, bio izložen na skupu u vidu usmenog saopštenja (pod istim ili sličnim naslovom), detaljniji podaci o projektu, konferenciji i slično, navode se u navesti gdje se navode. Rad koji je već objavljen u nekom časopisu ne može biti preštampan u ovom časopisu.
- Autori moraju da potvrde da se njihov rukopis trenutno ne razmatra za objavljivanje negdje drugdje.
- Autori su dužni da navedu sve izvore koje su koristili u pisanju njihovog rukopisa.
- Autori su dužni da se pridržavaju etičkih standarda koji se odnose na naučnoistraživački rad.

Obaveze recenzenta

- Recenzija mora biti objektivna. Komentari koji se tiču ličnosti autora smatraju se neprimjerenim. Sud recenzenata mora biti jasan i potkrepljen argumentima.
- Recenzenti bi trebalo svoje stavove da iskažu jasno, sa pratećim argumentima.
- Recenzenti bi trebalo da čuvaju u povjerenju sve informacije u vezi članka i smatraju ih privilegovanim informacijama.
- Recenzent ne smije da bude u sukobu interesa sa autorima ili financijerom istraživanja. Ukoliko postoji sukob interesa, recenzent je dužan da o tome momentalno obavijesti urednika.
- Recenzent koji sebe smatra nekompetentnim za temu ili oblast kojom se rukopis bavi dužan je da o tome obavijesti urednika.

Obaveze urednika

- Urednici imaju punu odgovornost i ovlaštenje da odbiju/prihvate članak.
- Urednici su odgovorni za sadržaj i ukupni kvalitet publikacije.
- Urednici bi uvijek trebalo da razmotre potrebe autora i čitaoca pri pokušaju da se poboljša publikacija.
- Urednici bi trebalo da sačuvaju anonimnost pregledanog članka.
- Urednici bi trebali da osiguraju da je sav materijal koji objavljuju u skladu sa međunarodno prihvaljivim etičkim smjernicama.
- Urednici bi trebalo da djeluju ukoliko posumnjaju na zloupotrebu, bez obzira da li je rad objavljen ili ne, i preduzmu mjere kako bi uspjeli da riješe problem.
- Urednici ne bi trebalo da odbace članak na osnovu sumnje.

ISSN 2232-8211