SPORTSKE NAUKE I ZDRAVLJE

SPORTS SCIENCE AND HEALTH

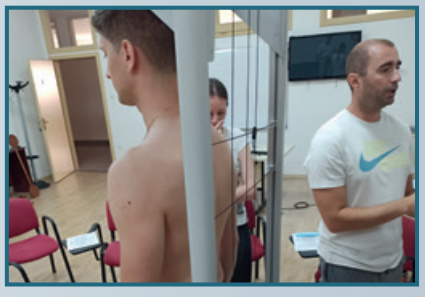
Volume 12 Issue 1

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 12 • Broj 1
Jun 2022.
Republika Srpska
Bosna i Hercegovina

Volume 12 • Issue 1
June 2022
The Republic of Srpska
Bosnia and Herzegovina



UDC: 612
UDC: 613
UDC: 796

www.siz-au.com

APEIRON
ΑΠΕΙΡΟΝ

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 MARKOS, 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
citefactor.org/contact
scopus.com
scholar.google.com
doisrpska.nub.rs
crossref.org
road.issn.org
cosmosimpactfactor.com
erihplus.nsd.no
worldcat.org
doaj.org
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. 12 (2022) No. 1 (1-104)

Sadržaj / Contents

Effect of Core Muscles Strengthening Workouts in Improving the Static Balance of Judo Players 5
Hassan Soror Aboelwafa

Effects of Different Concurrent Training Methods on Aerobic and Anaerobic Capacity in U 21 soccer players 10
Khoudja Youcef, Mime Mokhtar, Belkadi Adel, Beboucha Wahib

Level of Students 'Functional Abilities as a Parameter for Determining Differences in Triglyceride, Cholesterol, Blood Sugar and Body Composition in Students 23
Nijaz Skender, Serra Ayse Cakar Saka, Natalija Kurtović, Ernest Šabić

The Relationship of Cardiorespiratory Fitness, Birth Weight and Parental BMI on Children' Obesity Status 31
Odnos između kardiorespiratorne kondicije, težine rođenja deteta i roditeljskog BMI[1], na status gojaznosti u detinjstvu
Zorica Stankovska, Serjoža Gontarev, Žarko Kostovski, Aleksandar Janković

The Impact of the Pilates Program on the Mobility of Middle-Aged Women 42
Nataša Nikić, Dejan Milenković

The Influence of European Diplomats in Montenegro on the Development of Sport at the end of the XIX Century Until the Beginning of the First World War 48
Uticaj evropskih diplomata u Crnoj Gori krajem XIX vijeka na razvoj sporta do početka prvog svjetskog rata
Dragan Krivokapić, Milovan Ljubojević, Danilo Bojanić

Construction and Validation of Arm Wingate Test for Determination of Anaerobic Abilities in Water Polo Juniors 58
Konstrukcija i Validacija Ručnog Wingate Testa za Procjenu Anaerobnih Sposobnosti Vaterpolo Juniora
Dario Vrdoljak, Tea Kaić, Ognjen Uljević

Impact of Motor Learning on Overall Skill-Related Anxiety 64
Tihomir Vidranski, Ivana Klaričić, Dejan Dragić

Relations Between Morphological Characteristics and the Motor Skill Handstand Against "A Vertical Surface in 11-Year-Old Female Pupils" 70
Povezanost morfoloških karakteristika i motoričkog znanja "stoj na rukama uz okomitu plohu kod jedanaestogodišnjih učenica"
Lidija Vlahović

The Effectiveness of a Suggested Mentoring Program Using Cascading Relaxation and Recreational Sporting Activity to Reduce the Level of Aggressive Behavior Among Secondary School Students Ages 16 to 18 Years An Experimental Study on Male Students of Sidi Saada Secondary School, Relizane, Algeria 80
Gorine Ahmed, Djamel Mokrani, Ahmed Benklaouaz Touati

Dalcroze Method and Its Impact to Motor, Locomotor Status and Movement Aestethic 87
Dalkroz metoda i njen uticaj na motoriku, lokomotorni aparat i estetiku pokreta
Svetlana Lazić

Prevalence of Overweight and Obesity Among Adults In Kosovo 94
Besnik Morina, Shqipe Bajçinca Brestovci

Instruction for authors submitting papers 100
Uputstvo za autore

Ethics 102
Etika

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

Uvažene koleginice i kolege, poštovani autori radova, dragi čitaoci!

Dvanaest godina izlaženja Časopisa „Sportske nauke i zdravlje“, uverava i vas i nas iz Redakcije, da smo na pravom putu razvoja struka i nauka iz različitih oblasti čovekovog znanja, pre svega iz sportskih i zdravstvenih nauka, kao i interdisciplinarnih područja.

I pored teškoća koje imamo svi u celom svetu, a izazvanih pandemijom covid-19, uspeli smo da i u tim godinama, slobodno mislimo, istražujemo, polemišemo, analiziramo različite fenomene vezane, pre svega za sport u najširem smislu te reči i zdravlja, takodje u svom njegovom kompleksitetu.

Kao rezultat toga su i radovi u ovom broju Časopisa, autora iz 8 država, a prvi put i iz Saudijske Arabije, tako da su iz 22 države do sada objavljeni prilozi u Časopisu!

Ponosni smo na činjenicu da je naš Časopis u SCOPUS citatnoj bazi, te zahvaljujući tome, broj zainteresovanih autora za objavljivanje radova, iz broja u broj raste.

Redakcijski odbor zahvaljuje pre svega autorima radova, bez kojih ovaj Časopis ne bi postojao, ali i recenzentima, bez kojih Časopis ne bi imao status kakav danas ima, jer svojim ponekad oštrim, ali dobronamernim kritikama, doprinose još kvalitetnijim radovima i verifikuju originalnost radova, njihovu stručnu i naučnu vrednost, kao i odredjeni doprinos nauci!

Znatiželja, istraživanje, učenje, pisanje-objavljivanje su *spiritus movens* znanja i utvrdjivanja naučnih činjenica svih autora i koautora, sa željom da se unapredi teorija i praksa oblasti koje su predmet njihovih radova.

Stoga, podsetimo se Aristotelove misli: ***„Koreni učenja su gorki, ali su plodovi slatki“!***

UREDNIŠTVO ČASOPISA

Dear colleagues, respected authors, dear readers!

Twelve years of publication of the Journal “Sports Science and Health” assures both you and us from the Editorial Board that we are on the right path to the development of professions and sciences from various areas of human knowledge, primarily from sports and health sciences, as well as interdisciplinary areas.

Despite the difficulties that we all have in the whole world, caused by the covid-19 pandemic, we managed to think freely, research, argue, analyze various phenomena related, above all, to sports in the broadest sense of the word and health, also in those years. in all its complexity.

As a result, there are also works in this issue of the Journal by authors from 8 countries, and for the first time from Saudi Arabia, so contributions from 22 countries have been published in the Journal so far!

We are proud of the fact that our Journal is in the SCOPUS citation database, and thanks to that, the number of authors interested in publishing their works is increasing.

The editorial board first of all thanks the authors of the papers, without whom this Journal would not exist, but also the reviewers, without whom the Journal would not have the status it has today, because with their sometimes harsh but well-intentioned criticisms, they contribute to even better quality papers and verify the originality of the papers, their professional and scientific value, as well as a certain contribution to science!

Curiosity, research, learning, writing-publishing are the spiritus movens of knowledge and determination of scientific facts of all authors and co-authors, with the desire to improve the theory and practice of the fields that are the subject of their works.

Therefore, let’s remember Aristotle’s thought: “***The roots of education are bitter, but the fruit is sweet”!***

JOURNAL EDITORIAL

https://doi.org/10.7251/SSH2201005A
Original scientific paper

UDC: 796.853.23.012.55
Originalni naučni rad

Effect of Core Muscles Strengthening Workouts in Improving the Static Balance of Judo Players

Hassan Soror Aboelwafa
Self-Development Department, Deanship of Preparatory Year & Supporting Studies, Imam Abdulrahman bin Faisal University, Saudi Arabia

Correspondence:
Hassan Soror Aboelwafa, Self-Development Department, Deanship of Preparatory Year & Supporting Studies, Imam Abdulrahman bin Faisal University, Saudi Arabia, haboelwafa@iau.edu.sa

Abstract: *Core muscles have multiple benefits for athletes and non-athletes, such as their importance in improving motor performance and preventing injuries. Judo players perform various movements during training or matches, such as bending, rotation, and flexion, which depend heavily on the muscles around the torso as well as the balance requirements during throwing to reach the optimal position of the throw. This study aimed to verify the effectiveness of intense training during the preparation period to strengthen the core muscles on the static balance of the judo players. In total, 24 judo players participated in the study to form two groups: an experimental group (12 players), who were trained via intense core muscle workouts (8 exercises) according to specific instructions (three times per week / 6 weeks), and a control group (12 players), who were trained on various muscle groups (three times per week / 6 weeks). The Flamingo test (European Fitness Test–Euro Fit) was applied to measure the static balance of the players (pretest–posttest). The results showed an improvement in the static balance for both groups, the comparison between the two groups showed the experimental group indicated statistically significant changes ($p < 0.05$) than the control group in terms of static balance because of core muscle strengthening workouts. The results obtained confirm the effectiveness of core muscle strengthening workouts in improving the static balance of judo players. Therefore, coaches can use these workouts during the preparation period and can manage training loads according to the characteristics of the players by regularly measuring the static balance through field or laboratory, results of this tests can be help in planning training programs.*

Keywords: *Core Muscles, Static Balance, judo.*

Introduction

Throwing skills in judo include a skill that requires balance and stability during the throwing phase to specifically achieve effectiveness in performing a throw, especially those performed from standing on one leg, such as *Uchi Mata*, Harai *Goshi*, and *Osoto Gari*. This requires improvement of balance for players in training, which can be achieved by training the core muscles that have a major role in the player's balance and stability.

By observing unsuccessful throwing in junior competitions, it has been shown that many players lose balance during the throwing phase or do not use the correct throwing position.

In Judo, balance is of utmost importance, as the athletes need to maintain posture control and good balance to avoid losing points and ultimately the match (Alonso et al. (2009), Aboelwafa, H. S. (2021).

A number of scientific studies that have studied the reasons for failing throwing attempts in judo have described the many reasons that lead to this, including the player taking a correct position that enables him to balance to achieve the throw effectively (Kajmovic, H., & Huremovic, D. (2017), Gutiérrez-Santiago, et al. (2013), Gutiérrez, A., Prieto, I., & Cancela, J. M. (2009), Prieto, et al. (2016), and Prieto Lage, et al. (2014).

The muscles around the pelvis, lower back, and hip regions constitute what is referred to as the "core," and they play a principal role in the transfer of forces between the trunk and extremities (Kellis, E., et al. (2020). Core muscles are responsible for all the major movements of the body. These muscles give strength and stability to the movements, such as bending, twisting, crouching etc. (Chakravarthy, M., & Vivekanandhan, T. (2020).

Core strengthening is a very important part of physical preparation. It is not only for athletes but also for regular people. These muscles play a vital role in bending, twisting, sitting, or standing for time periods during daily activity (Chakravarthy, M., & Vivekanandhan, T. (2020). The training of core muscles is key in sports training to improve performance and reduce the risk of injuries (Nuhmani, S. (2021), Huxel Bliven, K. C., & Anderson, B. E. (2013).

Therefore, it was important to include core muscle strengthening workouts in training programs in judo to improve performance as well as to prevent injuries, which can be dangerous. This study examined the effect and effectiveness of core muscle workouts in improving the static balance for judo players, and the results found can be suggested to coaches.

Materials and methods

The participants included 24 male judo players from local clubs in Egypt who participated in the study. They have at least five years of training experience, and they participated in multiple local championships; the players' data are shown in Table (1).

All participating players were at the beginning of the preparation period and did not suffer from any injuries. We obtained consent from all the players to participate in the study, and they pledged to perform the exercises according to the instructions of the researcher and assistant coaches.

The players were randomly assigned to experimental and control groups. The first group (the experimental group) included 12 players who were trained for a period of 6 weeks with core muscle strengthening workouts according to the performance instructions shown in Figure (1).

The second group (the control group) was not trained in the same workouts assigned to the first group, except for the judo skills exercises that they participated in.

The training instructions were explained to the players by the researcher and the assistant coaches, and their questions about the study were answered and motivated them to attend and participate effectively to obtain accurate results.

The balance test (Flamingo) from the European test battery was used to measure the static balance of the players. In this test, each player stands on one foot on a crossbar (1-inch wide, 1-inch high and 20-inches long) and holds the other foot by the ankle using the hand. Each player stood for one minute, and we counted the number of attempts fails, giving the player a rest for 30 seconds, and then, we repeated the test with another leg, The average was calculated for the two measures (Adam, C., et al (1987), Jakobsen, M. D, et al. (2011), Aboelwafa, H. S., et al. (2019).

The intensive training for core muscles lasted for 6 weeks and included 8 workouts aimed at strengthening the core muscles (rectus abdominis, external and internal obliques, transverse abdominis, multifidus, quadratus lumborum, and lumbar erector spinae).

The experimental group underwent intensive training with core muscle strengthening workouts for a period of 6 weeks (three times per week) within the training unit during the preparation period, and the physical training is shown in Figure (1). However, the control group did not undergo the same intensive training for core muscles, but they trained as usual, which included a variety of muscle groups.

Figure 1. *Core Muscles Strengthening Workouts Protocol*

The pretest for static balance was measured using the Flamingo test for both groups one day before the start of training, and the posttest for static balance was measured one day after the end of the specified training period (6 weeks).

Statistical analysis was performed using IBM SPSS (Version 21.0). The Shapiro–Wilk test ($p<0.05$) was applied, and the pre- test and post-test data from each group were compared via paired sample t-test. Data are presented as the mean and standard deviation of the mean**.**

Results

All participants in the study, whose characteristics are shown in Table (1), were regularly participating in the exercises, participated in the performance according to the training program for each group.

Table 1. *The players' data*

Group	NO.	Age (years)	Body mass (kg)	Body height (cm)	BMI (kg/m²)	Training experience (years)
Experimental Group	12 players	17.08	70.50	1.77	22.46	6.1
Control Group	12 players	17.58	71.34	1.78	22.46	6.6

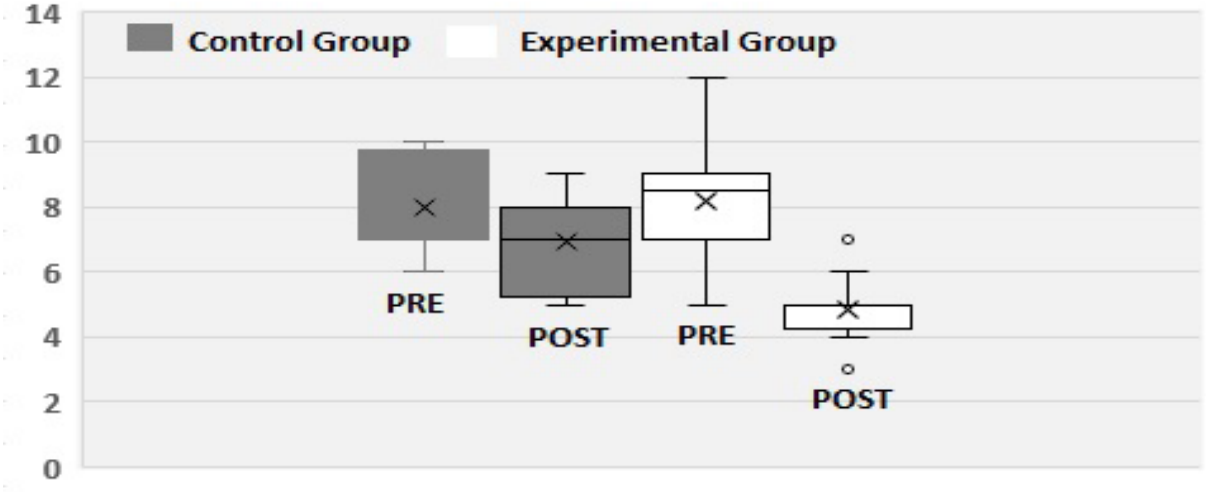
Table (2) shows the results of the paired sample T test (pretest - posttest), The table shows that there are statistically significant differences at the 0.05 level in favor of the post-measurement, and there is no correlation between the values during the pre- and post-measurement.

Table 2. *the result of paired sample T test (pretest - posttest)*

		Paired Samples Correlations			Paired Differences				
Pair 1	post - pre	N	Correlation	Sig.	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
								Lower	Upper
		24	.300	.155	2.20833	1.97768	.40369	1.37323	3.04344

Figure (2) shows the differences between the two groups in the pre- and post-measurements of the balance test (Flamingo) after 6 weeks of applying the program. The decreasing numbers in the figure indicate the balance level progress in the flamingo test. Both groups achieved an increase in their balance level with a different value for each group. Comparing the results of the two groups, the experimental group was significantly superior.

Figure 2. *Pretest and posttest measurement of flamingo test*



Discussion and Implications

According to the player data and the physical training program during the preparation period, which aimed to strengthen the core muscles to improve the static balance and statistical analysis, the results of our study showed that there was progress for both groups (experimental and control) in the flamingo test, but the progress in the experimental group was very high compared to the post-measurements of the control group. This difference can be explained by the effect of core muscle strengthening workouts during the preparation period for the experimental group to improve static balance.

The progress of the control group was limited compared to the experimental group, as the physical exercises for this group included the muscle groups in all parts of the body, and the intensity of the exercises differed from the exercises for the experimental group.

Improving the level of balance is closely associated to these results due to the role of core muscles in balance and stability during motor performance. (Kajmovic, H., & Huremovic, D. (2017), Gutiérrez-Santiago, et al. (2013), Gutiérrez, A., Prieto, I., & Cancela, J. M. (2009), Prieto, et al. (2016), and Prieto Lage, et al. (2014).

When performing throwing skills in judo, the player makes rotation and flexion movements around the main axis to reach the most appropriate position for throwing. This requires strong core muscles that enable the player to maintain balance and stability during performance, especially in the throwing phase, as most of the skills during the throwing phase require flexion movement in the forward and down direction to throw the defender. This requires a large contraction force of the rectus abdominis muscles, which is one of the important core muscles, in addition to the contribution of other core muscles to support performance and maintain balance and stability of the body. (Chakravarthy, M., & Vivekanandhan, T. (2020), (Nuhmani, S. (2021), Huxel Bliven, K. C., & Anderson, B. E. (2013).

There are throwing skills in judo that are performed from one foot. This means that the player needs balance and stability during the throwing phase for success of the throwing phase, and the skills of the player must be supported by physical abilities to achieve a successful throwing phase. Strengthening the core muscles can achieve this according to the results of the current study with the appropriate intensity during the training period.

Strengthening the core muscles has another benefit besides supporting and improving motor performance, including the prevention of injuries, which can stop the player from continuing training and competitions. (Nuhmani, S. (2021), Huxel Bliven, K. C., & Anderson, B. E. (2013).

Conclusion

The effect of intense workouts to strengthen the core muscles and their role in improving the static balance of judo players has been verified, which benefits skill performance, and this improvement can be observed during training and competitions.

The researcher suggests using the training program used in this study to strengthen the core muscles during the preparation period with a controlled training load according to the characteristics and type of players. The preparation period is the most suitable for improving balance, for strengthening the core muscles with varying intensity during training periods (preparation, competitions) and for gradation in the load intensity during the progress of training.

Coaches can use core muscle strengthening workouts with high-level players by adding weights to some of the workouts to achieve high load levels.

The importance of measuring the balance of judo players periodically before and during the training season via simple physical measurements, such as the flamingo test (the European fitness test), or via laboratory tests to verify the players' balance levels to provide accurate data of the players, it will enable improved training process planning.

Acknowledgments
The researcher thanks all the volunteer players for participating in the research, as well as the assistant coaches, for their great efforts that contributed to the completion of this study.

Disclosure statement
No potential conflict of interest was reported by the author.

References

Aboelwafa, H. S., Elkilany, A. M., & Al-Hariri, M. T. (2019). Measurement of physiological fitness level among male college students in dammam, Saudi Arabia using the European fitness test–EuroFit. *Glob. J. Health Sci*, vol. 11, no. 11, pp. 21-32; DOI:10.5539/gjhs.v11n11p21

Aboelwafa, H. S. (2021). Kinematics characteristics of Seoi-Nage and reverse skill in judo. *Journal of Physical Education and Sport*, Vol. 21 (1), Art 24, pp. 174-179; DOI:10.7752/jpes.2021.01024

Alonso, A. C., Brech, G. C., & Moscoli, F. (2009). Estudo comparativo do equilíbrio postural entre atletas de judô e indivíduos sedentários.

Adam, C., Klissouras, V., Ravazzolo, M., Renson, R., Tuxworth, W., Kemper, H. C. G., ... & Levarlet-Joye, H. (1987). EUROFIT-European test of physical fitness.

Chakravarthy, M., & Vivekanandhan, T. (2020). Effect of selected core strengthening workouts & Balanced diet in reducing weight among college teachers under Calicut University. *Int J Physiol Nutr Phy Educ*, 5(1), 109-112.

Gutiérrez-Santiago, A., Prieto, I., Camerino, O., & Anguera, M. T. (2013). Sequences of errors in the judo throw Morote Seoi Nage and their relationship to the learning process. Proceedings of the Institution of Mechanical Engineers, Part P: *Journal of Sports Engineering and Technology*, 227(1), pp.57-63; DOI: 10.1177/1754337111431916

Gutiérrez, A., Prieto, I., & Cancela, J. M. (2009). Most frequent errors in judo Uki Goshi technique and the existing relations among them analysed through T-patterns. *Journal of sports science & medicine,* 8(CSSI3), pp. 36-46.

Huxel Bliven, K. C., & Anderson, B. E. (2013). Core stability training for injury prevention. *Sports health*, 5(6), 514-522.

Jakobsen, M. D., Sundstrup, E., Krustrup, P., & Aagaard, P. (2011). The effect of recreational soccer training and running on postural balance in untrained men. *European journal of applied physiology*, 111(3), pp. 521-530; DOI 10.1007/s00421-010-1669-2

Kajmovic, H., & Huremovic, D. (2019). Analysis of Unsuccessfully Performed Throwing Techniques by Senior Male Competitors at Bosnia, and Herzegovina State Championship. *Applicable Research in Judo, 55*.

Kellis, E., Ellinoudis, A., Intziegianni, K., & Kofotolis, N. (2020). Muscle thickness during core stability exercises in children and adults. *Journal of human kinetics*, volume 71, pp. 131-144; DOI: 10.2478/hukin-2019-0079

Nuhmani, S. (2021). Efficacy of dynamic Swiss ball training in improving the core stability of collegiate athletes., *Physical Activity Review*, vol. 9(1), pp. 9-15; doi: 10.16926/par.2021.09.02

Prieto, I., Gutiérrez, A., Camerino, O., & Anguera, M. T. (2016). Typical errors and behavioral sequences in judo techniques: knowledge of performance and the analysis of t-patterns in relation to teaching and learning the ouchi-gari throw. *In Discovering Hidden Temporal Patterns in Behavior and Interaction* (pp. 143-153). Springer, New York, NY.

Prieto Lage, I., Gutiérrez-Santiago, A., & Prieto, M. Á. (2014). Knowledge of errors in the teaching-learning process of judo-techniques: osoto-guruma as a case study. *Journal of Human Kinetics*, volume 41 pp. 253-263; DOI: 10.2478/hukin-2014-0053.

Primljen: 12. maj 2022. / Received: May 12, 2022
Prihvaćen: 19. maj 2022. / Accepted: May 19, 2022

https://doi.org/10.7251/SSH2201010Y
Original scientific paper

UDC: 613.72/.73:796.035
Originalni naučni rad

Effects of Different Concurrent Training Methods on Aerobic and Anaerobic Capacity in U 21 soccer players

Khoudja Youcef[1,2], Mime Mokhtar[1,2], Belkadi Adel[1,2], Beboucha Wahib[1]

[1]*Laboratory of Optimizing Research Programmes on Physical and Sports Activities, Institute of Physical Education and Sport ,University of Abdelhamid Ibn Badis - Mostaganem, 27000 Algeria*

[2]*Training-University Research Projects (PRFU N° J00L02UN270120220003 Agreement: January 2022), 16000 Algeria*

Correspondence:
Belkadi Adel, Laboratory of Optimizing Research Programmes on Physical and Sports Activities, Institute of Physical Education and Sport, University of Abdelhamid Ibn Badis - Mostaganem, 27000 Algeria, adel.belkadi@univ-mosta.dz

Abstract: ***Purpose:*** *The main aim of this study is to investigate the effect of the concurrent training method of muscular strength training or muscular endurance training combined with high-intensity interval training (HIIT) on the aerobic threshold (AerT) and anaerobic threshold (AT).*

Material and methods: *Twenty soccer player from the University team were recruited. Participants were divided into muscular strength training group (MS, N = 10) and the muscular endurance training group (ME, N = 10). All subjects sustained the regular specific training programs during the experimental period and had additional different concurrent training twice per week for twelve weeks. power output during the graded exercise test, peak power (PP), average power (AP), fatigue index (FI) during anaerobic power test were tested by graded exercise test on Wingate anaerobic power test. as well as one-repetition maximum (1-RM) of lower limbs and Romanian Deadlift (RDL) - Hamstring Leg Exercise were tested simultaneously before and after the experiment. Data were analysed by two-way mixed design ANOVA.*

Results: *After 12 weeks of training, the AT power output, 1-RM of half squat and the 1-RM of RDL were significantly higher than before training (MS: 407.12 ± 52.92 vs 431.78± 48.84 watt, 157.45 ± 35.66 vs 169.87 ± 47.31 kg, 120.16± 15.28 vs 122.56± 19.39 kg; ME: 411.11 ± 48.48 vs 429.16 ± 52.13 watt, 135.34 ± 26.27 vs 144.41 ± 35.78 kg, 96.93 ± 24.57 vs 103.46 ± 24.15 kg, p <.05) in MS group and ME group. Time to exhaustion of graded exercise test in ME group was significantly higher than before training (22.13 ± 7.73 vs 25.78 ± 8.74 min, 23.44 ± 7.73 vs 24.78 ± 8.74 p <.05). The AerT power output, PP, AP, and FI were no significant changes in both groups. Nevertheless, all dependent variables were no significant difference between groups before and after training.*

Conclusion: *Conducting the concurrent training method of muscular strength training or muscular endurance training combined with HIIT twice per week for twelve weeks increased soccer players' aerobic endurance as well as 1-RM of lower limbs. The concurrent training method of muscular endurance training combined with HIIT also promoted the performance of time to exhaustion. However, there were no significant difference between two training methods and minor significant benefits on anaerobic power.*

Keywords: *adapted physical activity, protocol, chronic low back pain.*

Introduction

There are many aspects to successful sports performance, including advanced technical preparation, strategy and physical fitness. soccer has clear physical requirements (Bloomfield, Polman, & O'Donoghue, 2007). Soccer Team sports need high levels of aerobic capacity (Hoff, Wisløff, Engen, Kemi, & Helgerud, 2002), weightlifters need a high level of muscle strength (Krzysztofik, Wilk, Wojdała, & Gołaś, 2019; Reggiani & Schiaffino, 2020). However, many sports require multiple physical abilities at the same time to achieve optimal performance (Mujika, Halson, Burke, Balagué, & Farrow, 2018). For example, in rugby, athletes need to have the acceleration and explosive power to surpass the opponent's crossing line, the muscle mass and muscle strength of the ball, long-distance movement and the aerobic ability to continuously intercept and tackle (Winter et al., 2016); soccer players need aerobic capacity, Repetitive sprint ability, maximum muscle strength and explosive power (Alemdaroğlu, 2012; Stojanovic, Ostojic, Calleja-González, Milosevic, & Mikic, 2012). Therefore, having both good aerobic and anaerobic abilities in most sports is the key to becoming a top athlete(Adel, Mokhtar, Abdelkader, Mohamed, & Othman, 2019; Buchheit, Mendez-Villanueva, Delhomel, Brughelli, & Ahmaidi, 2010). Aerobic endurance and anaerobic power are key

factors that determine the level of soccer players (Helgerud, Engen, Wisloff, & Hoff, 2001; Tumilty, 1993). Previous studies have found that soccer player has a higher aerobic power output in the incremental test to exhaustion (Dittrich, da Silva, Castagna, de Lucas, & Guglielmo, 2011; Impellizzeri, Rampinini, & Marcora, 2005), The peak power (PP) and average power (AP) measured by the Wingate anaerobic power test can predict the performance of soccer players(Al'Hazzaa, Almuzaini, Al-Refaee, & Sulaiman, 2001). Therefore, increasing aerobic capacity and anaerobic power at the same time will help improve soccer skills performance (Amani-Shalamzari et al., 2019; Belkadi et al., 2015). Common ways to improve aerobic endurance include moderate continuous training and high intensity interval training (HIIT). Studies have confirmed that both continuous training and HIIT can improve aerobic endurance(Schaun, Pinto, Silva, Dolinski, & Alberton, 2018), but the time spent and training volume of HIIT are significantly lower than continuous training (Wen et al., 2019), and some studies have pointed out The effect of HIIT on aerobic endurance training is better than continuous training (Way, Sultana, Sabag, Baker, & Johnson, 2019; Wen et al., 2019). Anaerobic power can be improved through resistance training and power training (Helgerud et al., 2001; Impellizzeri et al., 2005). recent studies have pointed out that athletes can increase anaerobic power by increasing muscle strength or increasing the percentage of fast-twitch muscle fibers (Beboucha, Belkadi, Benchehida, & Bengoua, 2021; Lievens, Klass, Bex, & Derave, 2020). In addition to high training load and low training volume muscle strength training (Vmst) can increase the maximum muscle strength (one-repetition maximum, 1-RM) (S. Benhammou, Mourot, Mokkedes, Bengoua, & Belkadi, 2021; Tillin & Folland, 2014), few studies have found that both adults and adolescents perform low training load and high training Extensive muscular endurance training can also achieve the benefits of 1-RM improvement (Farrell, Lantis, Ade, Cantrell, & Larson, 2018; Ferley, Scholten, & Vukovich, 2020). The integrated analysis of Stricker (2020) shows that resistance training for children and adolescents is beneficial in various aspects, including: muscle strength and explosive power, injury prevention and injury recovery, cardiopulmonary fitness, body composition, bone density (Stricker et al., 2020). Among them, by designing appropriate short-term resistance training, children and adolescents can increase their muscle strength by 30% (Behm, Faigenbaum, Falk, & Klentrou, 2008; Belkadi, Benchehida, Benbernou, & Sebbane, 2019). The integrated analysis of Cavar (2019) unifies the young athletes to conduct resistance training for at least 6 weeks (Cavar et al., 2019) with an average of 2.6 ± 0.9 times per week, the range of training intensity and training volume There are multiple groups (60-80% 1-RM × 2-3 groups × 8-15 reps) from medium load to near maximum load, which can significantly improve muscle strength. endurance training and resistance training in different periods and on different days were usually needed to improve aerobic and anaerobic capacity at the same time (Kraemer & Ratamess, 2004). Force training is carried out. This training method is called concurrent training (Robineau, Lacome, Piscione, Bigard, & Babault, 2017; Sousa et al., 2020). However, Hickson's (1980) research found that synchronized training produces a phenomenon called interference effect, which results in less muscle-lifting than resistance training alone (Hickson, 1980), muscle hypertrophy (Hickson, 1980; Kraemer & Ratamess, 2004) or explosive power (Mikkola, Rusko, Izquierdo, Gorostiaga, & Häkkinen, 2012). However, few recent studies have found that pairing with endurance training has little or no impact on the effectiveness of resistance training (B Alabinis, Psarakis, Moukas, V Assiliou, & Behrakis, 2003; McKay, Paterson, & Kowalchuk, 2009) Methenitis (2018) pointed out that low-volume and short-term HIIT or sprint interval training ,endurance training combined with resistance training has the lowest or no negative impact on the adaptation induced by resistance training (Lalia, Ali, Adel, Asli, & Othman, 2019; Methenitis, 2018).The resistance training part is often carried out by explosive force, strengthening, muscle strength and muscular endurance training, and endurance training is carried out by running, swimming, rowing or cycling. Continuous or intermittent endurance training(Gäbler, Prieske, Hortobágyi, & Granacher, 2018).

The study on adolescents has no interference effect compared to resistance training or endurance training alone, synchronized training may have the better training effect. This may be related to the fact that Gäbler et al. (2018) and Gäbler and Granacher (2019) mentioned that adolescents are different from adults in body measurement, physiological characteristics, and biomechanics, and therefore, synchronized training may be related to the different responses of adults(Gäbler & Granacher, 2019; yassin zenati, belkadi, & benbernou, 2021). In summary, both aerobic and anaerobic capacity are required by athletes in many sports. Moderate to mid-to-high intensity resistance training can increase the neuromuscular recruitment of young people to enhance muscle strength. If the target is adolescents and use HIIT's synchronized training, you can train for the two abilities on the same day, and avoid interference effects as much as possible. However, there is notable paucity been conducted to determine the possible effects of resistance

training with HIIT on aerobic endurance and anaerobic power by combining muscle strength or muscle endurance. Therefore, this study will conduct different synchronized training twice a week for 12 weeks to explore the changes in the aerobic and anaerobic capacity of adolescents after the intervention of the two training methods.

Purpose: of the study was To explore the aerobic threshold (AerT) power and anaerobic threshold (AT) power during aerobic exercise with the same HIIT for twelve-week muscle strength training or muscle endurance training for U21 soccer players; and explore the anaerobic exercise influence of peak power (PP), average power (AP), fatigue index (FI) and 1-RM of lower limbs.

Materials and Methods

Participants

Twenty male soccer players from soccer university team were recruited in this study. The experimental participants had no chronic diseases such as heart disease and high blood pressure, and no serious bone and muscle injuries were reported within six months. Before the start of the experiment, the participants took various pre-tests and were matched-paired with AT scores. The participants were divided into muscle strength (MS) group and muscle endurance (ME) group. All experiment participants fill in personal information, health survey form and experiment participant consent form before the experiment. During the experiment, no extra strenuous exercise or resistance training was allowed except for normal soccer training and activities. During the experiment, participants were also required to eat and maintain daily habits, the study was conducted in accordance with the principles of the Helsinki Declaration and was approved by the Ethic Committee of the local physical and education sports Institute N°PRFU N° J00L02UN270120220003.

Table 1. *Baseline characteristics of participants. Mean ± SD*

Variable	Groups	
	MS group N=10	ME group N=10
Age	19.50 ± 1 .50	19.95±0.25
Height (cm)	168 .89±6.33	170.11±4 .85
Weight(kg)	69.36±3 .85	70.36±4 .85
BMI (kg/m2)	26.60±2 .60	25.80±2 .80
Training experience (years)	7.00±2.50	8.50±3.50

BMI = body mass index; MS = muscle strength; ME = muscle endurance

Experimental design

Participants in the experiment took the Incremental soccer test **(Footeval)**, Wingate anaerobic power test, and 1-RM estimation test for lower limbs before the experiment. After two days of rest, they began to perform simultaneous training twice a week for 12 weeks. Resistance training was performed with low load and high repetitions, while resistance training was performed with low load and high repetitions in the ME group. The two trainings were separated by at least 48 hours; during the two groups of experimental participation. Participants will carry out special soccer training normally; after the 12th week, 48 hours later, the participants' Incremental soccer test (Footeval), Wingate anaerobic power test, and lower limb 1-RM estimated test performance will be measured again to evaluate 12 weeks benefits of resistance training, the experimental framework is shown in Figure 1.

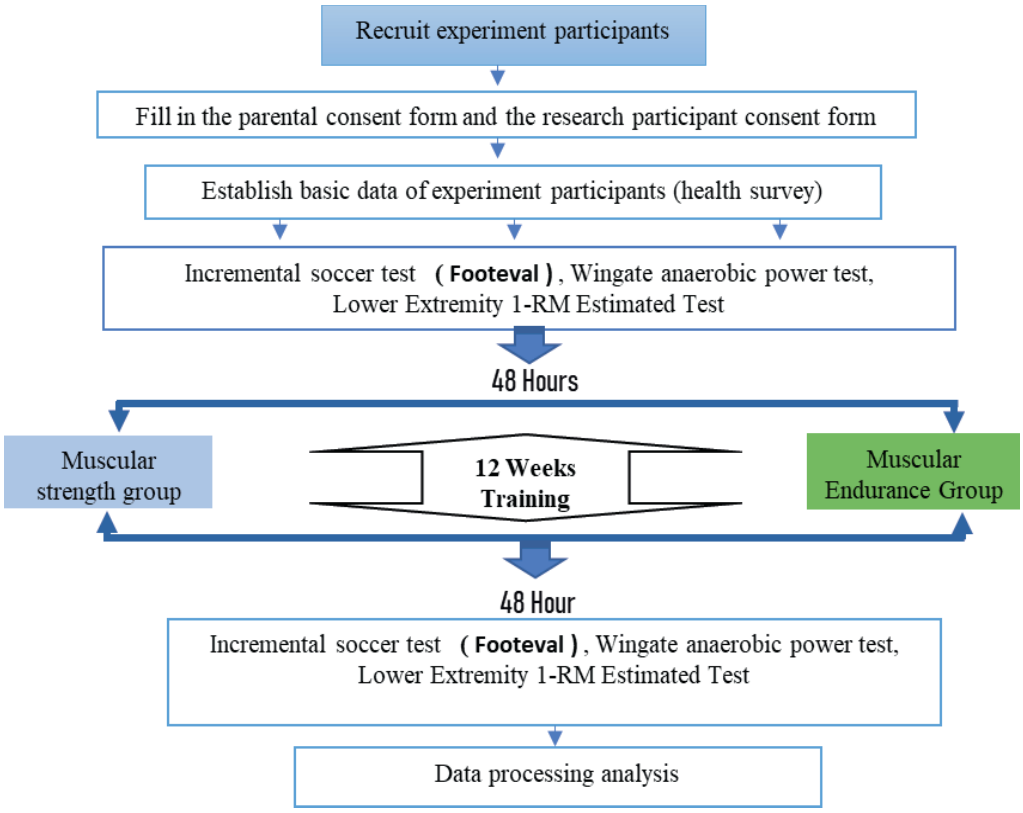


Figure 1. *Experimental framework*

Table 2. *Training schedule*

1_ 4 weeks				
Training content		**load**	**Number of Rep/sets.sc**	**Rest**
MS group	Lift actions exercise	85% 1_RM	2 sets /6Rep	3mn
	Auxiliary actions	75% 1_RM	3 sets /10 rep	1mn
	Body Plank exercise	own weight	10 sets /10s	10mn
	HITT	90% AEROBIC	8 sets /60s	60s
ME group	Lift actions exercise	67%1_RM	2 sets /12Rep	30sc
	Auxiliary actions	67%1_RM	2 sets /12Rep	30sc
	Body Plank exercise	own weight	8 sets /10s	10sc
	HITT	90% AEROBIC	8 sets /60s	60sc
5_ 8 weeks				
Training content		**load**	**Number of rep/sets.sc**	**Rest**
MS group	Lift actions exercise	85% 1_RM	4 Sets /6Rep	3mn
	Auxiliary actions	75% 1_RM	5 Sets/10 Rep	1mn
	Body Plank exercise	own weight	10 sets/10 s	10mn
	HITT	90% AEROBIC	10 Sets/60 s	60s
ME group	Lift actions exercise	67%1_RM	3 Sets /15Rep	30sc
	Auxiliary action	67%1_RM	3 Sets /15Rep	30sc
	Body Plank exercise	own weight	10 Sets/10 s	10sc
	HITT	90% AEROBIC	10 Sets/60 s	60sc
9_ 12 weeks				
Training content		**load**	**Number of rep/sets.sc**	**Rest**
MS group	Lift actions exercise	85% 1_RM	5Sets /6Rep	3mn
	Auxiliary actions	75% 1_RM	5 Sets/10 Rep	1mn

	Body Plank exercise	own weight	10 Sets/10 s	10mn
	HITT	90% AEROBIC	10 Sets/60 s	60s
ME group	Lift actions exercise	67%1_RM	3 Sets /18Rep	30sc
	Auxiliary actions	67%1_RM	3 Sets /18Rep	30sc
	Body Plank exercise	own weight	12 Sets/10 s	10sc
	HITT	90% AEROBIC	12 Sets/60s	60sc

Note: Lift actions exercise: half squat, Romanian deadlift, auxiliary actions: one-foot leg push, Standing Hip Flexion with Cable, lift Heel, toe lift, Body Plank exercise, HIIT: high intensity Interval training

Figure 2. *Training action exercise*

The experimental process:

- Experimental participants completed the Incremental soccer test (Footeval), the Wingate anaerobic power test, and the lower limb 1-RM estimation test in sequence on three different days before the experiment. The interval between each experiment was at least 24 hours so that the experimental participants could Complete with best effort in each test.
- Two days after the pre-test was completed, the two groups of experimental participants began to perform twice a week for 12 weeks, each time the muscular strength or muscular endurance of the 7 movements are combined with endurance training. The two trainings are separated by at least 48 hours. The two groups of experimental participants normally conduct special training.
- The two resistance training schedules are based on Haff and Triplett (2015) in the NSCA book(G. Haff & Triplett, 2015). Resistance training principles and youth resistance training principles, balanced development of adolescents' front and rear muscle groups, including core exercises: half squats, Romanian dead lift (RDL), auxiliary exercises: single leg push, standing and single foot Hip flexion, heel lift, toe lift and joint actions: stick pose, and refer to the research and design training content of (Hill-Haas, Bishop, Dawson, Goodman, & Edge, 2007)) training volume adjustment for adolescent muscle strength training and refer to the research (Ignjatovic, Radovanovic, Stankovic, Marković, & Kocic, 2011)Adjust the training volume for adolescent

muscle endurance training, and calculate the total training volume of the two groups in the way of load × number of groups × times.

- The specific content is shown in Table 2, and the training action diagram is shown in Figure 2-1-to Figure2-6.
- The endurance training schedule uses a stationary bicycle to perform HIIT and adjusts the intensity according to (McKay et al., 2009). During the training, the revolutions per minute (rpm) of the bicycle must be maintained above 100 rpm.
- 48 hours after the 12th week of the training period, the incremental soccer test (Footeval), Wingate anaerobic power test, and lower limb 1-RM estimation test will be performed again on different days.

Tests items and methods:

Wingate Anaerobic Test

Wingate anaerobic with stationary bicycle (Bar-Or, 1987). The test is used to determine peak anaerobic power and anaerobic capacity. Anaerobic power is the ability to produce energy by the ATP-PC energy pathway. Anaerobic capacity is the combined ability of both anaerobic pathways to produce energy and so is shown as the average power output during the test.

The Footeval Test

Is an incremental and intermittent football (soccer) specific test designed by (Manouvrier, Cassirame, & Ahmaidi, 2016)The test is based on the 20m shuttle test, though it incorporates dribbling of a soccer ball and 30 second rest periods after every minute. With the aim to measure aerobic fitness and skill in soccer players.

Equipment required: 30m x 10m grassed field area, measuring tape, marker cones, soccer balls, soccer goal, portable barrier for reflecting the kicked ball, audio track and audio player as shown in the figure 3.

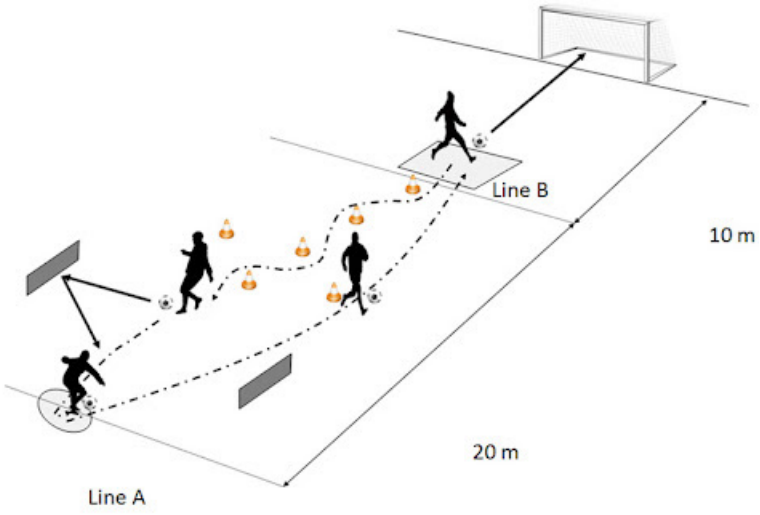


Figure 3. *(Footeval) Test intermittent (soccer) specific test*

One-Repetition Maximum or 1-RM test:

Repetition maximum is often expressed as 1RM or one-repetition maximum. This indicates the heaviest weight you can lift with maximum effort in a single repetition. A 1RM is your personal weightlifting record for a squat, deadlift, or any other weightlifting exercise.

The 1RM measurement is a standard in weight training for marking improvement(Seo et al., 2012), By establishing your 1RM and tracking it, you are able to observe your progress. According to (Gregory & Travis, 2015)1-RM test process adjusted to 6-RM test process, the entire test must measure the weight of 6-RM within 5 times, and use (G. G. Haff & Triplett, 2015) The table "Estimated 1-RM and Load Weight" estimates the weight of 1-RM.

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 t-test for normally distributed variables. Comparison by two-way ANOVA, mixed design Between and within

AerT power, AT power, PP, AP, FI and squat, RDL. To detect the sub-group differences, the rate % of change of the pre- and post-test values between each group, and compare the difference in the rate of change between groups by independent sample t test. A p value of <0.05 was considered statistically significant. the effect size of the pre- and post-measurement values between each group. Judgment of the amount of effect: Very small (trivial): <0.20, small (small): 0.20-0.49, medium (moderate): 0.50-0.79, large:> 0.80 (Hedges & Schauer, 2019)

Results

The results shown in Table 3 referred to the influence of twelve weeks of different synchronized training on aerobic endurance, the AerT power of the two groups was not significantly different, before training the AT power of the second group was significantly better than before training (p <.05); only the ME group had significantly better time to exhaustion than before training (p <.05), There is no significant difference between the two groups before and after the test group.

The effect of AT power in the MS group and ME group were 0.48 and 0.36, respectively; the effect of exhaustion time in the ME group was 0.24, which was a small effect.

Table 3. *Aerobic threshold power and anaerobic threshold power*

	MS group	ME group
(AerT) power (watt)		
Before training	160.44 ± 53.73	164.00 ± 64.44
After training.	176.22 ± 33.50	179.57 ± 45.70
Change rate (%)	49.85 ± 61.54	40.04 ± 67.12
(AT) power(watt)		
Before training	407.12 ± 52.92	411.11 ± 48.48
After training.	431.78± 48.84*	429.16 ± 52.13*
Change rate (%)	13.15 ± 7.17	08.60 ± 4.50
exhaustion Time(min)		
Before training	22.13 ± 7.37	23.44 ± 7.73
After training.	25.22 ± 8.24	24.78 ± 8.74*
Change rate (%)	11.57 ± 18.61	12.63 ± 10.13

Note: MS group: muscular strength group, ME group: muscular endurance group, AerT: aerobic threshold, AT: anaerobic threshold Values are expressed as mean ± standard deviation, each group n = 10
** Significant difference compared with previous test (p <.05).*

The results shown in Table 3,4 and 5 referred to the influence of twelve weeks of different synchronized training on anaerobic performance, twelve weeks later, the weight of the muscle strength group was 73.91 ± 6.64 kg, and the weight of the muscle endurance group was 72.13 ± 7.45kg. The results of PP, relative PP, AP, relative AP and FI of the muscle strength group and muscle endurance group before and after the test are shown in Table 4. There was no significant difference between the two groups of PP, relative PP, AP, relative AP and FI after twelve weeks of training, and there was no significant difference between the two groups before and after the test.

Table 4. *Peak power average and fatigue index*

	MS group	ME group
PP (watt)		
before training	710.57 ± 172.12	716.89 ± 210.15
after training.	744.82 ± 206.38	729.19 ± 225.56
Change rate (%)	4.53 ± 11.03	1.32 ± 6.80
Relative pp (watt)kg/w		
before training	13.00 ± 1.35	13.22 ± 2.19

after training.	13.43 ± 1.62	13.28 ± 2.39
Change rate (%)	3.60 ± 10.18	0.32 ± 6.76
Ap (watt)		
before training	441.28 ± 132.45	446.45 ± 141.43
after training.	448.22 ± 128.45	444.92 ± 143.72
Change rate (%)	1.82 ± 4.39	-O.53 ± 0.27
Relative Ap (watt) kg/w		
before training	8.00 ± 1.14	8.19 ± 1.39
after training.	8.07 ± 1.11	8.07 ± 1.44
Change rate (%)	0.97 ± 4.15	-1.48 ± 5.74
F I (%)		
before training	64.33 ± 10.38	66.51 ± 10.85
after training.	66.09 ± 8.74	58.68 ± 12.10

Note: MS group: muscular strength group, ME group: muscular endurance group, PP: peak power, AP: average power, FI: fatigue index. Values are expressed as mean ± standard deviation, each group n = 10

Table 5. *Maximum muscle strength of lower limbs*

	MS group	ME group
Half squat (kg)		
before training	157.45 ± 35.66	135.34 ± 26.27
after training	169.87 ± 47.31*	144.41 ± 35.78*
Change rate (%)	12.83 ± 10.34	10.69 ± 8.82
relative to squat (kg/kg/w)		
before training	2.34 ± 0.40	2.16 ± 029
after training	2.52 ± 0.49*	2.37 ± 0.38*
Rate of change	7.92 ± 10.07	9.65 ± 9.49
(%) Romanian deadlift (kg)		
before training	120.16± 15.28	96.93 ± 24.57
after training	122.56± 1939*	103.46 ± 24.15*
Rate of change	9.05 ± 9.44	8.41 ± 9.44
(%) vs. Romanian deadlift (kg/kgw)		
before taking	1.71 ± 0.26	1.61 ± 0.26
after training	1.85 ± 0.29*	1.72 ± 0.29*
Change rate (%)	8.06 ± 7.99	7.28 ± 8.33

Note: MS group: muscular strength group, ME group: muscular endurance group, AerT: aerobic threshold, AT: anaerobic threshold Values are expressed as mean ± standard deviation, each group n = 10
** Significant difference compared with previous test (p <.05)*

Discussion

The main study was conducted to evaluate the effect of twelve weeks of different synchronized training on the aerobic endurance of U21 scoor players, In this study, after 12 weeks of muscle strength and muscle endurance training with the same HIIT, the AerT power and AT power after the two types of training have a tendency to increase, and the AT power of the two groups has improved significantly, and the effect is small (ES: 0.36-0.48), the result of AT power increase is in line with our expected result. In the previous studies of synchronized training, most of the aerobic endurance indicators used V̇O2max (Dittrich et al., 2011; Farrell et al., 2018; Impellizzeri et al., 2005; McKay et al., 2009; Wen et al., 2019); however, AT and endurance sports performance are also highly correlated (Gharaezibaei, 2021), and predict the performance of soccer players or long-distance runners by analyzing AT(Hoff et al., 2002;

Impellizzeri et al., 2005; Messonnier et al., 2022; Schaun et al., 2018). Speed or power Higher output means that athletes can maintain higher speed or power output during long-term exercise (Izquierdo, Häkkinen, Gonzalez-Badillo, Ibáñez, & Gorostiaga, 2002; Mohammed, Bachir, Eddine, & Adel, 2018). The change of AT may be Resynthesis of creatine acid, supplementation of glucose and oxygen, and elimination of lactic acid are related to positive adaptation (Benchehida et al., 2021; Kendrick et al., 2008; McKay et al., 2009; Schumann, Yli-Peltola, Abbiss, & Häkkinen, 2015). Therefore, the results of this study show that the two groups of different forms of synchronized training have significantly increased the power output of AT, and it can be inferred that the aerobic endurance performance of the two groups of athletes has improved significantly. However, the AerT power did not change significantly in the results of this study. Skovgaard (2018) believe that the load corresponding to AerT is the upper limit of pure aerobic metabolism (Hill-Haas et al., 2007; Skovgaard et al., 2018; Messonnier et al., 2022). Previous studies have pointed out that resistance training can increase the running economy of well-trained long-distance runners by 8% (Gorostiaga, Izquierdo, Iturralde, Ruesta, & Ibáñez, 1999; Kraemer, Ratamess, & French, 2002; Krzysztofik et al., 2019). HIIT can improve neuromuscular characteristics and then manifest in muscle strength and work economy(Mikkola et al., 2012; Tillin & Folland, 2014; García-Pinillos, Cámara-Pérez, Soto-Hermoso, & Latorre-Román, 2017), while improving anaerobic metabolism (Ziemann et al., 2011). The training program designed in this study did not train for aerobic metabolism, so it could not improve AerT power. the use of resistance training combined with HIIT synchronized training found that the power output of AT has been significantly improved after training (Petré, Löfving, & Psilander, 2018), which are the same as the results presented in this study; if the order of resistance training and endurance training is reversed (HIIT first, then resistance training), the power output of AT is not significantly different from before training (Fyfe, Bartlett, Hanson, Stepto, & Bishop, 2016; Ignjatovic et al., 2011; Saddek et al., 2020). However, a study of healthy adults with moderate activity points out that regardless of the order of resistance exercise and endurance exercise, the power of AT can be significantly increased (Lee et al., 2020). The results of this study showed that only the ME group made significant progress in exhaustion time in the wingate test. In the past, synchronized training was used to improve individual endurance performance(Hickson, 1980; Mujika et al., 2018; Petré et al., 2018; Winter et al., 2016),but high-intensity training will increase more type II Muscle fibers, not aerobic type I muscle fibers (García-Pinillos et al., 2017; Lievens et al., 2020; Mikkola et al., 2012; Mokhtar et al., 2019; Reggiani & Schiaffino, 2020)High-volume resistance training may improve monocarboxylate transporter proteins MCT1 and MCT4, thereby increasing lactate clearance and increasing the load corresponding to AT (Adel, Abdelkader, et al., 2019; Mohamed, Mohamed, Mohammed, Mokrani, & Belkadi, 2019). Lantis, Farrell III, Cantrell, & Larson (2017) proved that high-volume resistance training can delay the appearance of 4 mmol·L-1 and increase leg muscle strength for experimental participants with endurance training experience(Farrell et al., 2018). Therefore, it can be inferred that the ME group increased the lactic acid clearance rate after training, and the exhaustion time in the wingate test was longer than before the training. However, the current research on synchronized training for young players is limited compared with adults, and the synchronized training research that allows young athletes to use HIIT as an endurance training method focuses on actual sports performance and the impact of V̇O2 (Buchheit et al., 2010; Karahan, 2020; Wen et al., 2019), there is a limited research to explore the change of aerobic capacity through [la-] calculating AerT and AT.

After 12 weeks of muscle strength and endurance training with the same HIIT, there was no significant difference between PP and AP after the two trainings and before training, and the FI showed an increasing trend; however, the half squats and RDL 1-RM of the two groups As well as the relative half squat, RDL,1-RM has been significantly improved after training, and the effect is small to medium (ES: 0.27-0.62). This result is in line with our expectation that by improving the 1-RM of the lower limbs. Previous studies with adults found that synchronized training did not only significantly improved the 1-RM of the upper or lower limbs, but also significantly enhanced the PP of the upper or lower limbs (Hartono, Martin-Arrowsmith, Peeters, & Churchward-Venne, 2022; Murlasits, Kneffel, & Thalib, 2018; Parastesh, Saremi, Hashemi, Ramezani, & Shavandi, 2022). However, some studies have found that although the 1-RM of the lower limbs is significantly increased compared to before training, there is no significant change in PP (Adel, Abdelkader, et al., 2019; Adel, Alia, & Mohammed, 2020). The study of (Jones et al., 2021) divided 08 men with casual exercise habits into resistance training group, HIIT + resistance training group, and medium-intensity continuous training + resistance training group, for 8 weeks, 3 times a week training intervention . The results showed that 1-RM, CMJ in the resistance training group the performance training effect is significantly better than the other

two groups. The author pointed out that although synchronized training significantly improves 1-RM, resistance training has a more significant improvement in 1-RM training effect than synchronized training. Therefore, it may be related to the interference effect of synchronized training, which affects the development of 1-RM. There is no significant improvement in the PP that makes the reverse jump. In addition, HIIT can improve the aerobic and anaerobic capacity, physical fitness and performance of time to exhaustion of well-trained athletes (Gäbler et al., 2018; Kraemer et al., 2002; Lee et al., 2020). (Schumann et al., 2015) let men and women with leisure sports habits use the Wingate test (do their best) to perform HIIT. The results show that after training, PP, AP and FI are significantly better than the previous test. (Adel, Abdelkader, et al., 2019) compare the difference between HIIT (85~100% HRmax) and high-intensity continuous running (85% HRmax). The results show that only PP and AP improved significantly after training in the HIIT group. The common point of the above studies is that they all use the maximum training intensity for HIIT, while the twelve-week HIIT in this study maintained the same training intensity, only increasing the training volume after the 4th and 8th weeks. It is speculated that the factors that did not improve anaerobic power may be related to the insufficient training intensity of HIIT. In many synchronized training studies targeting teenagers in the past, the use of moderate to medium-to-high intensity resistance training (60-85% 1-RM) combined with endurance training can significantly improve the 1-RM of ordinary teenagers and young athletes (García-Pinillos et al., 2017; Lee et al., 2020; Robineau et al., 2017). Such results are usually attributed to increased neuromuscular activation rather than muscle hypertrophy (Reggiani & Schiaffino, 2020). In this study, the two types of simultaneous training with 67-85% 1-RM training load improved the 1-RM of the lower limbs of young soccer player s, supporting the results of previous studies. It can be inferred that athletes at this stage do not need to use maximum load for resistance training to improve 1-RM performance. The study of (Saddek Benhammou et al., 2021) used elite male long-distance runners to compare the performance differences between 12-week muscle strength training and endurance training on teams. The results showed that the 1-RM, running economy, and peak speed of the two training methods were significantly improved after training, but V̇O2max and HRmax did not improve significantly. The author believes that because the experimental participants are high-level athletes, the trainability of aerobic capacity is limited; on the other hand, the addition of resistance training does not have a negative impact on V̇O2max. This result can explain the difference between resistance training and endurance training. They do not interfere with each other, but have the concept of additional benefits (Izquierdo et al., 2002). The same as this study is that they all improve 1-RM, but it may be due to the relationship between different levels, different dependent variables of the test, and different exercise patterns. The aerobic capacity (AT) of this study has improved, and the anaerobic capacity (PP) There is no difference.

Conclusions

This study is divided into two types of synchronized training for 12 weeks, two training interventions per week, namely muscle strength training with HIIT and muscle endurance training with HIIT, and their effects on aerobic endurance, anaerobic power and 1-RM. Conclusion In order to improve the AT power of young athletes under normal soccer training conditions, both types of synchronized training can also improve 1-RM of the lower limbs. In this study, PP, AP, and FI have not changed. It is recommended that if young athletes are allowed to perform HIIT endurance training in future studies, attention should be paid to the adjustment of training intensity. This study originally expected that the various indicators of the muscle strength group after training were significantly higher than the muscle endurance group, but the results of the two groups were not significantly different in each variable. Therefore, it can be inferred that regardless of whether the synchronized training is carried out by muscle strength or muscle endurance, resistance training loads at medium to medium-to-high intensity (67-85% 1-RM) can improve aerobic endurance and 1 -RM effect, it is recommended that the coach can follow the exercise. The training status and development situation of the staff choose a suitable training method. Finally, the standard deviation of each variable in the results of this study is very large. It is speculated that athletes at this stage (junior high school, high school) have large differences in abilities, and gender may also be one of the factors. It is recommended that the ethnic conditions of experimental participants in future studies are as large as possible Similarity, to avoid inconsistencies in the abilities of various experimental participants, resulting in unclear training effects.

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. doi: 10.2478/afepuc-2019-0013

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*(4), 293-299. doi: 10.32474/OSMOAJ.2020.03.000168

Adel, B., Mokhtar, M., Abdelkader, B., Mohamed, S., & Othman, B. (2019). Effects of tow protocol cold water immersion on the post match recovery and physical performance in youth handball players. *International Journal of Sport Culture and Science*, *7*(2), 1-12.

Alemdaroğlu, U. (2012). The relationship between muscle strength, anaerobic performance, agility, sprint ability and vertical jump performance in professional basketball players. *Journal of human kinetics*, *31*(2012), 149-158.

Al'Hazzaa, H. M., Almuzaini, K. S., Al-Refaee, S. A., & Sulaiman, M. A. (2001). Aerobic and anaerobic power characteristics of Saudi elite soccer players. *Journal of Sports Medicine and Physical Fitness*, *41*(1), 54.

Amani-Shalamzari, S., Khoshghadam, E., Donyaei, A., Parnow, A., Bayati, M., & Clemente, F. M. (2019). Generic vs. Small-sided game training in futsal : Effects on aerobic capacity, anaerobic power and agility. *Physiology & behavior*, *204*, 347-354.

B Alabinis, C. P., Psarakis, C. H., Moukas, M., V Assiliou, M. P., & Behrakis, P. K. (2003). Early Phase Changes by Concurrent Endurance and Strength Training. *The Journal of Strength & Conditioning Research*, *17*(2), 393-401.

Bar-Or, O. (1987). The Wingate anaerobic test. An update on methodology, reliability and validity. *Sports Medicine (Auckland, N.Z.)*, *4*(6), 381-394. doi: 10.2165/00007256-198704060-00001

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*(1).

Behm, D. G., Faigenbaum, A. D., Falk, B., & Klentrou, P. (2008). Canadian Society for Exercise Physiology position paper : Resistance training in children and adolescents. *Applied Physiology, Nutrition, and Metabolism*, *33*(3), 547-561. doi: 10.1139/H08-020

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*(3), 51-61. doi: 10.26524/ijpefs1936

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.

Benchehida, A., Belkadi, A., Zenati, Y., Benbernou, O., Cherara, L., & Sebbane, M. (2021). Implementation of An Adapted Physical Activity Therapy Protocol for Patients with Low Back Pain. *GYMNASIUM*, *22*(1), 83-96.

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*. doi: 10.1016/j.scispo.2020.10.002

Benhammou, Saddek, Mourot, L., Coquart, J., Belkadi, A., Mokkedes, M. I., & Bengoua, A. (2021). The 180/20 intermittent athletic test : A new intermittent track test to assess the maximal aerobic speed in middle-distance runners. *Revista Andaluza de Medicina Del Deporte*. doi: 10.33155/j.ramd.2021.08.001

Bloomfield, J., Polman, R., & O'Donoghue, P. (2007). Physical Demands of Different Positions in FA Premier League Soccer. *Journal of Sports Science & Medicine*, *6*(1), 63-70.

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. *The Journal of Strength & Conditioning Research*, *24*(10), 2715-2722.

Cavar, M., Marsic, T., Corluka, M., Culjak, Z., Zovko, I. C., Müller, A., … Hofmann, P. (2019). Effects of 6 weeks of different high-intensity interval and moderate continuous training on aerobic and anaerobic performance. *The Journal of Strength & Conditioning Research*, *33*(1), 44-56.

Dittrich, N., da Silva, J. F., Castagna, C., de Lucas, R. D., & Guglielmo, L. G. A. (2011). Validity of Carminatti's test to determine physiological indices of aerobic power and capacity in soccer and futsal players. *The Journal of Strength & Conditioning Research*, *25*(11), 3099-3106.

Farrell, J. W. I., Lantis, D. J., Ade, C. J., Cantrell, G. S., & Larson, R. D. (2018). Aerobic Exercise Supplemented With Muscular Endurance Training Improves Onset of Blood Lactate Accumulation. *The Journal of Strength & Conditioning Research*, *32*(5), 1376-1382. doi: 10.1519/JSC.0000000000001981

Ferley, D. D., Scholten, S., & Vukovich, M. D. (2020). Combined Sprint Interval, Plyometric, and Strength Training in Adolescent Soccer Players : Effects on Measures of Speed, Strength, Power, Change of Direction, and Anaerobic Capacity. *The Journal of Strength & Conditioning Research*, *34*(4), 957-968. doi: 10.1519/JSC.0000000000003476

Fyfe, J. J., Bartlett, J. D., Hanson, E. D., Stepto, N. K., & Bishop, D. J. (2016). Endurance Training Intensity Does Not Mediate Interference to Maximal Lower-Body Strength Gain during Short-Term Concurrent Training. *Frontiers in Physiology*, *7*. Consulté à l'adresse https://www.frontiersin.org/article/10.3389/fphys.2016.00487

Gäbler, M., & Granacher, U. (2019). Concurrent Training in Children and Adolescents. In M. Schumann & B. R. Rønnestad (Éds.), *Concurrent Aerobic and Strength Training : Scientific Basics and Practical Applications* (p. 255-275). Cham: Springer International Publishing. doi: 10.1007/978-3-319-75547-2_17

Gäbler, M., Prieske, O., Hortobágyi, T., & Granacher, U. (2018). The Effects of Concurrent Strength and Endurance Training on Physical Fitness and Athletic Performance in Youth : A Systematic Review and Meta-Analysis. *Frontiers in Physiology*, *9*. Consulté à l'adresse https://www.frontiersin.org/article/10.3389/fphys.2018.01057

García-Pinillos, F., Cámara-Pérez, J. C., Soto-Hermoso, V. M., & Latorre-Román, P. Á. (2017). A High Intensity Interval Training (HIIT)-Based Running Plan Improves Athletic Performance by Improving Muscle Power. *The Journal of Strength & Conditioning Research*, *31*(1), 146-153. doi: 10.1519/JSC.0000000000001473

Gharaezibaei, R. (2021). An Evaluation of the Effectiveness of Exercise Training-Based Cardiac Rehabilitation to Improve Aerobic Fitness.

Undergraduate Student Research Internships Conference. Consulté à l'adresse https://ir.lib.uwo.ca/usri/usri2021/researchoutputshowcase/206

Gorostiaga, E. M., Izquierdo, M., Iturralde, P., Ruesta, M., & Ibáñez, J. (1999). Effects of heavy resistance training on maximal and explosive force production, endurance and serum hormones in adolescent handball players. *European Journal of Applied Physiology and Occupational Physiology*, *80*(5), 485-493. doi: 10.1007/s004210050622

Gregory, H., G., & Travis, T., N. (2015). *Essentials of Strength Training and Conditioning 4th Edition*. Human Kinetics.

Haff, G. G., & Triplett, N. T. (2015). *Essentials of strength training and conditioning 4th edition*. Human kinetics.

Haff, G., & Triplett, N. (2015). Essentials of strength training and conditioning. *Research outputs 2014 to 2021*. Consulté à l'adresse https://ro.ecu.edu.au/ecuworkspost2013/1882

Hartono, F. A., Martin-Arrowsmith, P. W., Peeters, W. M., & Churchward-Venne, T. A. (2022). The Effects of Dietary Protein Supplementation on Acute Changes in Muscle Protein Synthesis and Longer-Term Changes in Muscle Mass, Strength, and Aerobic Capacity in Response to Concurrent Resistance and Endurance Exercise in Healthy Adults : A Systematic Review. *Sports Medicine*. doi: 10.1007/s40279-021-01620-9

Hedges, L. V., & Schauer, J. M. (2019). Statistical analyses for studying replication : Meta-analytic perspectives. *Psychological Methods*, *24*(5), 557.

Helgerud, J., Engen, L. C., Wisloff, U., & Hoff, J. A. N. (2001). Aerobic endurance training improves soccer performance. *Medicine and science in sports and exercise*, *33*(11), 1925-1931.

Hickson, R. C. (1980). Interference of strength development by simultaneously training for strength and endurance. *European Journal of Applied Physiology and Occupational Physiology*, *45*(2), 255-263. doi: 10.1007/BF00421333

Hill-Haas, S., Bishop, D., Dawson, B., Goodman, C., & Edge, J. (2007). Effects of rest interval during high-repetition resistance training on strength, aerobic fitness, and repeated-sprint ability. *Journal of Sports Sciences*, *25*(6), 619-628. doi: 10.1080/02640410600874849

Hoff, J., Wisløff, U., Engen, L. C., Kemi, O. J., & Helgerud, J. (2002). Soccer specific aerobic endurance training. *British Journal of Sports Medicine*, *36*(3), 218-221. doi: 10.1136/bjsm.36.3.218

Ignjatovic, A., Radovanovic, D., Stankovic, R., Marković, Z., & Kocic, J. (2011). Influence of resistance training on cardiorespiratory endurance and muscle power and strength in young athletes. *Acta Physiologica Hungarica*, *98*(3), 305-312. doi: 10.1556/aphysiol.98.2011.3.7

Impellizzeri, F. M., Rampinini, E., & Marcora, S. M. (2005). Physiological assessment of aerobic training in soccer. *Journal of sports sciences*, *23*(6), 583-592.

Izquierdo, M., Häkkinen, K., Gonzalez-Badillo, J. J., Ibáñez, J., & Gorostiaga, E. M. (2002). Effects of long-term training specificity on maximal strength and power of the upper and lower extremities in athletes from different sports. *European Journal of Applied Physiology*, *87*(3), 264-271. doi: 10.1007/s00421-002-0628-y

Jones, T. W., Eddens, L., Kupusarevic, J., Simoes, D. C. M., Furber, M. J. W., van Someren, K. A., & Howatson, G. (2021). Aerobic exercise intensity does not affect the anabolic signaling following resistance exercise in endurance athletes. *Scientific Reports*, *11*(1), 10785. doi: 10.1038/s41598-021-90274-8

Karahan, M. (2020). Effect of skill-based training vs. Small-sided games on physical performance improvement in young soccer players. *Biology of Sport*, *37*(3), 305.

Kendrick, I. P., Harris, R. C., Kim, H. J., Kim, C. K., Dang, V. H., Lam, T. Q., … Wise, J. A. (2008). The effects of 10 weeks of resistance training combined with β-alanine supplementation on whole body strength, force production, muscular endurance and body composition. *Amino Acids*, *34*(4), 547-554. doi: 10.1007/s00726-007-0008-3

Kraemer, W. J., & Ratamess, N. A. (2004). Fundamentals of resistance training : Progression and exercise prescription. *Medicine and Science in Sports and Exercise*, *36*(4), 674-688. doi: 10.1249/01.mss.0000121945.36635.61

Kraemer, W. J., Ratamess, N. A., & French, D. N. (2002). Resistance training for health and performance. *Current Sports Medicine Reports*, *1*(3), 165-171. doi: 10.1007/s11932-002-0017-7

Krzysztofik, M., Wilk, M., Wojdała, G., & Gołaś, A. (2019). Maximizing Muscle Hypertrophy : A Systematic Review of Advanced Resistance Training Techniques and Methods. *International Journal of Environmental Research and Public Health*, *16*(24), 4897. doi: 10.3390/ijerph16244897

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*(1), 30-36.

Lee, M. J.-C., Ballantyne, J. K., Chagolla, J., Hopkins, W. G., Fyfe, J. J., Phillips, S. M., … Bartlett, J. D. (2020). Order of same-day concurrent training influences some indices of power development, but not strength, lean mass, or aerobic fitness in healthy, moderately-active men after 9 weeks of training. *PLOS ONE*, *15*(5), e0233134. doi: 10.1371/journal.pone.0233134

Lievens, E., Klass, M., Bex, T., & Derave, W. (2020). Muscle fiber typology substantially influences time to recover from high-intensity exercise. *Journal of Applied Physiology*, *128*(3), 648-659.

Manouvrier, C., Cassirame, J., & Ahmaidi, S. (2016). Proposal for a Specific Aerobic Test for Football Players : The "Footeval". *Journal of Sports Science & Medicine*, *15*(4), 670-677.

McKay, B. R., Paterson, D. H., & Kowalchuk, J. M. (2009). Effect of short-term high-intensity interval training vs. Continuous training on O2 uptake kinetics, muscle deoxygenation, and exercise performance. *Journal of Applied Physiology (Bethesda, Md.*, *107*(1), 128-138. doi: 10.1152/japplphysiol.90828.2008

Messonnier, L. A., Oyono-Enguéllé, S., Vincent, L., Dubouchaud, H., Chatel, B., Sanchez, H., … Féasson, L. (2022). Lower Muscle and Blood Lactate Accumulation in Sickle Cell Trait Carriers in Response to Short High-Intensity Exercise. *Nutrients*, *14*(3), 501. doi: 10.3390/nu14030501

Methenitis, S. (2018). A Brief Review on Concurrent Training : From Laboratory to the Field. *Sports (Basel, Switzerland)*, *6*(4), E127. doi: 10.3390/sports6040127

Mikkola, J., Rusko, H., Izquierdo, M., Gorostiaga, E. M., & Häkkinen, K. (2012). Neuromuscular and Cardiovascular Adaptations During Concurrent Strength and Endurance Training in Untrained Men. *International Journal of Sports Medicine*, *33*(9), 702-710. doi: 10.1055/s-0031-1295475

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. doi: 10.2478/afepuc-2019-0004

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*(3), 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*(6), 288-295.

Mujika, I., Halson, S., Burke, L. M., Balagué, G., & Farrow, D. (2018). An integrated, multifactorial approach to periodization for optimal performance in individual and team sports. *International journal of sports physiology and performance*, *13*(5), 538-561.

Murlasits, Z., Kneffel, Z., & Thalib, L. (2018). The physiological effects of concurrent strength and endurance training sequence : A systematic review and meta-analysis. *Journal of sports sciences*, *36*(11), 1212-1219.

Parastesh, M., Saremi, A., Hashemi, Y., Ramezani, S., & Shavandi, N. (2022). The effect of concurrent endurance-resistance training on serum testosterone levels, body composition, muscular strength and international index of erectile function in older men. *Advances in Rehabilitation*, *36*(1).

Petré, H., Löfving, P., & Psilander, N. (2018). The Effect of Two Different Concurrent Training Programs on Strength and Power Gains in Highly-Trained Individuals. *Journal of Sports Science & Medicine*, *17*(2), 167-173.

Reggiani, C., & Schiaffino, S. (2020). Muscle hypertrophy and muscle strength : Dependent or independent variables? A provocative review. *European Journal of Translational Myology*, *30*(3), 9311. doi: 10.4081/ejtm.2020.9311

Robineau, J., Lacome, M., Piscione, J., Bigard, X., & Babault, N. (2017). Concurrent Training in Rugby Sevens : Effects of High-Intensity Interval Exercises. *International Journal of Sports Physiology and Performance*, *12*(3), 336-344. doi: 10.1123/ijspp.2015-0370

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*(2), 241-251. doi: 10.2478/afepuc-2020-0020

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*(10), 2730-2742.

Schumann, M., Yli-Peltola, K., Abbiss, C. R., & Häkkinen, K. (2015). Cardiorespiratory Adaptations during Concurrent Aerobic and Strength Training in Men and Women. *PLOS ONE*, *10*(9), e0139279. doi: 10.1371/journal.pone.0139279

Seo, D., Kim, E., Fahs, C. A., Rossow, L., Young, K., Ferguson, S. L., … So, W.-Y. (2012). Reliability of the One-Repetition Maximum Test Based on Muscle Group and Gender. *Journal of Sports Science & Medicine*, *11*(2), 221-225.

Skovgaard, C., Christiansen, D., Christensen, P. M., Almquist, N. W., Thomassen, M., & Bangsbo, J. (2018). Effect of speed endurance training and reduced training volume on running economy and single muscle fiber adaptations in trained runners. *Physiological reports*, *6*(3), e13601.

Sousa, A. C., Neiva, H. P., Izquierdo, M., Alves, A. R., Duarte-Mendes, P., Ramalho, A. G., … Marinho, D. A. (2020). Concurrent Training Intensities : A Practical Approach for Program Design. *Strength & Conditioning Journal*, *42*(2), 38-44. doi: 10.1519/SSC.0000000000000520

Stojanovic, M. D., Ostojic, S. M., Calleja-González, J., Milosevic, Z., & Mikic, M. (2012). Correlation between explosive strength, aerobic power and repeated sprint ability in elite basketball players. *Journal of Sports Medicine and Physical Fitness*, *52*(4), 375.

Stricker, P. R., Faigenbaum, A. D., McCambridge, T. M., Fitness, C. on S. M. A., LaBella, C. R., Brooks, M. A., … Peterson, A. R. (2020). Resistance Training for Children and Adolescents. *Pediatrics*, *145*(6). doi: 10.1542/peds.2020-1011

Tillin, N. A., & Folland, J. P. (2014). Maximal and explosive strength training elicit distinct neuromuscular adaptations, specific to the training stimulus. *European Journal of Applied Physiology*, *114*(2), 365-374. doi: 10.1007/s00421-013-2781-x

Tumilty, D. (1993). Physiological characteristics of elite soccer players. *Sports medicine*, *16*(2), 80-96.

Way, K. L., Sultana, R. N., Sabag, A., Baker, M. K., & Johnson, N. A. (2019). The effect of high Intensity interval training versus moderate intensity continuous training on arterial stiffness and 24 h blood pressure responses : A systematic review and meta-analysis. *Journal of Science and Medicine in Sport*, *22*(4), 385-391.

Wen, D., Utesch, T., Wu, J., Robertson, S., Liu, J., Hu, G., & Chen, H. (2019). Effects of different protocols of high intensity interval training for VO2max improvements in adults : A meta-analysis of randomised controlled trials. *Journal of Science and Medicine in Sport*, *22*(8), 941-947.

Winter, E. M., Abt, G., Brookes, F. B. C., Challis, J. H., Fowler, N. E., Knudson, D. V., … Yeadon, M. R. (2016). Misuse of "Power" and Other Mechanical Terms in Sport and Exercise Science Research. *The Journal of Strength & Conditioning Research*, *30*(1), 292. doi: 10.1519/JSC.0000000000001101

Yassin Zenati, Belkadi, Adel, & Benbernou, Othman. (2021). Functional Movement Screening as a Predictor of Injury in Highly Trained Female's Martial Arts Athletes. *Polish Hyperbaric Research*, *71*(2), 67-74. doi: 10.2478/phr-2020-0012

Ziemann, E., Grzywacz, T., Luszczyk, M., Laskowski, R., Olek, R. A., & Gibson, A. L. (2011). Aerobic and Anaerobic Changes with High-Intensity Interval Training in Active College-Aged Men. *The Journal of Strength & Conditioning Research*, *25*(4), 1104-1112. doi: 10.1519/JSC.0b013e3181d09ec9

Primljen: 10. april 2022. / Received: April 10, 2022
Prihvaćen: 09. jun 2022. / Accepted: Juny 09, 2022

https://doi.org/10.7251/SSH2201023S
UDC: 796.42.012.1/.2:[371.3::796
Original scientific paper
Originalni naučni rad

Level of Students 'Functional Abilities as a Parameter for Determining Differences in Triglyceride, Cholesterol, Blood Sugar and Body Composition in Students

Nijaz Skender[1], Serra Ayse Cakar Saka[2], Natalija Kurtović[1], Ernest Šabić[1]
[1]Faculty of Pedagogy, University of Bihać, Bosnia and Herzegovina
[2]Istanbul Technical University, Department of Physical Education and Sports, Turkey

Correspondence:
Nijaz Skender, Faculty of Pedagogy, University of Bihać, Bosnia and Herzegovina
nijazs@yahoo.com

Abstract: *The aim of the study was to determine the differences in the level of fat, sugar and body structure based on the level of functional abilities. The sample of respondents are students of the University of Bihać who also completed the shuttle run test (BEEPT). T-test for independent samples revealed the existence of statistically significant differences between the arithmetic means of the two groups of subjects for (AMAS, p = 0 .011), (BMI p = 0 .000), (FAT%, p = 0.000), (FMKG p) = 0.000). A statistically significant difference was also found in the variable triglycerides (TRIGL p = 0.019), while in the other variables no statistically significant difference was found in the two groups of subjects in favor of subjects who had better results in functional abilities. The coefficient of discriminant canonical correlation is (0.512), as is Wilks lambda, (0.738), which indicates very high discrimination between groups (sig. 000). The greatest contribution to the formation of the discriminatory function was given by the variables FMKG - .801, FATPR -.760, BMI - .707, AMAS - .390, TRIGL - .358, HOLE - .235. The centroids of the groups show a large distance between the results of the groups because they are located at both ends of the coordinate system. The first group consists of positive results of a total of 7 variables, which means that the respondents of the first group had significantly better results in these variables.*
Based on the results, it can be concluded that the increase in cholesterol triglycerides and some parameters of body structure affected the level of health status as well as body composition in students.

Keywords: *functional abilities, triglycerides, body structure.*

Introduction

An active lifestyle has become a key factor in reducing obesity and / or coronary problems associated with human behavior, such as those caused by a lack of exercise or movement. Regular physical activities in students have been shown to have positive effect on improving strength and endurance, which helps in building healthy bones and muscles, control weight, reduces stress and anxiety, and increases self-esteem and may improve blood pressure, cholesterol levels (Physical Activity Guidelines Advisory Committee report, 2008) and favorable cardiovascular risk profiles as well (Andersen, et al., 2006). The prevalence of overweight and obesity has increased significantly in all societies around the world over the past three decades, and all indications are that this trend is likely to continue with far-reaching negative public health effects (Finkelstein EA, at.al. 2012). The risk of type 2 diabetes, cardiovascular disease, certain types of cancer and mortality, and from them and in general, is directly proportional to the degree of obesity (Lu, Y., et al. 2014, McGee, DL. 2005). Health is a state of complete physical, mental, and social well-being and not merely the absence of disease (World Health Organization, 1946). Obesity creates a substantial risk of developing hypertension, Type 2 diabetes, dyslipidemia, and heart disease (Sachdev et al.,2005)

The level of functional abilities, ie the size of energy capacities as well as the level of their use significantly differs from individual persons. Knowledge of these characteristics are important prerequisites for the implementation of those forms of physical activity that will allow to increase and optimal use of the functional capabilities of the organism. Of the energy supply, the biggest problem is the supply of oxygen, because it is related to the activity of the respiratory system, as well as the activity of the cardiovascular system. (Skender, N., 2008). The level of functional abilities is directly related to the performance of aerobic work and is related to the level of physical activity of a person.

The role of energy systems is the conversion of chemical energy into a usable form (adenosine triphosphate, ATP) for all cellular functions. ATP is present in cells in very small amounts. About 5 micromoles of ATP per gram are stored in skeletal muscle, while the amount of creatine phosphate (CP), another phosphate compound rich in energy, is 20-30 μmol per gram of muscle. Degradation and production of ATP in muscles and other cells in the body is an extremely dynamic process. A 70 kg man (sedentary lifestyle) has only about 80 grams of ATP stored in his body. (Vučetić, 2009). In order to satisfy the need for energy, it is necessary to create a sufficient amount of ATP.

In order to restore ATP and thus keep its concentration in the muscle cell constant, energy from chemical sources that release energy without the presence of oxygen is used, and these are the so-called anoxidative or anaerobic energy processes, and from chemical sources that require the presence of oxygen and these are the so-called. oxidative or aerobic energy processes (Guyton and Hall, 2003).

A sedentary lifestyle is a risk factor for a range of chronic heart disease and obesity, and the importance of regular physical exercise for the student population is very important. Adequate levels of physical exercise during the week along with proper eating habits improves weight reduction and maintains within optimal limits. Physical exercise must be in accordance with the needs and goals and based on the initial diagnostic condition of the person performing it. The intensity and extent of exercise must be individual without risk to the health of the individual, but to provide an increase in the level of motor skills.

The results of many studies show the positive effects produced by physical programs activities or exercise on blood pressure values in normotensive or hypertensive individuals, lipidogram (mainly on the level of total cholesterol, HDL cholesterol and triglycerides), regulation of body weight and especially the composition of the body (its non-fat component and segments of the fatty component, especially the visceralbody fat) in overweight and obese individuals (Mišigoj – Duraković, M., at al. 2012).

The aim of this study is to analyze differences in body structure, triglyceride levels, cholesterol and blood sugar based on functional ability parameters tested through a beep test

Materials And Methods

This research was done within a project funded by the Ministry of Education and Science of the Federation of BiH. The aim of this project is to determine the level of physical activity of students at the University of Bihać and the relationship with the morphological characteristics, body composition, functional abilities and health status of students The survey was carried out among student population in 2021 (Skender, N. at al. 2021).

Sample of respondents

The sample of respondents are students of the University of Bihać, a total of 125 male and female students aged 21.5, ± 2.15 years. Students are divided into two groups. The group also consisted of students with better results in functional abilities and the other group consisted of students with poorer results in functional abilities.

Functional ability measures

We used the Beep test (BEEPT) to measure functional abilities. The sample of variables consisted of functional abilities by which we assessed the level of aerobic capacity through Beep test. The test is performed in such a way as to measure a distance of 20 meters, a metronome is determined to measure the speed of each section. After each level run, the speed of the examinees increases. Respondents run to the extreme. When they stop, the number of levels and the number of sections run within the levels are recorded. After that, the level of oxygen consumption is read on the tables. Complete test protocol was taken from the site (Ramsbottom, R., Brewer, J., and Williams, C. 1988, Copyright© Loughborough University 2002).

Health status measurement

Health status of students was measured through: SUK - Blood sugar, HOL - Cholesterol, TRIGL – Triglycerides. The results of the health condition were measured by blood analysis in the certified medical laboratory "Alfa" in Bihać. Laboratory analysis was done in the morning before consuming any nutrition.

Body composition measures

BIA was measured using a TANITA body composition parameter analyser (the model of TANITA body composition analyser BF-350) in relation to the body composition and age of the subjects. This body composition assessment set includes the following variables: AMAS - WEIGHT - body weight, FAT% - Percentage of total body fat, FFM - fat free mass. The mass of fat released consisted of muscle, bone, tissue, water and other masses of fat released in the body, TBW - total body water. The total mass of water in the body is the amount of water expressed in lb, kg, or st.lb. BMI Body mass index - body mass index (estimate of body weight) is the ratio of height to weight. BMRKCAL: Basal metabolic rate - the basic metabolic rate represents the total energy released from the body to maintain normal body function in the resting phase such as respiration and circulation (1kcal = 4.184 kJ), FMKG - FAT MASS - total weight of fat mass per kilogram of body weight (in kg, lb).

Statistical analysis

All results were processed by statistical mathematical procedures, Descriptive Indicators, T-test and Discriminant Analysis, using IBM SPSS Statistics software, 20. Manifest variables applied in this study were processed by standard descriptive procedures in order to determine the normality of the distribution, which was tested by the Kolomogorov - Smirnov procedure. For the obtained results, the following parameters were calculated: Arithmetic mean - Mean, Standard error - Error, Standard deviation - St. dev., Variance, Minimum value - Min, Maximum value - Max, Range, Rank, Coefficient of curvature - SKEWNESS, Coefficient of elongation - KURTOSIS.

Results

Table 1 shows the results of the central dispersive parameters of measuring instruments for all variables covered by this study. The values of minimum and maximum result, arithmetic mean, standard deviation, variance, skewness and kurtosis are shown. A good look at the table shows a good balance of descriptive statistics results. The results are within the normality of the distribution of the applied manifest variables. Analyzing standard deviation and variance it is seen that significant variability between variables.

Based on kurtosis and skewness, we can assess the balance of results, which shows the mesocourt distribution of these results. This was quite to be expected because the sample was taken from the natural population by the method of random sampling, and the number of 125 respondents is quite sufficient for normal distribution when it comes to applied variables that we treated in the paper.

The central dispersive parameters have been analyzed in Table No. 2, where the central dispersive parameters were performed for both groups of respondents. The first group consisted of 59 subjects who had better results in the Beep test of functional abilities and the second group consisted of subjects with poorer results in the beep test. Based on the results of central dispersive parameters, it can be seen the existence of a certain difference in some variables such as body weight, triglycerides, body mass index, percentage of fat mass, and fat mass per kg of body weight.

Table 1. *Descriptive parameters for all respondents, Descriptive Statistics for all samples*

	N	Min	Max	Mean		Std. Dev	Var	Skewn		Kurt	
	Stat.	Stat.	Stat.	Stat	Std. Er	Stat	Stat	Stat	Std. Er	Stat	Std. Er
AMAS	125	42.70	101.30	66.1968	1.220	13.648	186.26	.536	.217	-.407	.430
BMI	125	16.10	34.60	23.5808	.35531	3.97246	15.780	.458	.217	-.271	.430
FAT%	125	5.60	43.60	25.1328	.76318	8.53266	72.806	.036	.217	-.524	.430
FMKG	125	1.30	42.50	17.3408	.75504	8.44157	71.260	.738	.217	.346	.430
FFMKG	125	25.80	73.70	49.1468	.87758	9.81162	96.268	1.081	.217	.520	.430
TBW	125	27.50	54.00	36.1024	.62838	7.02549	49.357	1.220	.217	.472	.430
BMRKCAL	125	1244.00	2249.00	1561.86	19.96	223.23	49835.32	1.068	.217	.414	.430
BEEPT	125	1.80	12.10	4.9224	.21571	2.41169	5.816	1.352	.217	1.114	.430
SUK	125	3.60	6.90	4.9096	.04723	.52799	.279	.783	.217	2.393	.430
HOL	125	2.00	7.80	4.4184	.07970	.89112	.794	.835	.217	1.602	.430
TRIGL	125	.80	5.08	1.4515	.04816	.53844	.290	2.975	.217	15.755	.430

Table 2. *Central tendency measurments for two groups of respondents*

Group Statistics					
	GR	N	Mean	Std. Dev	Std. Er. Me.
AMAS	1	59	62.9373	12.95286	1.68632
	2	66	69.1106	13.68838	1.68492
BMI	1	59	21.9559	3.17502	.41335
	2	66	25.0333	4.07066	.50106
FAT%	1	59	21.4220	7.46560	.97194
	2	66	28.4500	8.09241	.99611
FMKG	1	59	13.5068	6.14379	.79985
	2	66	20.7682	8.77444	1.08006
FFMKG	1	59	49.4466	10.39937	1.35388
	2	66	48.8788	9.32709	1.14809
TBW	1	59	36.2000	7.61013	.99076
	2	66	36.0152	6.51654	.80213
BMRKCAL	1	59	1553.72	237.649	30.939
	2	66	1569.13	211.095	25.984
SUK	1	59	4.9186	.46367	.06036
	2	66	4.9015	.58296	.07176
HOL	1	59	4.2881	.77462	.10085
	2	66	4.5348	.97484	.11999
TRIGL	1	59	1.3331	.33529	.04365
	2	66	1.5574	.65471	.08059

Analysis of differences in arithmetic means of two groups of T-test subjects

Determining the differences between the two groups of respondents was performed on the basis of the T-test for independent samples (Table 3). T-test analysis for independent samples revealed the existence of statistically significant differences for four body composition tests and a health test. T-test showed that there are statistically significant differences for the following body composition tests (AMAS t = -2.582, p = 0 .011), (BMI t = 4.673, p = 0 .000) t, (FAT%, t = - 5.027, p = 0.000), (FMKG t = -5.300, p = 0.000). For other variables of body structure, no statistically significant difference was found between the arithmetic means of the two groups of subjects. A statistically significant difference was also found in the variable representing the health status of triglycerides (TRIGL t = -2.369, p = 0.019), while no statistically significant difference was found in the other variables in the two groups of subjects.

Table 3. *T-test for Independent Samples Test*

	Levene's Test for Equ of Var.		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tai)	Mean Difference	Std. Error Difference	95% Confidence Inter. of the Difference	
								Lower	Upper
AMAS	.477	.491	-2.582	123	.011	-6.17332	2.39126	-10.90668	-1.43996
			-2.590	122.590	.011	-6.17332	2.38383	-10.89212	-1.45452
BMI	5.344	.022	-4.673	123	.000	-3.07740	.65855	-4.38096	-1.77385
			-4.738	120.850	.000	-3.07740	.64956	-4.36339	-1.79141
FAT%	.867	.354	-5.027	123	.000	-7.02797	1.39806	-9.79534	-4.26060
			-5.050	122.871	.000	-7.02797	1.39172	-9.78283	-4.27311
FMKG	7.568	.007	-5.300	123	.000	-7.26140	1.37019	-9.97360	-4.54920
			-5.403	116.558	.000	-7.26140	1.34398	-9.92320	-4.59961
FFMKG	2.987	.086	.322	123	.748	.56782	1.76430	-2.92451	4.06015
			.320	117.289	.750	.56782	1.77513	-2.94765	4.08329

TBW	3.848	.052	.146	123	.884	.18485	1.26373	-2.31663	2.68632
			.145	114.903	.885	.18485	1.27476	-2.34023	2.70992
BMRKCAL	.958	.330	-.384	123	.702	-15.40755	40.13506	-94.85245	64.03735
			-.381	116.816	.704	-15.40755	40.40319	-95.42527	64.61017
SUK	.439	.509	.180	123	.857	.01713	.09497	-.17086	.20512
			.183	121.409	.855	.01713	.09377	-.16851	.20277
HOL	3.575	.061	-1.554	123	.123	-.24671	.15876	-.56096	.06753
			-1.574	121.384	.118	-.24671	.15674	-.55702	.06359
TRIGL	12.655	.001	-2.369	123	.019	-.22437	.09473	-.41188	-.03687
			-2.448	99.169	.016	-.22437	.09165	-.40623	-.04252

Discriminative analysis

To determine global differences through discriminative analysis, the following values were calculated; discrimination coefficient, canonical correlation coefficient, percentage of explained group variability, Bartlett's value CHI square test, CHI square degrees of freedom, Wilks lambda value, and probability error hypothesis rejection the value of the canonical correlation is equal to 0. The criterion for the discriminant strength of the applied variables was the so-called Wilks lambda. Significant discriminant variables were used in the interpretation of the results and they explain a certain percentage of variability. (Skender, 2004).

Based on Table 4, we can determine that one statistically significant discriminant function was isolated. We estimate this on the basis of the coefficient of discriminant canonical correlation, which is .512, indicating a very high discrimination between groups, which is statistically significant at the level of $p < .01$, (sig..000). Based on these results, we determine the affiliation of each entity to one of the analyzed groups.

Wilks lambda was used as a criterion for the discriminative strength of the applied system of variables, which is also very high with .738, which also indicates high discrimination between the two groups of respondents.

Analyzing the matrix of the structure of table number 5, which shows the correlations of individual manifest variables with the discriminant function, ie explain the relative contribution of each variable in the formation of the discriminant function. The greatest contribution to the formation of the discriminatory function was given by the variables FMKG - .801, FAT% -.760, BMI - .707, AMAS - .390, TRIGL - .358, HOL - .235.

Table 6 presents the centroids of two groups of subjects, namely the 1st group of subjects with better results in functional abilities and the 2nd group of subjects with poorer results in functional abilities. We can conclude that the two groups are very distant from each other because they are located at two ends of the coordinate system. The first group consists of positive results of a total of 7 variables, which means that the respondents of the first group had significantly better results in these variables. On the negative pole are the respondents of the second group who have a very small and negative projection in the variables FFMKG -.049, SUK -.027, TBWKG -.022.

Table 4. *Discriminant Canonical analysis*

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.356a	100.0	100.0	.512
Test of Function	**Wilks' Lambda**	**Chi-square**	**df**	**Sig.**
1	.738	35.598	12	.000

Table 5. *Structure Matrix*

	Funct.
	1
FMKG	.801
FAT%	.760
BMI	.707
AMAS	.390
TRIGL	.358
HOL	.235
BMRKCAL	.058
FFMKG	-.049
SUK	-.027
TBWKG	-.022

Table 6. *Centroids at Groups*

Grupa	Funct.
	1
1.00	-.626
2.00	.559

Discussion and Conclusion

This study aimed to determine the level of differences in body structure and some health status parameters such as triglycerides, cholesterol and blood sugar in two groups of University student respondents. The groups were formed on the basis of better and worse results in performing the beep test which is a classic test of functional abilities that assesses aerobic abilities in students. Based on that, we assessed the level of their physical activities as it is the functional abilities that develop through physical activity. The universities are an ideal environment for the promotion of physical activity and significance for the health condition of the student. The results of the t-test showed a significant difference between the two groups of the subjects. Subjects of the better group (59) of subjects had a lower weight of approximately 6.5 kg. , better BMI by 4 index points, better results with the percentage of fat mass and fat mass per kg of body weight. Skender et al. (2021) also found a high level of association of BMI with the level of functional abilities BEEP test. All this indicates that body composition highly influences the level of functional abilities, which was shown here through four variables with very high statistical significance. Observational studies provide compelling evidence that regular physical activity and a high fitness level are associated with a reduced risk of premature death from any cause and from cardiovascular disease in particular among asymptomatic men and women (Darren E.R. Warburton 2006).

The fact that doing regular physical activities affect the health status and longevity in a positive way is a clear phenomenon, which lowers the death risk between %20-35 as taking part in regular exercises. Moreover, provided that the person is phsically active, the death risk especially by cardiovascular diseases diminishes dramatically by almost half. In a study which were carried about with former football players aged between 40-50, participants were divided into two groups as active (n=30); who scored above 3000 metabolic equivalent of task (MET) and sedentary group (n=30); who scored below 3000 MET-minutes/week. Several blood tests such as complete blood count, serum lipids and thyroid functions which include hemoglobin (Hb), hematocrit (Hct), red blood cell count (RBC) and white blood cell count (WBC), triglyceride (Tg), low-density, lipoprotein cholesterol (LDLc), high-density lipoprotein cholesterol (HDLc) and total cholesterol (Tc) were examined. Also, Bioelectric Impedance Measurements (BIA) were applied to the participants. Among the participants, there were no significant differences in dietary habits, alcohol consumption and smoking levels. However, those who are in active group that have more active lifestyle had significantly higher body weight, body mass index and body fat levels when compared to the physically active group ($p < 0.001$). Both two groups were considered as overweight according to the BMI mean values. According to the result of this study, there were no statistically significant differences in blood parameters between groups and the blood counts and thyroid functions were found within the normal reference ranges. However, Tg, Tc and LDL levels of sedentary group (SG) were higher than active group (AG). While Triglyceride value were 153.18 ± 91.81(mg/dL) in AG, it was 191.54 ± 126.14 (mg/dL) in SG.($p < 0.162$). Also, total cholesterol level in AG was 205.63 ± 38.15(mg/dL), while it was 223.03 ± 35.71(mg/dL) in SG ($p < 0.073$). Low-density, lipoprotein cholesterol (LDLc) level was 118.11 ± 28.23 (mg/dL) in AG, and 130.91 ± 30.41(mg/dL) in SG ($p < 0.046$). According to the results of this study, sedentary former football players had higher levels of cardiovascular risks with higher body weight, LDLc, BF% and BMI values (Melekoglu, T. at al. 2019) . The fact that body composition, serum lipids concentration and body fat levels are significant indicators of coronory heart disease, type 2 diabetes and metabolic abnormalities is an obvious phenomenon. Moreover, high body mass index, low-density lipoprotein cholesterol and body fat levels are related to higher metabolic risks. Most importantly, obesity and owerweight is one of the primary risk factors of mortality. Furthermore, adiposity can give rise to cancers such as colon, breast, kidney and endometrium (Goh G H, L. At al. 2014).

In a study conducted (Kelley GA, Kelley KS. 2006), which included the effects of aerobic exercise in adult men for at least 2 months, indicated significant reductions in total serum cholesterol (2%) and triglycerides (9%), increased HDL levels cholesterol (3%) and the trend of lowering LDL-cholesterol levels

It is known that elite athletes live longer and healthier than sedentary individuals according to the literature studies. High-intensity and mid-intensity training have beneficial effects on health and daily life. In this sense, cardiovascular system is improved with regular training and its effects are seen in body with wider heart and muscle structures. Moreover, doing regular exercise slows down the biological aging process such as body composition and cardiorespiratory functions. In contrast, in sedentary individuals, there is a risk of cardiovascular diseases as serum lipids are negatively affected by gain weight. Active life provides a healthier body composition, blood values and less risks of cardiovascular diseases (Green DJ. at al. 2012).

The level of functional abilities that can be significantly increased by increasing physical activity, especially in the student population dominated by a sedentary lifestyle, due to obligations at their faculties is very important and should work to improve conditions for more active sports, more physical activity and better organization of physical exercise in colleges.

Of the variables representing the health condition of the variable (TRIGL), triglyceride levels made the greatest discrimination in relation to discriminant canonical function. In addition, the variable cholesterol also has a strong association with discriminant canonical function. In our study, we confirmed that insufficient physical activity in students affects the increase in triglycerides and cholesterol. This clearly shows that the decrease in aerobic capacity caused by lower levels of movement in students can significantly affect the increase in blood triglycerides in the student population. These results can serve to better promote physical activity and guide the student population to align their obligations with the required physical activity. (Žanetić, M. et al. 2021). Given that the research was conducted during the pandemic, it probably affected the level of movement in students and had a negative effect on physical activity and negatively reflected on the level of increased triglyceride levels in students, which was confirmed in their study (Sabic, E., Skender, N., et al., 2021).

There is ample evidence to conclude that a level of physical activity of 150 to 250 minutes per week, in the absence of intervention to reduce caloric intake, produces modest weight loss. (Donnelly JE, Blair SN, Jakicic JM at al. 2009., Slentz CA, Duscha BD, Johnson JL at al. 2004).

This study showed that insufficient physical activity measured through functional abilities has a negative effect on body structure and triglycerides, which significantly affects the deterioration of health in students.

The conclusion derived from this research is that the results we obtained must be used to increase the level of physical activity in leisure time in order to reduce the effects of a sedentary lifestyle that are reflected in the health of students.

Acknowledgment
This research is funded by the Ministry of Education and Science of the Federation of Bosnia and Herzegovina

References

Andersen, L. B., Harro, M., Sardinha, L. B., Froberg, K., Ekelund, U., Brage, S. and Anderssen, S. A. (2006). Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study). *The Lancet*, 368 (9532), pp. 299—304

Copyright © Loughborough University and sports coach UK, 2002. BEEP test.

Čule, M., Milinović, I., Davor Pavlović, D. (2021). Differences in Body Composition and Cardiovascular Cystem parameters in University students according to self rated health status. 9th International Scientific Conference on Kinesiology, 2021, str. 223- 226) Opatija, Croatia.

Darren E.R. Warburton, Crystal Whitney Nicol and Shannon S.D. Bredin (2006). Health benefits of physical activity: the evidence. *Canadian Medical Assosiation Journal*. (CMAJ) 174 (6) 801-809;

Donnelly JE, Blair SN, Jakicic JM at al. (2009). American College of Sports Medicine position stand. Appropriate physical activity interven tion strategies for weight loss and prevention of weight regain for adults. *Med Sci Sports Exer*, 41:459–71.

Finkelstein EA, Khavjou OA, Thompson H., Justin G Trogdon., Liping Pan., Bettylou Sherry., William Dietz. (2012).Obesity and severe obesity forecasts through 2030. *Am J Prev Med*; 42:563–70.

Goh LGH., Dhaliwal SS., Welborn TA., Lee AH., Della PR. (2014) Anthropometric measurements of general and central obesity and the prediction of cardiovascular disease risk in women: a cross-sectional study. *BMJ Open* 1;4:04138.

Green DJ.; Spence A.; Rowley N.; Thijssen DHJ.; Naylor, LH. (2012).Vascular Adaptation in Athletes: Is There an 'Athlete's Artery'? *J. Exp. Physiol*. 97: 295–304.

Guyton, A.C., Hall, J.E. (2003). Medicinska fiziologija. Zagreb: Medicinska naklada.

Kelley GA, Kelley KS. (2006). Aerobic exercise and lipids and lipoproteins in men: a meta-analysis of randomized controlled trials. J Mens Health Gend;3:61-70.

Lu, Y., Hajifathalian, K., Ezzati, M., Woodward, M., Rimm, E., Danaei. G. (2014). Metabolic mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease and stroke: a pooled analysis of 97 prospective cohorts with 1.8 million participants. Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration (BMI Mediated Effects). ;383:970–83.

McGee DL; Diverse Populations Collaboration. (2005). Body mass index and mortality: a meta-analysis based on person-level data from twenty observational studies. *Ann Epidemiol*;15:87–97.

Melekoglu T.,Sezgin E., Işın A., Türk A.(2019). The Effects of a Physically Active Lifestyle on the Health of Former Professional Football Players. *Sports* ;7:75.

Mišigoj-Duraković, M., Sorić, M., Duraković, Z. (2012). Mišigoj-Duraković M, et al. Physical Activity and Cardiovascular Diseases, *Arh Hig Rada Toksikol* ;63(Supplement 3):13-22.

Physical Activity Guidelines Advisory Committee report. 2008. [report] Washington, DC: U.S. *Department of Health and Human*

Ramsbottom, R., Brewer, J., Williams, C. (1998). A progrerssive shuttle run test to wstimate maximal oxygen upatake. *Br. J. Sports Med*. 22; 141-144.

Sachdev, H. S., Fall, C. H., Osmond, C., Lakshmy, R., Dey Biswas, S. K., Leary, S. D., Reddy, K. S., Barker, D. J., & Bhargava, S. K. (2005). Anthropometric indicators of body composition in young adults: relation to size at birth and serial measurements of body mass index in childhood in the New Delhi birth cohort. *The American journal of clinical nutrition*, 82(2), 456–466.

Skender N., Ćeleš N., Kurtović N., Čolakhodzić E., Šabić E. (2021). Relationship Between Functional Abilities and Morphological Characteristics, Bmi, and Some Health Condition Parameters of Student Population at University Of Bihać. *19th International Sport Sciences Congress 11– 14 November*, 2021. Belek, Antalya: Turkey.

Skender, N., (2008). Transformacioni procesi antropoloških obilježja. Bihać, Pedagoški fakultet.

Slentz CA, Duscha BD, Johnson JL at al. (2004). Effects of the amount of exercise on body weight, body composition, and measure of cen tral obesity: STRRIDE – a randomized controlled study. *Arch In tern Med*;164:31–9.

Šabić, E., Skender, N., Kurtović, N., Nešić. B.M. (2021). Perception Of Physical Exercise During The Covid-19 Pandemic Period. *IOSR Journal of Sports and Physical Education* 8(4):45-52

Tabaković, M., Turković, S., Skender, N. (2005). Diskriminativna analiza nekih bazičnih motoričkih sposobnosti učenika sportske gimnazije i učenika mješovite srednje škole 2005. U Zbornik radova NTS Nove tehn ologije u sportu. Fakultet sporta i tjelesnog odgoja Sarajevo, Sarajevo.

Vučetić, V. (2009). Dijagnostički postupci za procjenu energetskih kapaciteta sportaša. *U Jukić, I., Milanović, D., Šalaj, S. & Gregov, C.(ur.). Zbornik radova*, *7*, 20-31.

Warburton, D.E.R.; Nicol, C.W.; Bredin, S.S.D. Health benefits of physical activity: The evidence. *CMAJ* 2006, 174, 801–809

WHO (World Health Organization). 1946. Preamble to the Constitution of the World Health Organization as adopted by the International Health Conference, New York, June 19–July 22, 1946; signed on July 22, 1946, by the representatives of 61 States (Off. Rec. World Health Organ., no. 2, p. 100). Geneva: WHO.

Žanetić, M., M., Trošt - Bobić, M., Mišigoj-Duraković, M. (2021). Specific changes in physical activity among Adolescents during a four-year period. *Preecidings 9th International Scientific Conference on Kinesiology*, Opatija, Croatia. 282-285

Primljen: 14. mart 2022. / Received: March 14, 2022
Prihvaćen: 10. april 2022. / Accepted: April 10, 2022

https://doi.org/10.7251/SSH2201031S
Original scientific paper

UDC: 613.25-053.4/.5:616-008.9
Originalni naučni rad

The Relationship of Cardiorespiratory Fitness, Birth Weight and Parental BMI on Children' Obesity Status

Odnos između kardiorespiratorne kondicije, težine rođenja deteta i roditeljskog BMI[1], na status gojaznosti u detinjstvu

Zorica Stankovska[1], Serjoža Gontarev[2], Žarko Kostovski[2], Aleksandar Janković[3]

[1]Ss. Cyril and Methodius University Skopje, St. Kliment Ohridski Faculty of Pedagogy, North Macedonia
[2]Ss. Cyril and Methodius University Skopje, Faculty of Physical Education, Sport and Health, North Macedonia
[3]University Novi Sad, Faculty of Pedagogy, Sombor, Serbia

Correspondence:
Žarko Kostovski
Ss. Cyril and Methodius University Skopje, St. Kliment Ohridski Faculty of Pedagogy, North Macedonia
zarkok@ukim.edu.mk

[1]Univerzitet Sv. Kiril i Motodij Skopje, Peadgoški fakultet Sv. Kliment Ohridski
[2]Univerzitet Sv. Kiril i Motodij Skopje, Fakultet fizičkog obrazovanja, sporta i zdravlja
[3]Pedagoški fakultet Sombor, Univerzitet Novi Sad

Korespondencija:
Žarko Kostovski
Univerzitet Sv. Kiril i Motodij Skopje, Peadgoški fakultet Sv. Kliment Ohridski
zarkok@ukim.edu.mk

Abstract: *The aim of the study was to determine the differences in cardiorespiratory fitness, parents' body mass index, birth weight between a group of children with normal and overweight / obesity and to determine how much the studied variables affect the risk of their biological offspring being overweight. The research was conducted on a sample of 1096 respondents, aged 6 to 10 years, randomly drawn from several primary schools in the Skopje region. The sample is divided into two sub-samples according to gender, 496 male respondents and 600 female respondents. Cardiorespiratory fitness was assessed with the 20m shuttle run test according to the procedures described in FITNESSGRAM. The children were classified into two groups, based on the percentages of the body mass index, according to the IOTF standard. The birth weight of the children was assessed from the pediatric records of each child at birth. The condition of overweight / obese parents was defined according to the classification of the World Health Organization. Data on the education of parents (especially mothers and fathers) were collected through a questionnaire.. The prevalence of overweight and obesity in this study was 22.6% and 14.9%, for the entire sample of respondents without statistically significant gender differences. The results of the research indicate the connection between obesity of parents and their children. Furthermore, the results suggest that low cardiorespiratory fitness and high birth weight are predictors of OV / OB in childhood.*

Keywords: *children; obesity status; cardiorespiratory fitness; birth weight; parental BMI*

Sažetak: *Cilj istraživanja bio je da se utvrde razlike u kardiorespiratornoj kondiciji, indeksu telesne mase roditelja i rođenoj težini, između grupe dece sa normalnom i prekomernom telesnom težinom/gojaznošću i da se utvrdi koliko proučavane varijable utiču na rizik od prekomerne težine njihovog biološkog potomstva. Istraživanje je sprovedeno na uzorku od 1096 ispitanika, uzrasta od 6 do 11 godina, izabranih po slučajnom izboru iz nekoliko osnovnih škola u regionu Skoplja. Uzorak je podeljen u dva poduzorka prema polu, 496 ispitanika muškog pola i 600 ispitanica. Kardiorespiratorna kondicija je procenjena testom trčanja na 20 metara u skladu sa procedurama opisanim u FITNESSGRAM-u. Deca su klasifikovana u dve grupe, na osnovu procenta indeksa telesne mase, prema IOTF standardu. Rođena težina dece je procenjena iz pedijatrijske dokumentacije svakog deteta pri rođenju. Stanje težina/gojaznih roditelja definisano je prema klasifikaciji Svetske zdravstvene organizacije. Podaci o obrazovanju roditelja (posebno majke i oca) prikupljeni su anketnim upitnikom. Prevalencija prekomerne težine i gojaznosti u ovoj studiji iznosila je 22,6% i 14,9%, za ceo uzorak ispitanika bez statistički značajnih polnih razlika. Rezultati istraživanja ukazuju na vezu između gojaznosti roditelja i njihove dece. Štaviše, rezultati sugerišu da su niska kardiorespiratorna sposobnost i visoka porođajna težina prediktori OV/OB (prekomerne težine/gojaznosti) u detinjstvu.*

Ključne reči: *deca, gojaznost, kardiorespiratorni fitness, težina na rođenju, roditeljski BMI*

[1] Body mass index

Introduction

Obesity in children has developed since early childhood. The prevalence of childhood obesity has increased significantly in recent decades around the world. The origins of obesity are complex and are influenced by genetic and environmental factors. Obesity and adolescence in childhood persist into adulthood (Simmonds, M., et al. 2016) and are associated with serious cardiovascular disease (Sommer, A. & Twig, G.2018).

Obesity in childhood and later in adolescence is associated with an increased risk of cardiovascular, metabolic and endocrine disorders (Ebbeling, C. B.at al. 2002). Vei et al. (2007), in one of their studies, showed that birth weight is associated with obesity and diabetes in young people. Birth weight (BV) is also present as an important marker of genetic factors associated with increased obesity prevalence.

The results of the study showed that the offsprings of obese parents have an increased risk of obesity due to common genes. (Gordon-Larsen P., in general. 2007). The likely presence of obesity involves changes in the balance between energy intake and energy expenditure. Physical activity, as well as a sedentary lifestyle and diet, appear to play an important role in long-term weight management. According to some studies, obesity in children of early preschool age is associated with other clinical factors that are easily assessed at birth (Baird et al., 2005). While the association between birth weight and obesity risk was found in children aged 4, 8, 10, and 12 (Maffeis et al., 1994), high birth weight was associated with higher BMI at age 7 (Toschke et al. ., 2004; Hui et al., 2008).

Material and methods

Study participants

The survey was conducted on a sample of 1,096 respondents, randomly selected from several primary schools in the Skopje region. The sample was divided into two subsamples by gender, that is 496 male respondents and 600 female respondents. The sample included all students whose parents agreed to participate in the project and who are mentally and physically healthy and regularly attend physical and health education classes. In addition, all students who did not do all the measurements and tests or for some other reason were excluded from the analysis. Respondents were treated in accordance with the Declaration of Helsinki. The protocols were approved by the Ethics Commission of the University of St. Cyril and Methodius "from Skopje. The measurements were realized in March, April and May 2019

Uvod

Gojaznost kod dece uočava se i razvija od ranog detinjstva. Prevalencija gojaznosti kod dece značajno je porasla u poslednjih nekoliko decenija širom sveta. Poreklo gojaznosti je složeno i na njega utiču genetski faktori i faktori životne sredine. Gojaznost i adolescencija u detinjstvu perzistiraju u odraslom dobu (Simmonds, M., at al. 2016) i povezani su sa ozbiljnim kardiovaskularnim oboljenjima (Sommer, A. & Tvig, G.2018).

Gojaznost u detinjstvu i kasnije u adolescenciji je povezana sa povećanim rizikom od kardiovaskularnih, metaboličkih i endokrinih poremećaja (Ebbeling, C. B.at al. 2002). Vei et al. (2007), u jednoj od svojih studija su pokazali da je težina na rođenju povezana sa gojaznošću i dijabetesom kod mladih ljudi. Rođena težina (BV) je takođe prisutna kao važan marker genetskih faktora povezanih sa povećanom prevalencijom gojaznosti.

Rezultati studije su pokazali da potomci gojaznih roditelja imaju povećan rizik od gojaznosti zbog zajedničkih gena. (Gordon-Larsen P., 2007). Verovatno prisustvo gojaznosti uključuje promene u ravnoteži između unosa energije i potrošnje energije. Čini se da fizička aktivnost, kao i sedentarni način života i ishrana igraju važnu ulogu u dugoročnom upravljanju težinom. Prema nekim studijama, gojaznost kod dece ranog predškolskog uzrasta je povezana sa drugim kliničkim faktorima koji se lako procenjuju pri rođenju (Baird et al., 2005). Veza između težina na rođenju i rizika od gojaznosti je pronađena kod dece uzrasta 4, 8, 10 i 12 godina (Maffeis et al., 1994), dok je visoka težina rođenja bila povezana sa višim BMI u dobi od 7 godina (Toschke et al., 2004; Hui et al., 2008).

Material i metode

Učesnici studije

Istraživanje je sprovođeno na uzorku od 1096 ispitanika, odabranih po slučajnom izboru iz nekoliko osnovnih škola u Skopskom regionu. Uzorak je podeljen na dva poduzorka prema polu, 496 ispitanika muškog pola i 600 ispitanica. Uzorkom su obuhvaćeni svi učenici za koje su roditelji pristali da učestvuju u projektu i koji su psihički i fizički zdravi i redovno pohađaju nastavu fizičkog i zdravstvenog vaspitanja. Osim toga, iz analize su isključeni svi učenici koji nisu uradili sva merenja i testove ili iz nekog drugog razloga. Ispitanici su tretirani u skladu sa Helsinškom deklaracijom. Protokole je odobrila Etička komisija Univerziteta Sv. Ćirila i Metodija" iz Skoplja. Merenja su realizovana u martu, aprilu i maju 2019. godine u standardnim škol-

in standard school conditions of regular physical education and health education.

Anthropometric measures

Anthropometric measurements were performed according to the standard methodology of the International Biological Program (IBP) and according to the recommendations of the World Health Organization (WHO). When measuring weight and height, the subjects were in underwear without shoes and the weight was measured with a medical decimal scale, with an accuracy of 0.1 kg. The height was measured in the Frankfurt horizontal plane with a telescopic altimeter (Martin Anthropometer) with an accuracy of 0.1 cm. Body mass index (BMI kg / m2) was calculated as weight in kilograms divided by square of height in meters

For this study, participants were classified as NOW or OV / OB according to the International Obesity Working Group (Cole et al., 2000). Parental BMI was calculated based on the weight and height reported by them and was used to assess weight status according to the recommendations of the World Health Organization. BMI is divided into three categories: normal weight (18.5 ≥ BMI <25 kg / m2); overweight (25 ≥ BMI <30 kg / m2) and obesity (BMI ≥ 30 kg / m2) (WHO, 1998). Further, to analyze the association between adolescent obesity and parental characteristics, parents were further divided into three groups: (1) both parents with normal weight, (2) one OV / OB parent, and (3) both OV / OB parents. The birth weight (BW) of adolescents was estimated based on the pediatric record of each child at birth. Potential confusers initially used,were selected based on previous reports. Low birth weight and macrosomia are defined as birth weight <2500 g or ≥ 4000 g, respectively.

Cardiorespiratory fitness

Cardiorespiratory fitness (CRF) was measured using a 20-meter shuttle test as previously described in the study by Legera et al. (1988). For this test, the children had to run back and forth between two lines set at a distance of 20 meters. An audible signal is emitted from a pre-recorded tape to dictate the running speed. The frequency of the audible signals increased so that the running speed increased by 0.5 km / h every minute from the initial speed of 8.5 km / h. The test ended when the children could no longer keep up with the sound signal. The last phase that the children reached was used to predict the maximum oxygen intake (VO2max) from the running speed corresponding to that phase (VO2max = 31.025 + 3.238 Ks - 3.248 A + 0.1536, where Ks = final speed and A = age).

skim uslovima redovne nastave fizičkog i zdravstvenog vaspitanja.

Antropometrijske mere

Antropometrijska merenja su vršena prema standardnoj metodologiji Međunarodnog biološkog programa (IBP) i prema preporukama Svetske zdravstvene organizacije (SZO). Pri merenju težine i visine, ispitanici su bili u donjem vešu bez cipela i težina je merena medicinskom decimalnom vagom, sa tačnošću od 0,1 kg. Visina je merena teleskopskim visinomerom (Antropometra po Martin-u) sa tačnost od 0,1 cm. Indeks telesne mase (BMI kg/m2) izračunat je kao težina u kilogramima podeljena sa kvadratom visine u metrima.

Za ovu studiju, učesnici su klasifikovani kao normalna težina (NOW) ili prekomerna težina/gojaznost (OV/OB) prema Međunarodnoj radnoj grupi za gojaznost (Cole et al., 2000). BMI roditelja je izračunat na osnovu težine i visine koju su sami prijavili i korišćen je za procenu statusa težine prema preporukama Svetske zdravstvene organizacije. BMI je podeljen u tri kategorije: normalna težina (18,5 ≥ BMI < 25 kg/m2); prekomerne težine (25 ≥ BMI < 30 kg/m2) i gojaznosti (BMI ≥ 30 kg/m2) (SZO, 1998). Dalje, za analizu povezanosti između gojaznosti adolescenata i karakteristika roditelja, roditelji su dalje podeljeni u tri grupe: (1) oba roditelja sa normalnom težinom, (2) jedan OV/OB roditelj i (3) oba roditelja OV/OB. Rođenja težina (BW) adolescenata je procenjen na osnovu pedijatrijskog kartona svakog deteta pri rođenju. Prvobitno uključeni potencijalni zbunjujući faktori odabrani su na osnovu prethodnih izveštaja. Mala težina rođenja i makrozomija su definisani kao težina rođenja < 2500 g ili ≥ 4000 g, respektivno.

Kardiorespiratorni fitnes

Kardiorespiratorni fitness (CRF) je meren korišćenjem trčanja 20m šatl testa kao što je prethodno opisano u studiji Legera et al. (1988). Za ovaj test, deca su morala da trče napred-nazad između dve linije postavljene na udaljenosti od 20 metara. Zvučni signal je emitovan sa unapred snimljene trake da diktira brzinu trčanja. Frekvencija zvučnih signala se povećala tako da se brzina trčanja povećavala za 0,5 km/sat svakog minuta od početne brzine od 8,5 km/h. Test je završen kada deca više nisu mogla da idu u korak sa zvučnim signalom. Poslednja faza koju su deca dostigla korišćena je za predviđanje maksimalnog unosa kiseonika (VO2max) iz brzine trčanja koja odgovara toj fazi (VO2max = 31,025 + 3,238 Ks – 3,248 A + 0,1536, gde je Ks = konačna brzina i A = starost).

Parent education

Data on the education of parents (especially mothers and fathers) were collected through a questionnaire answered by parents of children. Based on the responses of both parents, parental education is coded as 1: two parents with low / secondary education, 2: at least one parent with higher education, 3: two parents with higher education.

Statistics

Arithmetic means and Standard Deviations were calculated to describe participants' characteristics according to gender and obesity status. Comparisons between gender and obesity status were performed by independent t-test for anthropometric variables and v2 test for BMI, CRF, parental BMI and parental education categories. For both sexes, the independent group of predictors with BMI as the dependent variable (NOW and OV / OB) was examined using gradual logistic regression analysis with age, body weight, parental obesity status, and parental education as independent variables. Statistical analysis was performed using software SPSS 15 (SPSS, Chicago, IL, USA) and Microsoft Excel 2000 (Microsoft, Redmond, VA, USA). The significance level is set to Pp0.05.

Results

The characteristics of the examined sample by sex are shown in Table 1. The table shows that male subjects have higher body weight, higher birth weight and show better results in the test to assess cardiorespiratory capacity compared to female subjects ($P \leq 0.01$). Statistically significant differences between male and female respondents were not found in age, body height, BMI, paternal BMI and maternal BMI. The overall prevalence of overweight and obesity was 22.6% and 14.9%, respectively. A review of the $\chi 2$ test shows that no statistically significant differences in the degree of nutrition of boys and girls were found. In total, 51.1% of fathers were classified as overweight, while 22.3% were classified as obese. For mothers, the corresponding figures were 26.4% overweight and 16.5% obese.

Edukacija roditelja

Podaci o obrazovanju roditelja (posebno majke i oca) prikupljeni su putem anketnog upitnika na koji su roditelji dece odgovarali. Na osnovu odgovora oba roditelja, obrazovanje roditelja je šifrirano kao 1: dva roditelja sa niskim/srednjim obrazovanjem, 2: najmanje jedan roditelj sa visokim obrazovanjem, 3: dva roditelja sa visokim obrazovanjem.

Statistika

Aritmetičke sredine i standardne devijacije su izračunate da opišu karakteristike učesnika prema polu i statusu gojaznosti. Poređenja između polova i statusa gojaznosti vršena su nezavisnim t-testom za antropometrijske varijable i v2 testom za kategorije BMI, CRF, roditeljski BMI i obrazovanje roditelja. Za oba pola, nezavisna grupa prediktora sa BMI kao zavisna varijabla (NOW i OV/OB) ispitan je korišćenjem postepene logističke regresione analize sa uzrastom, telesnom masom, statusom gojaznosti roditelja i obrazovanjem roditelja kao nezavisnim varijablama. Statistička analiza je izvršena korišćenjem softvera SPSS 15 (SPSS, Chicago, IL, USA) i Microsoft Ekcel 2000 (Microsoft, Redmond, VA, USA). Nivo značajnosti je postavljen na P=0,05.

Rezultati

Karakteristike ispitivanog uzorka prema polu prikazane su u tabeli 1. Iz pregleda tabele vidi se da ispitanici muškog pola imaju veću telesnu težinu, veću trudničku težinu i pokazuju bolje rezultate u testu za procenu kardiorespiratorne sposobnosti u odnosu na ispitanice ženskog pola ($P \leq 0,01$). Statistički značajne razlike između ispitanika muškog i ženskog pola nisu nađene u starosti, telesnoj visini, BMI, očevom BMI i BMI kod majke. Ukupna prevalencija prekomerne težine i gojaznosti iznosila je 22,6%, odnosno 14,9%.

Table 1. *Sample characteristics*

Table 1. *Karakteristike uzorka*

Characteristics	Total (n = 1096)		Boys (n = 496)		Girls (= 600)		P-value
	Mean	SD	Mean	SD	Mean	SD	
Age (years)	8.87	3.10	8.83	1.47	8.90	3.98	NS
Height (sm)	134.63	10.69	134.96	10.51	134.36	10.83	NS
Weight (kg)	34.29	10.29	35.16	10.95	33.57	9.65	0.011
BMI (kg/m^2)	17.55	5.74	17.85	6.01	17.31	5.51	NS
Birth weight (BW) (kg)	3.28	0.59	3.36	0.59	3.21	0.58	0.000
CRF (VO_2 max)	48.14	3.38	48.87	3.56	47.53	3.09	0.000
CRF (laps)	3.43	1.41	3.78	1.57	3.14	1.19	0.000
Father BMI (kg/m^2)	27.45	3.72	27.46	3.58	27.44	3.84	NS
Mother BMI (kg/m^2)	23.90	3.85	23.95	4.26	23.85	3.45	NS
BMI (%)							
Normal weight	682	62.50%	311	62.80%	371	62.10%	
Overweight	247	22.60%	102	20.60%	145	24.30%	
Obese	163	14.90%	82	16.60%	81	13.60%	NS
P-BMI (%)							
Two parents with normal weight	180	18.70%	83	18.70%	97	18.80%	
At least one parent with OV/OB	547	56.90%	246	55.30%	301	58.30%	
Two parents with OV/OB	234	24.30%	116	26.10%	118	22.90%	NS
P-Edu (%)							
Two parents with Low/Middle education	352	33.20%	209	43.50%	143	24.70%	
At least one parent with High educatio	322	30.30%	135	28.10%	187	32.20%	
Two parents with High educatio	387	36.50%	137	28.50%	250	43.10%	0.000

Abbreviations: BMI. body mass index; CRF. cardiorepiratory fitness; NS. not significant; OV/OB. overweight/obese; P-BMI. parental BMI; P-Edu. parental education. NS=P > 0.05

Table 2 shows the differences in the studied variables between the groups of male respondents formed on the basis of the BMI classification. A review of Table 2 shows that the group classified as OV / OB is higher, has a higher body mass index (BMI), and both parents have a higher BMI than their peers classified in the normal body weight group (NOW). CRF values (number of rounds and VO2 max) were statistically significantly lower in OV / OB than in the NOW group. The body mass index (BMI) of statistical parents differed significantly between the NOW and OV / OB groups (P = 0.001). No statistically significant differences were found between group differences in parent education.

U tabeli 2 prikazane su razlike u proučavanim varijablama između grupa muških ispitanika formiranih na osnovu BMI klasifikacije. Pregled tabele 2 pokazuje da je grupa klasifikovana kao OV / OB viša, teža, ima viši indeks telesne mase (BMI), a oba roditelja imaju veći BMI od svojih vršnjaka klasifikovanih u grupu normalne telesne težine (NOW). CRF vrednosti (broj krugova i VO2 max) bile su statistički značajno niže u OV/OB nego u grupi NOW. Indeks telesne mase (BMI) roditelja, statistički značajno se razlikovao između grupa NOW i OV/OB (P = 0,001). Nisu nađene statistički značajne razlike između grupnih razlika u obrazovanju roditelja.

Table 2. *arithmetic mean and standard deviation of child and parent characteristics according to body mass index in boys*

Table 2. *Aritmetička sredina i standardna devijacija karakteristika deteta i roditelja prema indeksu telesne mase kod dečaka*

Characteristics	Normal weigh		Overweight/obese		P-value
	Mean	SD	Mean	SD	
Age (years)	8.74	1.43	8.98	1.53	NS
Height (sm)	133.35	9.84	137.74	11.04	0.000
Weight (kg)	29.98	6.32	44.00	11.46	0.000
BMI (kg/m^2)	15.31	5.08	22.06	5.00	0.000
Birth weight (BW) (kg)	3.32	0.59	3.42	0.57	NS
CRF (VO2 max)	49.98	3.35	47.01	3.13	0.000
CRF (laps)	4.19	1.59	3.09	1.25	0.000
Father BMI (kg/m^2)	26.84	3.42	28.50	3.61	0.000
Mother BMI (kg/m^2)	23.33	4.28	24.95	4.02	0.000
P-BMI (%)					
Two parents with normal weight	63	22.80%	20	11.90%	
At least one parent with OV/OB	155	56.20%	90	53.60%	
Two parents with OV/OB	58	21.00%	58	34.50%	0.001
P-Edu (%)					
Two parents with Low/Middle education	135	44.90%	74	41.30%	
At least one parent with High educatio	76	25.20%	58	32.40%	
Two parents with High educatio	90	29.90%	47	26.30%	NS
Birth weight					
< 2500 g	28	9.10%	11	6.10%	
2500 – 4000 g	249	80.80%	138	76.20%	
> 4000 g (macrosomia)	31	10.10%	32	17.70%	0.034

Abbreviations: BMI. body mass index; BW. birth weight; NS. not significant; PBMI. parental BMI. NS = P > 0.05.

Table 3 shows the differences in the studied variables between the groups of respondents formed on the basis of the BMI classification. From the overview of Table 3 it can be seen that the group classified as OV / OB is higher, the heavier ones have a higher body mass index (BMI), higher birth weight and both parents have a higher BMI compared to their peers classified in the normal weight group). CRF values (number of rounds and VO2 max) were statistically significantly lower in OV / OB than in the NOW group. The parent body mass index (BMI) differed statistically significantly between the NOW and OV / OB groups (P <0.001). Also, the respondents were not statistically significant between the group differences in terms of parent education.

U tabeli 3 prikazane su razlike u proučavanim varijablama između grupa ispitanica formiranih na osnovu BMI klasifikacije. Iz pregleda tabele 3 može se videti da je grupa klasifikovana kao OV/OB veća, teži imaju veći indeks telesne mase (BMI), veću porođajnu težinu i oba roditelja imaju veći BMI u odnosu na svoje vršnjake klasifikovane u grupa sa normalnom telesnom težinom (NOW). CRF vrednosti (broj krugova i VO2 mak) bile su statistički značajno niže u OV/OB nego u grupi NOW. Indeks telesne mase (BMI) roditelja se statistički značajno razlikovao između grupa NOW i OV/OB (P <0,001). Takođe, ispitanice nisu bile statistički značajne između grupnih razlika u pogledu obrazovanja roditelja.

Table 3. *arithmetic mean and standard deviation of the characteristics of the child and parent according to the body mass index in girls*

Table 3. *Aritmetička sredina i standardna devijacija karakteristika deteta i roditelja prema indeksu telesne mase kod devojčica*

Characteristics	Normal weigh		Overweight/obese		P-value
	Mean	SD	Mean	SD	
Age (years)	8.79	1.56	9.09	6.17	NS
Height (sm)	133.46	10.53	136.01	11.15	0.005
Weight (kg)	29.51	6.70	40.40	9.90	0.000
BMI (kg/m^2)	15.60	4.20	20.16	6.09	0.000
Birth weight (BW) (kg)	3.17	0.61	3.28	0.54	0.021
CRF (VO2 max)	48.28	3.03	46.26	2.77	0.000
CRF (laps)	3.49	1.25	2.57	0.83	0.000
Father BMI (kg/m^2)	26.62	3.36	28.85	4.20	0.000
Mother BMI (kg/m^2)	23.49	3.37	24.47	3.52	0.001
P-BMI (%)					
Two parents with normal weight	71	21.80%	25	13.20%	
At least one parent with OV/OB	198	60.90%	103	54.20%	
Two parents with OV/OB	56	17.20%	62	32.60%	0.000
P-Edu (%)					
Two parents with Low/Middle education	92	25.50%	51	23.60%	
At least one parent with High educatio	123	34.10%	62	28.70%	
Two parents with High educatio	146	40.40%	103	47.70%	NS
Birth weight					
< 2500 g	37	10.10%	16	7.20%	
2500 – 4000 g	301	82.50%	183	82.40%	
> 4000 g (macrosomia)	27	7.40%	23	10.40%	NS

Abbreviations: BMI. body mass index; BW. birth weight; NS. not significant; PBMI. parental BMI. NS = P > 0.05.

Table 4. *Prevalence of overweight and obesity by gradual multiple logistic regression analysis in boys*

Tabela 4. *Prevalencija prekomerne težine i gojaznosti postupnom višestrukom logističkom regresijskom analizom kod dječaka*

Explanatory variables	Unstandardized coefficient (B)	Wald statistics	p	OR (95% CI)
Age	-0.38	19.97	0.000	0.68 (0.58-0.81)
Stg	0.72	58.62	0.000	2.06 (1.71-2.47)
P-BMI (%)				
Two parents with normal weight	1.36	14.31	0.000	3.90 (1.92-7.88)
At least one parent with OV/OB	0.62	5.64	0.018	1.86 (1.11-3.09)
Two parents with OV/OB Ref				
Birth weight				
< 2500 g	1.55	9.44	0.002	4.71 (1.75-12.66)
2500 – 4000 g	0.53	2.40	0.122	1.70 (0.87-3.33)
> 4000 g (macrosomia) Ref				

**Dependent variable: overweight and obesity-BMI (Cole at al.. 2000. 2007)*

Table 5. *Prevalence of overweight and obesity by gradual multiple logistic regression analysis in girls*

Tabela 5. *Prevalencija prekomerne telesne težine i gojaznosti postupnom višestrukom logističkom regresijskom analizom kod djevojčica*

Explanatory variables	Unstandardized coefficient (B)	Wald statistics	p	OR (95% CI)
Age	-0.17	5.48	0.019	0.84 (0.73-0.97)
Stg	0.97	61.52	0.000	2.65 (2.07-3.37)
P-BMI (%)				
Two parents with normal weight	1.15	12.76	0.000	3.16 (1.68-5.95)
At least one parent with OV/OB	0.56	5.22	0.022	1.75 (1.08-2.82)
Two parents with OV/OB				
Birth weight				
< 2500 g	0.26	0.30	0.587	1.30 (0.51-3.30)
2500 – 4000 g	0.12	0.12	0.731	1.13 (0.58-2.20)
> 4000 g (macrosomia)				

**Dependent variable: overweight and obesity-BMI (Cole at al.. 2000. 2007)*

The relationship between overweight and obesity classified on the basis of BMI in male and female subjects and potential risk factors were determined by multinomial logistic regression analysis, and the results are shown in Tables 4 and 5. From the overview of Table 4 can be seen (OR): 2.06; confidence interval (CI): 1.71–2.47; P ≤ 0.01), low birth weight (OR: 4.71; CI: 1.75–12.66; P ≤ 0.05), with both parents with normal body weight (OR: 3.90; CI: 1.92-7.88; P <0.01) or one parent with normal body weight (OR: 1.86; CI: 1.11–3.09; P ≤ 0.05) were less likely to be classified as OV / OB compared to counterparts classified as NOW. From the overview of Table 5 it can be seen that girls with higher values of cardiorespiratory fitness CRF (OR: 2.64; CI: 2.07–3.37; P ≤ 0.01), with both parents with normal body weight (OR: 3 , 16; CI). Stk #: 1.68- 5.95; P <0.01) or one parent with normal body weight (OR: 1.75; CI: 1.08–2.82; P ≤ 0.05) are less likely to be classified as OV / OB compared to peers classified as NOW.

Discussion

This paper investigated the relationship between cardiorespiratory fitness and obesity status in children aged 6 to 11 years, taking into account the birth weight of children, body mass index and parental education. The prevalence of overweight and obesity in this study was 22.6% and 14.9% for the entire sample. Although the sample did not represent the entire population of the country, the prevalence of overweight and obesity was similar to the values reported in other studies conducted on samples of Macedonian children and adolescents (Gontarev & Ruždija, 2014; Gontarev, et al., 2018). The results of the study show that children of both sexes clas-

Odnos gojaznosti i gojaznosti klasifikovanih na osnovu BMI kod muških i ženskih ispitanika i potencijalnih faktora rizika utvrđen je multinomijalnom logističkom regresionom analizom, a rezultati su prikazani u tabelama 4 i 5. Iz pregleda tabele 4 može se videti dečaci sa višom kardiorespiratornom kondicijom CRF (OR): 2,06; interval poverenja (CI): 1,71–2,47; P ≤ 0,01), niska porođajna težina (OR: 4,71; CI: 1,75–12,66; P ≤ 0,05), sa oba roditelja sa normalnom telesnom težinom (OR: 3,90; CI: 1,92-7,88; P <0,01) ili jedan roditelj sa normalnom telesnom težinom (OR: 1,86; CI: 1,11–3,09; P ≤ 0,05) su manje verovatno bili klasifikovani kao OV / OB u poređenju sa kolegama klasifikovanim kao normalna težina (NOW). Iz pregleda tabele 5 može se videti da devojčice sa višim vrednostima kardiorespiratornog fitnesa CRF (OR: 2,64; CI: 2,07–3,37; P ≤ 0,01), sa oba roditelja sa normalnom telesnom težinom (OR: 3,16; CI). : 1,68- 5,95; P <0,01) ili jedan roditelj sa normalnom telesnom težinom (OR: 1,75; CI: 1,08–2,82; P ≤ 0,05), manje je verovatno da će biti klasifikovani kao OV / OB u poređenju sa vršnjacima klasifikovanim kao normalna težina (NOW).

Diskusija

Ovaj rad je istraživao vezu između kardiorespiratorne kondicije i gojaznog statusa kod dece uzrasta od 6 do 11 godina, uzimajući u obzir porođajnu težinu dece, indeks telesne mase i obrazovanje roditelja. Prevalencija prekomerne težine i gojaznosti u ovoj studiji iznosila je 22,6% i 14,9% za ceo uzorak ispitanika. Iako uzorak nije predstavljao celokupnu populaciju zemlje, prevalencija prekomerne težine i gojaznosti bila je slična vrednostima prijavljenim u drugim studijama sprovedenim na uzorcima makedonske dece i adolescenata (Gontarev &

sified as OV / OB show lower results in cardiorespiratory condition (number of laps and VO2 mak) compared to their peers classified as normal body weight (NOW). The results are consistent with previous studies that used a sophisticated methodology to assess body composition in children aged 8 to 11 years (Gutin, et al., 2004). Lee and Arslanian (2007) found that cardiorespiratory fitness was associated with lower visceral and abdominal subcutaneous fat levels measured by DEXA in 113 American adolescents aged 8 to 17 years. These findings were similar when anthropometric methods were used to assess total and central adiposity (Ortega, et al., 2007). Ruiz et al. (2006) found that cardiorespiratory condition was inversely related to total body fat estimated through the sum of five skin folds in Swedish and Estonian children aged 9 to 10 years.

Our results may have some significance from a preventive point of view, as they have potentially indicated some future negative health implications. Previous research suggests that low levels of cardiorespiratory fitness, excess body fat, and a sedentary lifestyle are predictors of certain cardiovascular and metabolic disorders (Janssen et al., 2005). Longitudinal studies also suggest that, regardless of the initial level of cardiorespiratory fitness, improvements in it are associated with a lower risk of developing obesity / obesity during puberty (Ortega, et al., 2011).

Moreover, the results of this study indicate that parental obesity is a strong predictor of overweight / obesity in children. The results are consistent with previous research suggesting a link between parents' obesity levels and their children's obesity status (Whitaker et al., 1997; Maffeis et al., 1998; Treuth et al., 2003). Moreover, our data clearly showed that the association was even stronger when obesity was detected in both, not just one parent, according to other studies (Davison and Birch, 2001; Herbert et al., 2006). For example, maternal obesity has been associated with obesity in younger children (Gordon-Larsen et al., 2007). This is particularly important because some data suggest that an overweight child living in a family where one or both parents are overweight is likely to remain obese during childhood, adolescence, and adulthood (Magarei et al., 2003). Namely, the results of the research suggest that obesity / childhood obesity occurs in the family circle, where in addition to the genetic factor, environmental factors also play an important role. Therefore, our data indicate the need to take into account the family environment when designing intervention programs to prevent or reduce obesity.

Numerous studies have examined the association

Ruždija, 2014; Gontarev, et al., 2018). Rezultati studije pokazuju da deca oba pola klasifikovana kao OV/OB pokazuju niže rezultate u kardiorespiratornoj kondiciji (broj krugova i VO2 max) u poređenju sa svojim vršnjacima klasifikovanim kao normalna telesna težina (NOW). Rezultati su u skladu sa prethodnim studijama koje su koristile sofisticiranu metodologiju za procenu telesne kompozicije kod dece uzrasta od 8 do 11 godina (Gutin, et al., 2004). Lee i Arslanian (2007) su otkrili da je kardiorespiratorna kondicija povezana sa nižim vrednostima visceralne i abdominalne potkožne masti merene DEKSA kod 113 američkih adolescenata starosti od 8 do 17 godina. Ovi nalazi su bili slični kada su antropometrijske metode korišćene za procenu ukupne i centralne adipoznosti (Ortega, et al., 2007). Ruiz i dr. (2006) su otkrili da je kardiorespiratorna kondicija obrnuto povezana sa ukupnom telesnom masnoćom procenjenom kroz zbir od pet kožnih nabora kod Švedske i Estonske dece uzrasta od 9 do 10 godina.

Naši rezultati mogu imati određeni značaj sa preventivne tačke gledišta, jer su potencijalno ukazali na neke buduće negativne implikacije po zdravlje. Prethodna istraživanja sugerišu da su nizak nivo kardiorespiratorne kondicije, višak telesne masti i sedentarni način života prediktori određenih kardiovaskularnih i metaboličkih poremećaja (Janssen et al., 2005). Longitudinalne studije takođe sugerišu da su, bez obzira na početni nivo kardiorespiratorne kondicije, poboljšanja u njoj povezana sa manjim rizikom od razvoja gojaznosti/gojaznosti tokom puberteta (Ortega, et al., 2011).

Štaviše, rezultati ove studije ukazuju da je gojaznost roditelja snažan prediktor prekomerne težine/gojaznosti kod dece. Rezultati su u skladu sa prethodnim istraživanjima koja sugerišu vezu između nivoa gojaznosti roditelja i statusa gojaznosti njihove dece (Vhitaker et al., 1997; Maffeis et al., 1998; Treuth et al., 2003). Naši podaci su jasno pokazali da je povezanost bila još jača kada je gojaznost otkrivena kod oba, a ne samo kod jednog roditelja, u skladu sa drugim studijama (Davison i Birch, 2001; Herbert et al., 2006). Na primer, gojaznost majki je bila povezana sa gojaznošću kod mlađe dece (Gordon-Larsen et al., 2007). Ovo je posebno važno jer neki podaci sugerišu da će dete sa viškom kilograma koje živi u porodici u kojoj jedan ili oba roditelja imaju višak kilograma verovatno ostati gojazno tokom detinjstva, adolescencije i odraslog doba (Magarei et al., 2003). Naime, rezultati istraživanja sugerišu da se gojaznost/gojaznost u detinjstvu javlja u krugu porodice, gde pored genetskog faktora važnu ulogu imaju i faktori sredine. Dakle, naši podaci ukazuju na potrebu da se pri osmišljavanju inter-

between maternal weight and the later development of cardiovascular disease (Karter et al., 1999; Vei et al., 2007) and obesity (Stettler et al., 2002). Our data show that boys with low birth weight are 4.71 less likely to be OV / OB. No association was found between girls and birth weight and the likelihood of being OV / OB. Some previous research has found a link between BW and the continued prevalence of obesity in children and adolescents (Curhan et al., 1996; Dubois and Girard, 2006; Vei et al., 2007). The results of our research showed that the mother's body weight, especially in boys, is a strong predictor of OV / OB in childhood and therefore intrauterine factors should be considered as a strategic option when creating an intervention program.

The advantages of this study are the size of the sample of children and the responses of parents to the nutritional status, education and birth weight of their children. This study also has some limitations that should be noted. First, the parent body mass index was determined based on self-reported data, which may affect the true prevalence of overweight and obesity (Treuth et al., 2003). However, BMI from self-reported data has been shown to be sufficiently accurate and widely used in epidemiological studies; on the other hand, objective measurements of the weight and height of large specimens can be difficult and unattainable due to organizational constraints. Second, the study did not consider the impact of diet on energy regulation. Future studies should include dietary factors that may be associated with obesity.

Conclusion

The prevalence of overweight and obesity in this study was 22.6% and 14.9%, respectively, for the entire sample of respondents without a statistically significant gender difference. Furthermore, the results of the research indicate the connection between obesity of parents and their children. The results suggest that low cardiorespiratory fitness and high birth weight are predictors of childhood OV / OB. Thus, the implementation of programs that promote active behavior in primary school children should not focus only on the suggestion of structured activities in or outside the school environment, but should take into account environmental aspects, such as parental awareness and counseling. Combining direct effort with indirect action (ie aimed at increasing the role of parents in promoting their children's physical activity, especially free outdoor play) can lead to stronger immediate results, as well as to structuring and maintaining healthy behavioral assets in later life.

ventnih programa za prevenciju ili smanjenje gojaznosti vodi računa o porodičnom okruženju.

Brojne studije su ispitivale povezanost između težine majke i kasnijeg razvoja kardiovaskularnih bolesti (Karter et al., 1999; Vei et al., 2007) i gojaznosti (Stettler et al., 2002). Naši podaci pokazuju da dečaci sa malom porođajnom težinom imaju 4,71 manje šanse da budu OV/OB. Nije pronađena povezanost između devojčica i težine rođenja i verovatnoće da budu OV/OB. Neka ranija istraživanja su otkrila vezu između BW i dalje prevalencije gojaznosti kod dece i adolescenata (Curhan et al., 1996; Dubois i Girard, 2006; Vei et al., 2007). Rezultati našeg istraživanja su pokazali da je telesna težina majke, posebno kod dečaka, snažan prediktor OV/OB u detinjstvu i zato intrauterine faktore treba posmatrati kao stratešku opciju pri kreiranju programa intervencije.

Prednosti ove studije su veličina uzorka dece i odgovori roditelja na status uhranjenosti, obrazovanje i porođajnu težinu njihove dece. Ova studija takođe ima neka ograničenja koja treba napomenuti. Prvo, indeks telesne mase roditelja određen je na osnovu podataka koji su sami prijavili, što može uticati na pravu prevalenciju prekomerne težine i gojaznosti (Treuth et al., 2003). Međutim, pokazalo se da je BMI iz podataka samoprijavljenih dovoljno tačan i da se široko koristi u epidemiološkim studijama; s druge strane, objektivna merenja težine i visine velikih uzoraka mogu biti teška i nedostižna zbog organizacionih ograničenja. Drugo, studija nije uzela u obzir uticaj ishrane na regulaciju energije. Buduće studije bi trebalo da uključuju i faktore ishrane koji mogu biti povezani sa gojaznošću.

Zaključak

Prevalencija prekomerne težine i gojaznosti u ovoj studiji iznosila je 22,6% i 14,9%, za ceo uzorak ispitanika bez statistički značajne polne razlike. Nadalje, rezultati istraživanja ukazuju na povezanost gojaznost roditelja i njihove dece. Rezultati sugeriraju da su niska kardiorespiratorna kondicija i visoka porođajna težina, prediktori OV/OB iz djetinjstva. Dakle, implementacija programa koji promovišu aktivno ponašanje dece u osnovnoj školi, ne bi trebalo da ih fokusiraju samo na sugestiju strukturirane aktivnosti u ili izvan školskog okruženja, nego treba uzeti u obzir okolne aspekte, kao što su svest roditelja i savetovanja. Kombinovanje direktnog napora sa indirektnim delovanjem (tj. usmerenim na povećati ulogu roditelja u promicanju fizičke aktivnosti njihove dece, posebno slobodna igra na otvorenom) može dovesti do jačih trenutnih rezultata, kao i na strukturiranje i održavanje zdravog načina života i ponašanja u kasnijim periodima života.

References

Baird J, Fisher D, Lucas P, Kleijnen J, Roberts H, Law C (2005). Being big or growing fast: systematic review of size and growth in infancy and later obesity. BMJ 331, 929.

Cole T, Bellizzi M, Flegal K, Dietz W (2000). Establishing a standard definition for child overweight and obesity worldwide: interna- tional survey. BMJ 320, 1240–1243.

Curhan GC, Chertow GM, Willett WC, Spiegelman D, Colditz GA, Manson JE et al. (1996). Birth weight and adult hypertension and obesity in women. Circulation 94, 1310–1315.

Davison KK, Birch LL (2001). Child and parent characteristics as predictors of change in girls' body mass index. Int J Obes Relat Metab Disord 25, 1834–1842.

Dubois L, Girard M (2006). Early determinants of overweight at 4.5 years in a population-based longitudinal study. Int J Obes (Lond) 30, 610–617.

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

Gordon-Larsen P, Adair LS, Suchindran CM (2007). Maternal obesity is associated with younger age at obesity onset in U.S. adolescent offspring followed into adulthood. Obesity (Silver Spring) 15, 2790– 2796.

Gordon-Larsen P, Mcmurray RG, Popkin BM (2000). Determinants of adolescent physical activity and inactivity patterns. Pediatrics 105, E83.

Gutin, B., Yin, Z., Humphries, M. C., Hoffman, W. H., Gower, B., & Barbeau, P. (2004). Relations of fatness and fitness to fasting insulin in black and white adolescents. *The Journal of pediatrics*, *145*(6), 737-743.

Herbert A, Gerry NP, Mcqueen MB, Heid IM, Pfeufer A, Illig T et al. (2006). A common genetic variant is associated with adult and childhood obesity. Science 312, 279–283.

Janssen I, Katzmarzyk PT, Boyce WF, Vereecken C, Mulvihill C, Roberts C et al. (2005). Comparison of overweight and obesity prevalence in school-aged youth from 34 countries and their relationships with physical activity and dietary patterns. Obes Rev 6, 123–132.

Karter AJ, Rowell SE, Ackerson LM, Mitchell BD, Ferrara A, Selby JV et al. (1999). Excess maternal transmission of type 2 diabetes. The Northern California Kaiser Permanente Diabetes Registry. Diabetes Care 22, 938–943.

Leger LA, Mercier D, Gadoury C, Lambert J (1988). The multistage 20 meter shuttle run test for aerobic fitness. J Sports Sci 6, 93–101.

Lee,S.J., Arslanian.S.A. (2007) Cardiorespiratory fitness and abdominal adiposity in youth. Eur J Clin Nutr, doi: 10.1038/sj.ejcn.1602541.

Maffeis C, Micciolo R, Must A, Zaffanello M, Pinelli L (1994). Parental and perinatal factors associated with childhood obesity in north- east Italy. Int J Obes Relat Metab Disord 18, 301–305.

Maffeis C, Talamini G, Tato L (1998). Influence of diet, physical activity and parents' obesity on children's adiposity: a four-year longitudinal study. Int J Obes Relat Metab Disord 22, 758–764.

Magarey AM, Daniels LA, Boulton TJ, Cockington RA (2003). Predicting obesity in early adulthood from childhood and parental obesity. Int J Obes Relat Metab Disord 27, 505–513.

Ortega, F. B., Tresaco, B., Ruiz, J. R., Moreno, L. A., Martin-Matillas, M., Mesa, J. L., ... & Castillo, M. J. (2007). Cardiorespiratory fitness and sedentary activities are associated with adiposity in adolescents. *Obesity*, *15*(6), 1589-1599.

Ortega, F. B., Artero, E. G., Ruiz, J. R., Jiménez-Pavón D. (2011) Physical fi tness levels among European adolescents: the HELENA study. Br J Sports Med 2011;45:20–29. doi:10.1136/bjsm.2009.062679

Ruiz, J. R., Rizzo, N. S., Hurtig-Wennlöf, A., Ortega, F. B., W ärnberg, J., & Sjöström, M. (2006). Relations of total physical activity and intensity to fitness and fatness in children: the European Youth Heart Study–. *The American journal of clinical nutrition*, *84*(2), 299-303.

Gontarev,S., Kalac, R.(2014) The relationship between overweight, obesity and physical fitness among eleven and twelve-year-old Macedonian adolescents. Journal of Physical Education and Sport 14(2):178-185

Gontarev S, Kalack R, Velickovska LA, Stojmanovska DS, Misovski A, Milenkovski J. (2018) Health-related physical fitness of normal, stunted and overweight children aged 6-14 years in Macedonia. Nutr Hosp 2018;35(5):1208-1214

Stettler N, Zemel BS, Kumanyika S, Stallings VA (2002). Infant weight gain and childhood overweight status in a multicenter, cohort study. Pediatrics 109, 194–199.

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

Sommer, A. & Twig, G. The Impact of Childhood and Adolescent Obesity on Cardiovascular Risk in Adulthood: a Systematic Review. Curr Diab Rep. 18, 91, https://doi.org/10.1007/s11892-018-1062-9 (2018).

Toschke AM, Grote V, Koletzko B, Von Kries R (2004). Identifying children at high risk for overweight at school entry by weight gain during the first 2 years. Arch Pediatr Adolesc Med 158, 449–452.

Treuth MS, Butte NF, Sorkin JD (2003). Predictors of body fat gain in nonobese girls with a familial predisposition to obesity. Am J Clin Nutr 78, 1212–1218.

Wei JN, Li HY, Sung FC, Lin CC, Chiang CC, Li CY et al. (2007). Birth weight correlates differently with cardiovascular risk factors in youth. Obesity (Silver Spring) 15, 1609–1616.

Whitaker RC, Wright JA, Pepe MS, Seidel KD, Dietz WH (1997). Predicting obesity in young adulthood from childhood and parental obesity. N Engl J Med 337, 869–873.

Primljen: 08. mart 2022. / Received: March 08, 2022
Prihvaćen: 30. april 2022. / Accepted: April 30, 2022

https://doi.org/10.7251/SSH2201042N
Original scientific paper

UDC: 796.015.132-055.2
Originalni naučni rad

The Impact of the Pilates Program on the Mobility of Middle-Aged Women

Nataša Nikić[1], Dejan Milenković[2]
[1]Faculty of Sport and Physical Education, University of Niš, Serbia
[2]Faculty of Sport, University „Union – Nikola Tesla", Belgrade, Serbia

Correspondence:
Dejan Milenković, Faculty of Sport, University „Union – Nikola Tesla", Belgrade, Serbia
dejan.milenkovic2309@gmail.com

Abstract: *The aim of the study was to determine the impact of a 16-week Pilates program on the mobility of middle-aged women. The research involved 16 Pilates female exercisers who have been practicing this recreational exercise for at least a year, three times a week. Shoulder Circumduction Test, V Sit and Reach Test, Groin Flexibility Test, Back Scratch Test and Calf Muscle Flexibility Test were used to assess flexibility. In addition to descriptive parameters, repeated-measures ANOVA and Fisher LSD were used in the analysis. 16-week Pilates program has had a positive effect on changes in mobility in female exercisers both in the upper part of the body, in the area of the shoulder girdle ($p < .05$), and in the lower part of the body, in the area of the pelvic girdle and hip joint ($p < .05$). There were no statistically significant changes in plantar flexion. It can be concluded that the Pilates program effectively affects the improvement of flexibility in the shoulder region and the pelvic girdle and hip joint, while in plantar flexors of the feet a statistically significant improvement in the level of mobility under the influence of Pilates exercise was not observed.*

Keywords: *female exercisers, pilates, training, flexibility.*

Introduction

Pilates means exercises which are tantamount to stretching, breathing and control of the position and movement of the body what is indicated by its original name "Contrology" (Wells, Colt & Bialocerkowski, 2012), ie. exercise consisting of physical and mental exercise of the body (Anderson & Spector, 2005). Pilates exercises are based on the six traditional principles: centering, concentration, control, precision, flow and breathing (Latey, 2002). Since Joseph Pilates designed this method in response to the weakness of his body due to various diseases he had, at first due to its nature, this exercise was used exclusively by dancers as a recovery from frequent injuries (Anderson & Spector, 2005). Later, Pilates became a widely used method of recreational exercise, and also in rehabilitation (Latey, 2001; Wells et al., 2012; Byrnes, Wu & Whillier, 2018) as well as the regulation of overweight and the fight against obesity when it can be used as an alternative method of exercise due to the positive effect on cardiorespiratory abilities and body composition (Rayes et al., 2019). Pilates exercise reduces the risk of heart disease (Schroeder, Crussemeyer & Newton, 2002), has a positive effect on the increase in aerobic endurance, and the dynamic balance (Vieira et al., 2017), increases the level of durability and the rate of metabolism of exercisers (Kılıç Uğurlu & Dikdağ, 2018).

Based on one of the principles (centering) which indicates that during the exercise the muscles of the center of the body (powerhouse – space between the ribs and the bottom of the pelvis) are tightened, Pilates is often used as an effective tool in cases when the exercisers have problems with pains in the lower back (La Touche, Escalante & Linares, 2008; Miranda, Souza, Schneider, Chagas & Loss, 2017). If the lower back control of body position and movement is taken into account, Pilates has a significant impact on static and dynamic balance, primarily in women (Oliveira, Almeida & Gorges, 2015).

When it comes to mobility, this ability is one of the very important elements in achieving skeletal-muscular function in order to reach the peak of movement performance (Phrompaet, Paungmail, Pirunsan & Sitilertpisan, 2011). There is a static and dynamic kind of mobility. Static mobility, which is subjective because it is determined by the subject's stretching tolerance, refers to the extent of joint movement in relaxed muscles (Knudson, Magnusson & McHugh, 2000; Nuzzo, 2020). When it comes to dynamic mobility, it represents a more objective type of this ability

and refers to the tension of the muscle tendon (stiffness of the muscle-tendon) within the normal range of motion in the joint (Gleim & McHugh, 1997; Nuzzo, 2019).

And in terms of improving mobility, the Pilates method with its characteristic way of exercising has a significant impact (Segal, Hein & Basford, 2004), which can be seen in the research with different age groups. Pilates exercise gives results in terms of improving the flexibility of children and adolescents (González-Gálvez, Poyatos, Marcos-Pardo, Souza Vale & Feito, 2015; Cibinello, Jesus Neves, Leão Carvalho, Valenciano & Fujisawa, 2020; Hartono, Kesoema, Isma & Anantyo, 2020), students (Kibar et al, 2016; Ružić, 2020), middle-aged people (Kloubec, 2010; Gürhan & Kenan, 2020), the elderly (Oliveira et al., 2015; Oliveira, Oliveira & Pires-Oliveira, 2016; Oliveira, Pires-Oliveira, Aducarub, Oliveira & Oliveira, 2017; Oliveira, Oliveira & Pires-Oliveira, 2017). Based on previous research, the aim of the research is to determine the impact of a 16-week Pilates program on the mobility of middle-aged women.

Material and Methods

Sample of respondents

The study involved 16 Pilates female exercisers (age = 46.14 ± 8.23; height = 167.94 ± 7.24; weight = 61.44 ± 6.64; BMI = 21.8 ± 2.09), who have been engaged in this recreational exercise for at least a year. Before the research was carried out, the written consent of all female exercisers was obtained, as well as the official permission of the aerobics studio in which the research was performed.

Research protocol and organization

The study was conducted over a period of four months (16 weeks). The female exercisers have been subjected to the Pilates training three times a week in the afternoon for an hour. Three tests were performed, initially in the first week, transiently after the eighth week, and the final test after the sixteenth week. During the initial testing, a trial test was first organized in order for the trainees to get acquainted with the way the tests would be performed. Then, an experimental test was performed in which each test was repeated three times, so the best result was taken for further analysis. A 20-minute warm-up was performed before each test. Seven tests were used to assess the level of mobility (http://www.topendsports.com/testing/tests/index.htm) which have been found to be reliable and valid for the assessment of the researched ability: Shoulder Circumduction Test (Lemmink, Kemper, de Greef, Rispens & Stevens, 2003), V Sit and Reach Test (Cuberek, Machová & Lipenská, 2013; Sporiš, Vučetić, Jovanović, Jukić & Omrčen, 2011), Groin Flexibility Test (Malliaras, Hogan, Nawrocki, Crossley & Schache, 2009), Back Scratch Test – left and right (Keith, Clark, Stump, Miller & Callahan, 2014) and Calf Muscle Flexibility Test – left and right (André, Carnide, Borja, Ramalho, Santos-Rocha & Veloso, 2016). In addition to flexibility tests, anthromoperative characteristics were measured as control variables in the study (height, mass), and then the body mass index (BMI) was calculated.

Statistical analyses

From the statistical descriptive parameters in the analysis, the arithmetic mean from the measures of central tendencies and the standard deviation from the measures of dispersion were used. From the comparative statistics, in order to obtain possible changes (differences) in three testings of flexibility in female exercisers, analysis of variance for dependent samples (repeated measures ANOVA) and post hoc analysis (Fisher LSD) were used to determine specific changes (differences) between tests. The significance level is $p < 0.05$.

Experimental program

Pilates trainings have been realized in the aerobics studio, three times a week (Tuesdays, Thursdays and Saturdays from 6 pm), for an hour. All training sessions were accompanied by music at a tempo of 60 to 80 bpm (beat per minute).

The structure of the training consists of three parts: introductory, main and final part of the training. The introductory part of the training consists of mobility exercises lasting 5 minutes and warm-up exercises lasting 10 minutes. At the beginning of each Pilates training, whole body mobility exercises are performed, so that the movements in the joints are performed with ease and their functionality is preserved. Each exercise is repeated 6 to 8 times, and the exercises are done either in isolation for a single joint or for several joints. In this part of the training, props such as

elastic bands, wooden sticks and massage rollers are used. The second part of the introductory part of the training includes warm-up exercises which prepare the body for the efforts in the main part of the training. All exercises are repeated 6 to 10 times.

The main part of the training lasts for 35 minutes, and the number of repetitions of each exercise is from 10 to 12. The exercises are aimed at strengthening and shaping certain muscle regions (arm muscles, gluteal region, lower extremity muscles, abdominal muscles and the back muscles. In this part, small and large balls, elastic weights and pilates hoops are used as props.

In the final part of the training, lasting 10 minutes, stretching exercises of large muscle groups and especially those muscles that were engaged in the main part of the training are applied. The emphasis in stretching exercises is to keep the extreme position to the limit of pain, for 20 to 40 seconds.

Results

In addition to the descriptive statistical parameters of all three testings, Table 1 presents the analysis of variance for dependent samples (repeated measures ANOVA) which calculated the changes in the mobility variables of Pilates female exercisers.

Table 1. *Descriptive statistics and significance of differences between testings*

	Descriptives (Mean±Std. Dev)			ANOVA	
Mobility variables	Pre-test	Mid-test	Post-test	F	Sig.
Shoulder Circumduction	46.88±16.21	44.31±14.85	40.06±12.4	34.28	.000*
V Sit and Reach Test	9.25±6.77	11.44±6.54	12.31±5.7	3.4	.047*
Groin Flexibility Test	7.13±4	5.63±3.2	3.94±1.61	18.89	.000*
Left Back Scratch Test	7.03±3.3	7.13±3.3	7.19±3.32	2.02	.150
Right Back Scratch Test	7.44±2.26	7.5±2.26	7.63±2.36	6.18	.006*
Left Calf Muscle Flex. Test	10.99±3.45	10.99±3.46	11.01±3.47	2.56	.094
Right Calf Muscle Flex. Test	10.94±2.62	10.95±2.63	10.96±2.64	1.55	.228

Statistically significant changes in the level of mobility were partially determined. In the variables Shoulder Circumduction (Sig. = .000), V Sit and Reach Test (Sig. = .047), Groin Flexibility Test (Sig. = .000) and Right Back Scratch Test (Sig. = .006) statistically significant changes are shown, while in other variables this was not the case.

In order to determine precisely between which testings there is a statistically significant change, an additional Post hoc analysis is approached using the Fisher LSD procedure for those variables in which statistical significance was recorded.

Table 2. *Post hoc results (Fisher LSD test)*

Shoulder Circumduction Test		Sig.	V Sit and Reach Test		Sig.
pre-test	mid-test	.004*	pre-test	mid-test	.081
	post-test	.000*		post-test	.017*
mid-test	post-test	.000*	mid-test	post-test	.475
	pre-test	.004*		pre-test	.081
post-test	pre-test	.000*	post-test	pre-test	.017*
	mid-test	.000*		mid-test	.475
Groin Flexibility Test		**Sig.**	**Right Back Scratch Test**		**Sig.**
pre-test	mid-test	.007*	pre-test	mid-test	.259
	post-test	.000*		post-test	.002*
mid-test	post-test	.003*	mid-test	post-test	.029*
	pre-test	.007*		pre-test	.259
post-test	pre-test	.000*	post-test	pre-test	.002*
	mid-test	.003*		mid-test	.029*

Table 2 shows the results of Post hoc analysis for mobility variables that show possible changes between each individual testing. In the Shoulder Circumduction Test and the Groin Flexibility Test, statistically significant changes were visible after the mid-test, and the changes intensified after the post-test. In the case of the V Sit and Reach Test, the Pilates program contributed to the changes only after the post-test, and only in relation to the beginning of the experimental treatment (Sig. = .017). The results in the Right Back Scratch Test show the progress in the second part of the Pilates program, because the changes are visible both in relation to the mid-test (Sig. = .029) and in relation to the pre-test (Sig. = .002).

Discussion

The application of the Pilates program in this study, in most tests positively affected the changes of mobility in female exercisers both in the upper part of the body, in the area of the shoulder girdle (Shoulder Circumduction Test – Sig. = .000; Right Back Scratch Test – Sig. = .006), and in the lower part of the body, in the area of the pelvic girdle and hip joint (V Sit and Reach Test – Sig. = .047; Groin Flexibility Test – Sig. = .000). A similar conclusion was reached by Rogers & Gibson (2009), who, after the eight weeks of Pilates exercise, found an improvement of mobility in the shoulder region (shoulder reach) and the pelvic region (sit-and-reach). They also noticed an improvement in the lower back extension.

It is interesting that in the Back Scratch Test only the right side showed a positive change after the program was performed, while in the left side this was not the case. This can be explained by the fact that all female exercisers are right-handed and that their right half of the shoulder region is more mobile, so the Pilates program also influenced better results in relation to the left side. In two tests that examined the mobility of the muscles that perform plantar flexion of the foot (Calf Muscle Flexibility Test), there were no statistically significant changes, although the results of plantar flexors of the left foot were close to statistical significance (Sig. = .094). It can be concluded that the duration of the Pilates program of 16 weeks was not enough to notice significant changes in this region of the body and that the results should be monitored over a longer period of time.

If the previous research on the topic of mobility under the influence of Pilates is analyzed, a number of similar results to this research can be seen, which indicate a positive effect of this type of exercise on mobility in different parts of the body. Pilates exercise has a positive effect on increasing the hamstring extensibility which further affects the increase in the inclination of the pelvis and trunk flexion (Vaquero-Cristóbal, López-Miñarro, Cárceles & Esparza-Ros, 2015; González-Gálvez, Marcos-Pardo,Trejo-Alfaro & Vaquero-Cristóbal, 2020). The improvement in the amplitude of the movement depends on the levels of stretching of the muscles that perform that movement. Under the influence of breathing techniques in Pilates exercise, an increase in the activity of the abdominal muscles during torso flexion is observed (Barbosa, Guedes, Bonifácio, Silva, Martins & Barbosa, 2015). Breathing technique in Pilates also helps patients with acute back pain who are subjected to operations of the back and have a restricted mobility (Tae-Sung-Hee & Joon, 2017). In addition to the mobility and endurance of the abdominal muscles, Pilates exercise also has a beneficial effect on the activity and mobility of the muscles of the lumbar region (Kibar et al., 2016).

It is believed that Pilates exercise through static stretching exercises has a positive effect on increasing of mobility in older women in the part of the trunk extension. (Oliveira, Oliveira & Pires-Oliveira, 2016). If a sample of older women is observed, Pilates exercise, in addition to torso mobility, also has a positive effect on the area of the upper extremities. Oliveira et al. (2017) found that Pilates exercise increases the isokinetic muscle strength of the flexors and extensors in the elbow joint in older women, which enables the functionality of the upper extremities. Pilates exercise also increases isokinetic muscle strength of flexors and extensors in the knee in older women (Oliveira, Oliveira & Pires-Oliveira, 2017), thus expanding its operations in lower extremities.

The positive effect of Pilates exercises can be seen in terms of isometric extension of the torso, as well as muscle strength during flexion in the hip joint (Kliziene et al., 2017). Based on the results of the research, it can be confirmed that in the period of 1–2 months after the end of the 16-week Pilates program as well, the endurance of the torso flexor muscles significantly depends on the endurance of the torso extensor muscles, which contributes to increased mobility of the observed region of the body.

Conclusion

Finally, it can be concluded that Pilates is an effective method of exercise to increase the mobility of different parts of the body. The research shows that increased levels of mobility as a result of Pilates can be seen in recreational athletes of different ages who exercise with the goal of improving physical abilities and well-being, but also in patients who have already had some postural disorder or some other type of health problem.

Regarding this paper, it was determined that the Pilates program improved the mobility of middle-aged women in most of the observed regions of the body, which was the goal of the research. The level of mobility was determined in the area of the shoulder and pelvic girdle and hip joint, as well as in the area of the lower leg and foot. After 16 weeks of Pilates exercises, there was an improvement in the shoulder and pelvic girdle and hip joint. However, it should be mentioned that in plantar flexors of the feet, a statistically significant improvement in mobility, under the impact of Pilates exercises, was not observed, which indicates the need for longer treatment of the applied Pilates program.

References

Anderson, B.D. & Spector, A. (2005). Introduction to Pilates Based Rehabilitation. *Orthopaedic Physical Therapy*. http://www.studioequilibrium.com.br/downloads/Introduction%20to%20Pilates-Based%20Rehabilitation.pdf.

André, H-I., Carnide, F., Borja, E., Ramalho, F., Santos-Rocha, R. & Veloso, A.P. (2016). Calf-raise senior: a new test for assessment of plantar flexor muscle strength in older adults: protocol, validity, and reliability. *Clinical Interventions in Aging*, *11*, 1661–1674. 10.2147/CIA.S115304.

Barbosa, A.V.C., Guedes, C.A., Bonifácio, D.N., Silva, A.F., Martins, F.L.M. & Barbosa, M.C.S.A. (2015). The Pilates breathing technique increases the electromyographic amplitude level of the deep abdominal muscles in untrained people. *Journal of Bodywork and Movement Therapy*, *19*(1), 57–61. 10.1016/j.jbmt.2014.05.011.

Byrnes, K., Wu, P-J. & Whillier, S. (2018). Is Pilates an effective rehabilitation tool? A systematic review. *Journal of Bodywork and Movement Therapy*, *22*(1), 192–202. https://doi.org/10.1016/j.jbmt.2017.04.008.

Cibinello, F.U., Jesus Neves, J.C., Leão Carvalho, M.Z., Valenciano, P.J. & Fujisawa, D.S. (2020). Effect of Pilates Matwork exercises on posterior chain flexibility and trunk mobility in school children: A randomized clinical trial. *Journal of Bodywork and Movement Therapy*, *24*(4), 176–181. https://doi.org/10.1016/j.jbmt.2020.06.016.

Cuberek, R., Machová, I. & Lipenská, M. (2013). Reliability of V Sit-and-Reach Test Used For Flexibility Self-assessment in Females. *Acta Univ. Palacki. Olomuc., Gymn*., *43*(1), 35–39. 10.5507/ag.2013.004.

Gleim, G.W. & McHugh, M.P. (1997). Flexibility and its effects on sports injury and performance. *Sports Medicine*, *24*(5), 289–299. https://link.springer.com/article/10.2165/00007256-199724050-00001.

González-Gálvez, N., Marcos-Pardo, P.J., Trejo-Alfaro, H. & Vaquero-Cristóbal, R. (2020). Effect of 9-month Pilates program on sagittal spinal curvatures and hamstring extensibility in adolescents: randomised controlled trial. *Scientific Reports*, *10*(1), 9977. 10.1038/s41598-020-66641-2.

González-Gálvez, N., Poyatos, M.C., Marcos-Pardo, P.J., Souza Vale, R.G. & Feito, Y. (2015). Effects of a pilates school program on hamstrings flexibility of adolescents. *Revista Brasileira de Medicina do Esporte*, *21*(4). https://doi.org/10.1590/1517-869220152104145560.

Gürhan, S. & Kenan, I., (2020). Investigation of the Effect of 8-Week Reformer Pilates Exercise on Flexibility, Heart Rate and Glucose Levels in Sedentary Women. *Asian Journal of Education and Training*, *6*(2), 226–230. 10.20448/journal.522.2020.62.226.230.

Hartono, G.E., Kesoema, T.A., Isma, R.A.P. & Anantyo, D.T. (2020). The Effect of Mat Pilates in Lumbar Flexibility of Overweight and Obese Children. *Diponegoro Medical Journal*, *9*(3), 220–224. http://ejournal3.undip.ac.id/index.php/medico.

Keith, N.R., Clark, D.O., Stump, T.E., Miller, D.K. & Callahan, C.M. (2014). Validity and Reliability of the Self-Reported Physical Fitness (SRFit) Survey. *Journal of Physical Activity and Health*, *11*(4), 853–859. 10.1123/jpah.2012-0264.

Kibar, S., Yardimci, F.Ö., Evcik, D., Ay, S., Alhan, A., Manço, M. & Ergin, E.S. (2016). Can a pilates exercise program be effective on balance, flexibility and muscle endurance? A randomized controlled trial. *The Journal of Sports Medicine and Physical Fitness*, *56*(10), 1139–1146. https://europepmc.org/article/med/26473443?mbid=synd_yahoohealth&client=bot&client=bot&client=bot.

Kılıç, T., Uğurlu, A., & Dikdağ, M. (2018). The Effect of REformer Pilates Exercises on Body Weight, Percent Body Fat and Flexibility in Sedentary Middle-aged Women. *SPORMETRE Journal of Physical Education and Sports Sciences, 16*(2), 153–161. https://doi.org/10.1501/Sporm_0000000362.

Kliziene, I., Sipaviciene, S., Vilkiene, J., Astrauskiene, A., Cibulskas, G., Klizas, S. & Cizauskas, G. (2017). Effects of a 16-week Pilates exercises training program for isometric trunk extension and flexion strength. *Journal of Bodywork and Movement Therapy*, *21*(1), 124–132. 10.1016/j.jbmt.2016.06.005.

Kloubec, J.A. (2010). Pilates for Improvement of Muscle Endurance, Flexibility, Balance, and Posture. *Journal of Strength and Conditioning Research*, *24*(3), 661–667. 10.1519/JSC.0b013e3181c277a6.

Knudson, D.V., Magnusson, P. & McHugh, M. (2000). Current issues in flexibility fitness. President's Council on Physical Fitness and Sports. *Research Digest*, *3*(10), 1–8. https://eric.ed.gov/?id=ED448119.

La Touche, R., Escalante, K. & Linares, M.T. (2008). Treating non-specific chronic low back pain through the Pilates method. *Journal of Bodywork and Movement Therapy*, 12, 364–370. https://doi.org/10.1016/j.jbmt.2007.11.004.

Latey, P. (2001). The Pilates method: history and philosophy. *Journal of Bodywork and Movement Therapy*, *5*, 275–282. https://doi.org/10.1054/jbmt.2001.0237

Latey, P. (2002). Updating the principles of the Pilates method – part 2. *Journal of Bodywork and Movement Therapy*, *6*, 94–101. 10.1054/

jbmt.2002.0289.

Lemmink, K.A.P.M., Kemper, H.C.G., de Greef, M.H.G., Rispens, P. & Stevens, M. (2003). The validity of the circumduction test in elderly men and women. *Journal of Aging and Physical Activity*, *11*(4), 433–444. https://doi.org/10.1123/japa.11.4.433.

Malliaras, P., Hogan, A., Nawrocki, A., Crossley, K. & Schache, A. (2009). Hip flexibility and strength measures: reliability and association with athletic groin pain. *British Journal of Sports Medicine*, *43*(10), 739–744. 10.1136/bjsm.2008.055749.

Miranda, La F., Souza, C., Schneider, A.T., Chagas, L.C. & Loss, J.F. (2017). Comparison of low back mobility and stability exercises from Pilates in non-specific low back pain: A study protocol of a randomized controlled trial. *Complementary Therapies in Clinical Practice*, 1–9. https://doi.org/10.1016/j.ctcp.2017.12.005.

Nuzzo, J.L. (2020). The Case for Retiring Flexibility as a Major Component of Physical Fitness. *Sports Medicine*, *50*, 853–870. https://doi.org/10.1007/s40279-019-01248-w.

Oliveira, F.C., Almeida, F.A. & Gorges, B. (2015). Effects of Pilates method in elderly people- Systematic review of randomized controlled trials. *Journal of Bodywork and Movement Therapy*, *19*(3), 500–508. https://doi.org/10.1016/j.jbmt.2015.03.003.

Oliveira, L.C., Oliveira, R.G. & Pires-Oliveira, D.A.A. (2016). Comparison between static stretching and the Pilates method on the flexibility of older women. *Journal of Bodywork and Movement Therapy*, *20*(4), 800–806. 10.1016/j.jbmt.2016.01.008.

Oliveira, L.C., Oliveira, R.G. & Pires-Oliveira, D.A.A. (2017a). Pilates increases the isokinetic muscular strength of the knee extensors and flexors in elderly women. *Journal of Bodywork and Movement Therapy*, *21*(4), 815–822. 10.1016/j.jbmt.2017.01.006.

Oliveira, L.C., Pires-Oliveira, D.A.A., Aducarub, A.C., Oliveira, L.S. & Oliveira, R.G. (2017b). Pilates increases isokinetic muscular strength of the elbow flexor and extensor muscles of older women: A randomized controlled clinical trial. *Journal of Bodywork and Movement Therapy*, *21*(1), 2–10. 10.1016/j.jbmt.2016.03.002.

Phrompaet, S., Paungmail, A., Pirunsan, U. & Sitilertpisan, P. (2011). Effects of Pilates Training on Lumbo-Pelvic Stability and Flexibility. *Asian Journal of Sports Medicine*, *2*(1), 16–2. 10.5812/asjsm.34822.

Rayes, A.B.R., Lira, C.A.B., Viana, R.B., Benedito-Silva, A.A., Vancini, R.L., Mascarin, N. & Andrade, M.S. (2019). The effects of Pilates vs. aerobic training on cardiorespiratory fitness, isokinetic muscular strength, body composition, and functional tasks outcomes for individuals who are overweight/obese: a clinical trial. *PeerJ*, 7, e6022. 10.7717/peerj.6022.

Rogers, K. & Gibson, A.J. (2009). Eight-week traditional mat Pilates training-program effects on adult fitness characteristics. *Research Quarterly for Exercise and Sport*, *80*(3), 569–574. 10.1080/02701367.2009.10599595.

Ružić, S. (2020). The Effects of Pilates With a Swiss Ball Program on Flexibility in Female College Students. *Facta Universitatis, Series Physical Education and Sport*, *18*(2), 439–446. https://doi.org/10.22190/FUPES200611041R.

Schroeder, J.M., Crussemeyer, J.A., & Newton, S.J. (2002). Flexibilty and heart rate response to an acute Pilates reformer session. *Medicine & Science in Sports & Exercise, 34*(5), S258. https://doi.org/10.1097/00005768-200205001-01443.

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*(12), 1977-1981. https://doi.org/10.1016/j.apmr.2004.01.036.

Sporiš, G., Vučetić, V., Jovanović, M., Jukić, I. & Omrčen, D. (2011). Reliability and Factorial Validity of Flexibility Tests For Team Sports. *Journal of Strength and Conditioning Research*, *25*(4), 1168–1176. 10.1519/JSC.0b013e3181cc2334.

Sung-Tae, K. & Joon-Hee, L. (2017). The effects of Pilates breathing trainings on trunk muscle activation in healthy female subjects: a prospective study. *Journal of Physical Therapy Science*, *29*(2), 194–197. 10.1589/jpts.29.194.

Vaquero-Cristóbal, R., López-Miñarro, P.A., Cárceles, F.A. & Esparza-Ros, F. (2015). The Effects Of The Pilates Method On Hamstring Extensibility, Pelvic Tilt And Trunk Flexion. *Nutricion Hospitalia*, *32*(5), 1967–1986. 10.3305/nh.2015.32.5.9678.

Vieira, N.D., Testa, D., Ruas, P.C., Salvini, T.F., Catai, A.M. & Melo, R.C. (2017). The effects of 12 weeks Pilates-inspired exercise training on functional performance in older women: A randomized clinical trial. *Journal of Bodywork and Movement Therapy*, *21*(2), 251–258. 10.1016/j.jbmt.2016.06.010.

Wells, C., Kolt, G.S. & Bialocerkowski, A. (2012). Defining Pilates exercise: A systematic review. *Complementary Therapies in Medicine*, *20*, 253–262. 10.1016/j.ctim.2012.02.005.

Primljen: 11. maj 2022. / Received: May 11, 2022
Prihvaćen: 30. maj 2022. / Accepted: May 30, 2022

https://doi.org/10.7251/SSH2201048K
Paper review

UDC: 796/799(497.16):339.9.012(4)"18/19"
Pregledni rad

The Influence of European Diplomats in Montenegro on the Development of Sport at the end of the XIX Century Until the Beginning of the First World War

Uticaj evropskih diplomata u Crnoj Gori krajem XIX vijeka na razvoj sporta do početka prvog svjetskog rata

Dragan Krivokapić, Milovan Ljubojević, Danilo Bojanić

Faculty of Sports and Physical Education, University of Montenegro, Montenegro

Correspondence:
Dragan Krivokapić
Faculty of Sports and Physical Education, University of Montenegro, Montenegro, dr.agan@t-com.me

Fakultet za sport i fizičko vaspitanje, Univerzitet Crne Gore, Crna Gora

Korespondencija:
Dragan Krivokapić
Fakultet za sport i fizičko vaspitanje, Univerzitet Crne Gore, Crna Gora, dr.agan@t-com.me

Abstract: *Decisions made at the Berlin Congress in 1878. finally resolved the issue of Montenegro's international status. This created the conditions for European countries to open their diplomatic embassies in Cetinje - the Principality of Montenegro. During this period, diplomatic activities with European countries intensified, which led to the emergence and development of new, hitherto unknown sports in Montenegro. Foreign diplomats contribute to getting to know, accepting and developing modern sports in Montenegro, which they themselves have been involved in. Arriving at the diplomatic embassies of their countries, they brought to Cetinje appropriate sports equipment and their own sports equipment which, after the construction of appropriate sports fields, they used for the first sports and recreational activities, until then mostly unknown in Montenegro. Thus, the first tennis rackets, golf equipment, skis, skates, rollerblades ..., arrived in the capital with foreign diplomats, for which the members of the prince's family and the court entourage showed great interest and soon got involved and mastered new sports and recreational activities. Shortly afterwards, these sports became interesting and accepted by a number of Cetinje residents, which resulted in the opening of several new sports clubs.*

Keywords: *the development of sports, diplomats, sport clubs, Montenegro.*

Sažetak: *Odlukama donešenim na Berlinskom kongresu 1878.godine Crna Gora je kroz razgraničenje sa okolnim državama definisala svoj međunarodno-pravni status. Time su stvoreni uslovi da u Cetinju - prijestonici Knjaževine Crne Gore, evropske države otvaraju svoja diplomatska predstavništva-poslanstva. U ovom periodu dolazi do intenziviranja diplomatske aktivnosti sa evropskim državama, što je dovelo do pojave i razvoja novih, do tada uglavnom, nepoznatih sportova u Crnoj Gori. Strane diplomate doprinose upoznavanju, prihvatanju i razvijanju modernih sportova u Crnoj Gori, kojima su se inače i sami bavili. Dolaskom u diplomatska poslanstva svojih država na Cetinju donose odgovarajuće sportske rekvizite i svoju sportsku opremu koju su ubrzo, nakon izgradnje odgovarajućih sportskih terena, koristili za prve sportsko-rekreativne aktivnosti, do tada nedovoljno poznate u Crnoj Gori. Tako u prestonicu sa stranim diplomatama ujedno stižu i prvi teniski reketi, oprema za golf, skije, sličuge i drugi sportski rekviziti za koje su se prvo zainteresovali članovi Knjaževe porodice i dvorska svita koji su se ubrzo uključili i ovladali osnovnim tehnikama i pravilima novih sportsko-rekreativnih aktivnosti. Nedugo potom, ovi sportovi su zainteresovali i bili prihvaćeni od jednog broja stanovnika Cetinja što je rezultovalo otvaranjem više novih sportskih klubova.*

Ključne reči: *razvoj sporta, diplomate, sportski klubovi, Crna Gora.*

Introduction

One of the most significant events in the European history of the nineteenth century is the Berlin Congress in 1978 on which Montenegro demarcated from the surrounding countries and thus defined its international legal sovereignty. In that way, conditions were met for European

Uvod

Jedan od značajnijih događaja u evropskoj istoriji devetnaestog vijeka predstavlja održavanje Berlinskog kongresa 1878. godine kojim se Crna Gora razgraničila sa okolnim državama i time definisala svoj međunarodno-pravni suverenitet. Tako su stvoreni

countries to open their diplomatic missions in Cetinje – the old royal capital of the principality of Montenegro. Thus, in the following period diplomatic missions of the following countries were open: England, Germany, Russia, Austria-Hungary, Turkey, the USA, Belgium, Bulgaria, Greece, Serbia, Italy, so during this period there were up to 12 missions-embassies in Cetinje (International Recognition of Montenegro, 1999). Numerous diplomats introduced new habits and manners to this smallest metropolis in Europe and contributed to learning about, accepting and developing modern sports in Montenegro they had previously played. It is known that in Europe during that period many sports were well developed and defined by rules and that European diplomats were happy to play sports such as: tennis, golf, ice-skating, fencing etc. which due to specific and demanding conditions necessary for their organisation were not available to wider social classes.

Coming to diplomatic missions of their countries in Cetinje, they brought adequate sports equipment that they soon, after the construction of adequate sports fields in Cetinje, used for sports and leisure activities until then mostly unknown in Montenegro. Thus, the first tennis rackets, golf equipment, skis, skates, rollerblades arrived in the old royal capital with foreign diplomats, and Prince Nikola and his numerous family members were the first to get acquainted with the current rules and techniques of using sports equipment brought by European diplomats.

In the period that preceded in Montenegro, physical exercise had more of a character of military preparation and took place through various types of competition in disciplines applicable in frequent war situation. For that reason, in the period prior to defining its state-legal status in Montenegro there weren't any organised sport competitions in sports developed in Europe and defined by generally accepted rules or sports clubs. Only with opening of many missions and with the arrival of European diplomats do sports activities in this period get the preconditions for more intensive development that was followed by the construction of a larger number of tennis courts, one golf course and skating rink. Soon other less known sports appeared and developed and numerous sports clubs with increasing number of members opened as well.

Methods

Historical method as well as a set of research procedures on events that happened in the past were used in this paper. Its use was achieved in several stages: In the first stage heuristic method was used in terms of collecting relevant data and covering of historical material through mostly secondary written sources. In the second

uslovi da u Cetinju - prestonici Knjaževine Crne Gore, evropske države otvaraju svoja diplomatska predstavništva. Tako se u prestonici u narednom periodu otvaraju diplomatska predstavništva: Engleske, Njemačke, Rusije, Austro-Ugarske, Turske, SAD, Belgije, Bugarske, Grčke, Srbije i Italije pa je tokom ovog perioda na Cetinju bilo i do 12 poslanstava-ambasada, (Međunarodno priznanje Crne Gore, 1999). Brojne diplomate unose nove navike i ponašanja u ovu najmanju metropolu u Evropi i doprinose upoznavanju, prihvatanju i razvijanju modernih sportova u Crnoj Gori, kojima su se prethodno inače i sami bavili. Poznato je da su u Evropi u tom periodu bili dobro razvijeni i pravilima definisani mnogi sportovi, a da su se evropske diplomate rado bavile sportovima kao što su: tenis, golf, klizanje na ledu, mačevanje i sl. a koji zbog specifičnih i zahtjevnih uslova potrebnih za njihovo organizovanje nisu bili dostupni širim društvenim slojevima. Dolaskom u diplomatska poslanstva svojih država na Cetinje oni donose odgovarajuće sportske rekvizite i svoju sportsku opremu koju su ubrzo, nakon izgradnje odgovarajućih sportskih terena na Cetinju, koristili za sportsko-rekreativne aktivnosti, do tada uglavnom nepoznate u Crnoj Gori. Tako u prestonicu sa stranim diplomatama ujedno stižu i prvi teniski reketi, oprema za golf, skije, klizaljke, koturaljke, a Knjaz Nikola i njegova brojna porodica se prvi upoznaju sa važećim pravilima i tehikom korištenja sportskih rekvizita i opreme koju su donijeli evropske diplomate.

U periodu koji je prethodio u Crnoj Gori fizičko vježbanje je imalo više karakter vojne pripreme i odvijalo se kroz razne vidove nadmetanja u disciplinama primjenjivim u čestim ratnim situacijama. Iz tog razloga, u periodu prije definisanja svog državno-pravnog statusa u Crnoj Gori nije bilo organizovanih sportskih takmičenja u sportovima koji su bili razvijeni u Evropi i definisani opšteprihvaćenim pravilima niti sportskih klubova. Tek otvaranjem brojnih poslanstava i dolaskom evropskih diplomata sportske aktivnosti u ovom periodu dobijaju preduslove za intenzivniji razvoj koji je zatim uslijedio izgradnjom većeg broja teniskih terena, jednog golf terena i klizališta. Ubrzo je došlo do pojave i razvoja i drugih, do tada manje poznatih sportova kao i otvaranja brojnih sportskih klubova sa sve većim brojem članova.

Metode

U ovom radu je korišten istorijski metod, kao skup istraživačkih postupaka o događajima koji su se zbili u prošlosti. Njegova primjena je ostvarena u nekolike faze:

stage – critics of sources, the analysis of the mentioned historical sources was carried out, whereas in the third, i.e. final stage – exposition, the results of the analysis of the mentioned historical sources were presented.

Historical sources

A great number of significant information on development of sports in Montenegro was left by foreign travel writers, diplomats, military officials and writers who wrote with a lot of inspiration about customs, lifestyle and sports competition in this area. A travel writer Viala de Somier (Somier, 1995), a French high-ranking official, left interesting records on sports in Montenegro. He talks about it with a lot of inspiration in the book "Historical and Political Journey to Montenegro", in which his writings abound with descriptions of knight competitions of Montenegrins, in which elements of competition, sports and physical culture are present in a broader sense.

Significant data on Montenegrin sports from the end of 19th century were left by the Norwegian captain Henrich Augusto Angell (Angle, 1991) who travelled through Montenegro in 1893 and left behind the travelogue "Through Montenegro on Skis". Angel was enchanted by Montenegrin landscapes and people, impressed by the appearance of what was then probably the smallest metropolis in Europe, where he was greeted with honours at the Montenegrin court.

The writer Simo Matavulj (Matavulj, 1923) often stayed in the Kingdom of Montenegro, who in his book "Notes of a Writer" gave a picturesque description of athletic competition, organized in honour of the arrival of a foreign ruler in Cetinje. In the mentioned book he talks about the level of development of sports in this area and the enviable level of physical fitness of Montenegrins.

The writer Ljubomir Nenadović often stayed in Montenegro and wrote about it with a lot of enthusiasm. (Nenadović, 1929). Among other things, he wrote about sports competitions that were the integral part of the life of the Montenegrin people and that can be traced back centuries through history.

In his text, Ljubomir Nenadović writes: "Playing the fiddles, singing, shooting from a rifle were their common parties. Together with their teacher, they ran, jumped, threw stones over

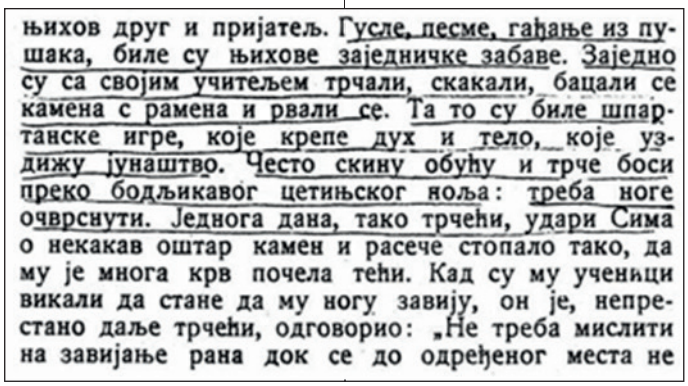

њихов друг и пријатељ. Гусле, песме, гађање из пушака, биле су њихове заједничке забаве. Заједно су са својим учитељем трчали, скакали, бацали се камена с рамена и рвали се. Та то су биле шпартанске игре, које крепе дух и тело, које уздижу јунаштво. Често скину обућу и трче боси преко бодљикавог цетињског поља: треба ноге очврснути. Једнога дана, тако трчећи, удари Сима о некакав оштар камен и расече стопало тако, да му је многа крв почела тећи. Кад су му ученици викали да стане да му ногу завију, он је, непрестано даље трчећи, одговорио: „Не треба мислити на завијање рана док се до одређеног места не

Figure 1. *Part of the text in which Nenadović in 1929 describes exercises and competitions of Montenegrins – On Montenegrins, p. 124.*

U prvoj fazi primjenjena je metoda heuristike, u smislu prikupljanja relevantnih podataka i obuhvatanja istorijske građe kroz uglavnom sekundarne pisane izvore. U drugoj fazi - kritici izvora, pristupilo se analizi pomenutih istorijskih izvora dok je u trećoj, odnosno završnoj fazi - ekspoziciji, izvršen prikaz rezultata do kojih se analizom pomenutih istorijskih izvora došlo.

Istorijski izvori

Veliki broj značajnih informacija o razvoju sporta u Crnoj Gori ostavili su strani putopisci, diplomate, vojni zvaničnici i književnici koji su sa puno nadahnuća pisali o običajima, načinu života i sportskim nadmetanjima na ovim prostorima. Putopisac Viala de Somier (Somier, 1995), inače Francuski visoki činovnik, ostavio je zanimljive zapise o sportu u Crnoj Gori. O tome, sa puno nadahnuća govori u knjizi „Istorijsko i političko putovanje u Crnu Goru", u kojoj njegovi zapisi obiluju opisima viteških nadmetanja Crnogoraca, u kojima su prisutni elementi takmičenja, sporta i fizičke kulture u širem smislu.

Značajne podatke o crnogorskom sportu s kraja XIX vijeka ostavio je norveški kapetan Henrich Augusto Angell, (Angel, 1991) koji je proputovao je kroz Crnu Goru 1893. godine i iza sebe ostavio putopis „Kroz Crnu Goru na skijama". Angel je bio očaran crnogorskim pejzažima i ljudima, bio je impresioniran izgledom tada vjerovatno najmanje metropole u Evropi u kojoj je dočekan sa počastima na crnogorskom dvoru.

U Kraljevini Crnoj Gori je često boravio književnik Simo Matavulj , (Matavulj, 1923), koji je u svom djelu "Bilješke jednog pisca" dao slikovit opis atletskog takmičenja, upriličenog u čast dolaska jednog inostranog vladara u Cetinje. U navedenom djelu govori o stepenu razvijenosti sporta na ovim prostorima i zavidnom nivou fizičke pripremljenosti crnogoraca.

Književnik Ljubomir Nenadović, često je boravio u Crnoj Gori i sa puno zanosa pisao o njoj (Nenadović, 1929). Između ostalog, pisao je i o sportskim nadmetanjima koja su bila sastavni dio života crnogorskog naroda i koja se mogu pratiti vjekovima kroz istoriju.

Slika 1. *Dio teksta u kojem Nenadović, 1929. opisuje vježbanja i nadmetanja crnogoraca - O Crnogorcima, str. 124.*

their shoulders and wrestled. These were spartan games that strengthen the mind and body, that elevate heroism".

Đuro Laković, (Laković, 2000), a scientific worker from Podgorica examined some phenomena analogous to sports in Montenegro. Although the manuscript titled Knight's Games in Montenegro has not been completed, it speaks in its own way about the sports enthusiasm of the people in this area and in the distant past.

Rastko Radunović (Radunović, 1980), a historian of sports and physical culture from Podgorica, published a long article in the journal Physical Culture entitled The Emergence and Development of Modern Sports in Montenegro until 1914, in which he presented a set of important data and gave some instructions for further research.

A very respectable source of information on the development of physical culture in this period are the books of historians Dr. Novak Jovanovic (Jovanovic, 1994) and Djuro Lakovic (Lakovic, 2000), which mostly served as a source of information and inspiration in the preparation of this paper.

Discussion

Montenegrin old royal capital Cetinje, in the period from Berlin Congress to the beginning of the World War I had the intensive cultural development thanks to the successful cooperation with the European states, which was followed by establishment of various sports societies and clubs. It should be especially emphasized that the first golf club in today's Western Balkans was established in Cetinje in 1906 and the sponsor of this organization was the princess Milica-Juta, the wife of the Crown Prince Danilo, the eldest son of the prince Nikola. The golf course was located in so-called Nova Varoš – a new part of the town, near the building of the Italian Embassy.

At the opening ceremony, the first game was played by the Princess and then members of the club were taking turns until dusk.

Figure 2. *"Glas Crnogorca" no.20 (20 June) in an article on establishment of the Golf Club in Cetinje*

(Golf club.) Под високим покровитељством Њеног Краљ. Височанства Књагиње Милице, на Цетињу је основан Golf club у којему су највише чланови из свијетлог двора и дипломатског кора. За клуб је узето земљиште између села Умаца и новог талијанског посланства поред самог колског пута који води к Ловћену. Припреме за отварање клуба и његову организацију чине се по упуствима г-ђе баронесе Кун и секретара турског посланства г. Џевад беја. Кад се врате на Цетиње чланови узвишене Књажевске Породице, клуб ће бити на свечан начин отворен у присуству свију својих чланова.

Slika 2. *Glas Crnogorca" br. 20, (20.juna)1906. - Članak o osnivanju golf kluba u Cetinju*

Đuro Laković, (Laković, 2000), naučni radnik iz Podgorice proučavao je neke pojave analogne sportu na tlu Crne Gore. Iako rukopis kojem je dao naslov Viteške igre u Crnoj Gori nije do kraja završen, on na svoj način govori o sportskom entuzijazmu naroda na ovim prostorima i u daljoj prošlosti.

Rastko Radunović, (Radunović, 1980), istoričar sporta i fizičke kulture iz Podgorice objavio je u časopisu Fizička kultura duži prilog pod naslovom Pojava i razvoj modernog sporta u Crnoj Gori do 1914. godine, u kojem je prezentirao niz značajnih podataka i dao neka uputstva za dalja istraživanja.

Veoma respektivan izvor informacija o razvoju fizičke kulture u ovom periodu predstavljaju knjige istoričara dr Novaka Jovanovića, (Jovanović, 1994) i Đura Lakovića (Laković, 2000) koje su nam najvećim dijelom poslužile kao izvor informacija i inspiracija u pripremi ovog rada.

Diskusija

Crnogorska prijestonica Cetinje, u vremenskom periodu od Berlinskog kongresa do početka Prvog svjetskog rata ima intenzivan kulturni razvoj zahvaljujući uspješnoj diplomatskoj saradnji sa evropskim državama, što je pratilo osnivanje raznih sportskih društava i klubova.

Posebno treba istaći da je 1906. godine na Cetinju formiran prvi golf klub na prostorima današnjeg zapadnog Balkana a pokrovitelj ove organizacije je bila knjeginja Milica-Juta supruga prestolonasljednika Danila, najstarijeg sina knjaza Nikole. Igralište se nalazilo u tzv. Novoj Varoši - novom dijelu grada, u neposrednoj blizini zgrade Italijanskog poslanstva. Na svečanom otvaranju prvu partiju je odigrala knjeginja, a onda su se do sumraka smjenjivali članovi kluba.

(Голф Клуб на Цетињу) Под високом заштитом Њеног Краљ. Височанства Престолонаслеђнице Књагиње Милице, у четвртак у 4½ час. послије подне било је званично отварање Голф Клуба. Њихова Краљ. Височанства Књаз Господар, Књагиња, Књаз Наслеђник, Престолонаслеђница, Књагиња Наталија, Књагиње Ксенија и Вјера и сви чланови Голф Клуба били су сакупљени; а у 5 час. Њ Кр Височанство Књагиња Престолонаслеђница прва је отпочела прву игру. Послије прве игре послужени су присутни чајем на самоме земљишту, гдје се налази Голф Клуб, и тако се та занимљива енглеска игра продужила до у сами мрак уз свирку војне музике, која је за вријеме чаја и игре свирала веселе комаде. Тек у 7½ час. Узвишена Књажевска Породица и сва присутна господа и даме разишли су се, задржавши у најпријатнијој успомени почетак ове занимљиве спортне игре.

Figure 3. *"Glas Crnogorca" no.27 (8 July) 1906., an article on opening of the Golf Club in Cetinje*

Slika 3. *Glas Crnogorca",br.27 (8.jula) 1906. - Članak o otvaranju Golf kluba u Cetinju*

Figure 4. *Ceremony regarding opening of the Golf club in Cetinje*

Slika 4. *Svečanost povodom otvaranja golf kluba u Cetinju*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

Figure 5. *Golf game at the club opening: Milica-Juta, wife of the Crown Prince Danilo*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 5. *Partija golfa na otvaranju kluba: Kneginja Milica - Juta, supruga prestolonasljednika Danila*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

Figure 6. *Golf club with which Princess Princess Milica-Juta made her first hit is kept in the Museum of Cetinje*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 6. *Štap za golf kojim je knjeginja Milica-Juta izvela prvi udarac čuva se u cetinjskom Muzeju*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

However, this game was and remains the privilege of a small circle of people, mostly the diplomatic corps and members of the ruling house. This fact is pointed out by the sports historian Radunović, 1980 in his paper: "The emergence and development of modern sports in Montenegro until 1914." This important event greatly complemented the rich sports history of Montenegro, where modern sports such as skating, tennis, football, fencing, skating, etc. began to develop. By founding these clubs, Montenegro has connected with European countries in the field of sports and thus formed the foundations of the rich Montenegrin history of sports.

Tennis can be said to have kept pace with the western parts of the Balkans or to be slightly behind them (Martinović, B. 1999). According to the author, data for this claim were found in a review published in England, a country that is extremely fond of this sport. A photo was published there, accompanied by the text "Montenegrin prince playing tennis in Cetinje"

Ova igra je ipak bila i ostala privilegija uzanog kruga ljudi, uglavnom diplomatskog kora i članova vladajuće kuće. Na tu činjenicu, ukazuje i istoričar sporta Radunović, 1980. u svom naučnom radu: "Pojave i razvoj modernog sporta u Crnoj Gori do 1914. godine" Ovaj značajni događaj uveliko je upotpunio bogatu sportsku istoriju Crne Gore, na čijem prostoru su počeli da se razvijaju moderni sportovi, poput klizanja, tenisa, fudbala, mačevanja, skejtinga, itd. Osnivanjem ovih klubova, Crna Gora se i na sportskom planu povezala sa evropskim državama i time formirala temelje bogate crnogorske istorije sporta.

Za tenis se može reći da je išao ukorak sa zapadnim dijelovima Balkana ili je zanemarljivo malo, kasnio (Martinović, B. 1999). Podaci za ovakvu tvrdnju nađeni su, prema navodima ovog autora u jednoj reviji izdatoj u Engleskoj, zemlji koja je ovom sportu izuzetno naklonjena. Tamo je objavljena fotografija koju prati tekst "Crnogorski Knjaz igra tenis na Cetinju"

Figure 7. *Review ZICK-Z: Montenegrin prince playing tennis in Cetinje*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 7. *Revija ZICK-Z: Crnogorski Knjaz igra tenis na Cetinju*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

And under that title, the text says that the Montenegrin prince received Mr. Michael Kalt Zejtig and his officers in Cetinje during the summer visit of the British Mediterranean fleet to the Bay of Kotor. The reception was followed by a tennis game organized by the wife of the British MP. It is further stated that the prince was dressed in a complete Montenegrin costume and that he played tennis well. Although Prince Nikola was familiar with tennis, since he graduated from the Lyceum of Louis the Great in Paris, this sport entered Montenegro only after the Berlin Congress, when foreign diplomatic representatives started coming to Cetinje. It was necessary to increase the diplomatic corps and gather a sufficient number of members in order for white sports to come to life in Montenegro.

There was a number of tennis courts among the diplomatic missions, which Martinović talks about, 1999. Also, Radunović, 1980 in the previously quoted text on the beginnings of modern sports in Montenegro gives approximate data, mentioning "a dozen courts" in Cetinje that existed in the early twentieth century. Radunović also states the fact that the first tennis club in Montenegro was founded in this city, in 1906, at the Italian embassy.

At first, tennis was played by diplomats and courtiers. It was not available to the wider masses. Only since 1906, since the founding of the tennis club, have the gates of tennis courts been opened for citizens, but there was still a small number of those who played this sport, Martinović, 1999. In the circle of embassies in Cetinje, a number of tennis courts has survived to this day. In his study on Cetinje, Martinović, 1999, says that tennis in Cetinje was especially developed at the end of the last and the beginning of this century, that there were 11 tennis courts in the city.

A ispod toga naslova, u tekstu piše da je crnogorski knjaz za vrijeme ljetne posjete britanske mediteranske flote kotorskom zalivu primio gospodina Majkla Kalta Zejtiga i njegove oficire na Cetinju. Poslije prijema uslijedila je partija tenisa koju je priredila supruga britanskog poslanika. Dalje se navodi podatak da je knjaz bio obučen u kompletnu crnogorsku nošnju i da je dobro igrao tenis. Iako je knjazu Nikoli tenis bio poznat, budući da je završio Licej Luja Velikoga u Parizu, ovaj sport ulazi u Crnu Goru tek poslije Berlinskog kongresa, kad su na Cetinje počeli da dolaze strani diplomatski predstavnici. Bilo je potrebno da se diplomatski kor uveća i okupi dovoljan broj članova kako bi bijeli sport zaživio u Crnoj Gori.

U krugu diplomatskih predstavništava je bio i jedan broj teniskih terena, o kojima govori Martinović, 1999. Takođe, i Radunović, 1980. u ranije citiranom tekstu o počecima modernog sporta u Crnoj Gori daje približan podatak, pominjući "desetak terena" koji su na Cetinju postojali početkom XX vijeka. Radunović navodi i podatak da je u ovom gradu, pri Italijanskom poslanstvu osnovan prvi teniski klub u Crnoj Gori, i to 1906. godine.

Tenisom su se u prvo vrijeme bavili diplomati i dvorska svita. On nije bio dostupan širim narodnim slojevima. Tek od 1906. godine, od osnivanja teniskog kluba, otvaraju se kapije teniskih igrališta za građanstvo, ali je i dalje bio mali broj onih koji su se bavili ovim sportom, Martinović, 1999. U krugu poslanstva na Cetinju, ostao je do danas sačuvan jedan broj teniskih igrališta.

U svojoj studiji o Cetinju, Martinović, 1999. kaže da je tenis na Cetinju krajem prošlog i početkom ovog vijeka bio naročito razvijen, da je u gradu bilo 11 teniskih igrališta.

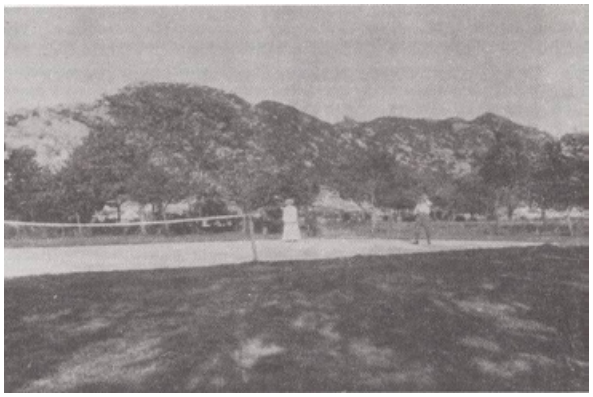


Figure 8. *Tennis court behind the Italian Embassy*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 8. *Teniski teren iza Italijanskog poslanstva*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

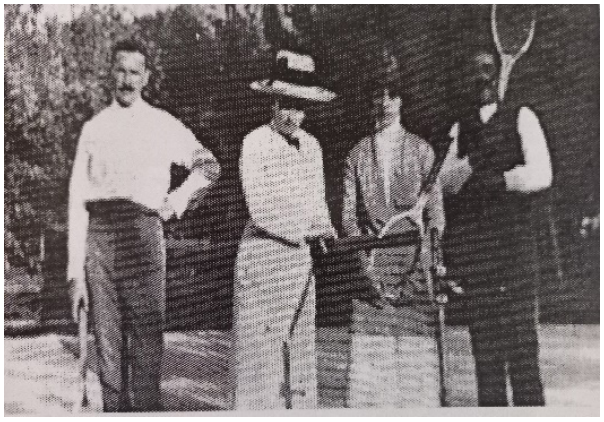


Figure 9. *Prince Danilo with his wife Milica and wife of English diplomat at the tennis class at the tennis court*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 9. *Knjažević Danilo sa suprugom Milicom i suprugom engleskog diplomate na času tenisa na dvorskom igralištu*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

In Cetinje, in 1891, the Society for Gymnastics, Skating and Fighting was formed. But this fight was really about fencing. So, the organization of fencing started early, through the appropriate association. This section consisted mainly of officers (Montenegro did not yet have a standing army), and students who studied abroad, in various European countries. Three years later, the Gorski vijenac society was founded and had a fencing section, Jovanović, 1994.

When it comes to the phenomenon of ice skating, a sport called skating (tociljanje) at the time, we will quote

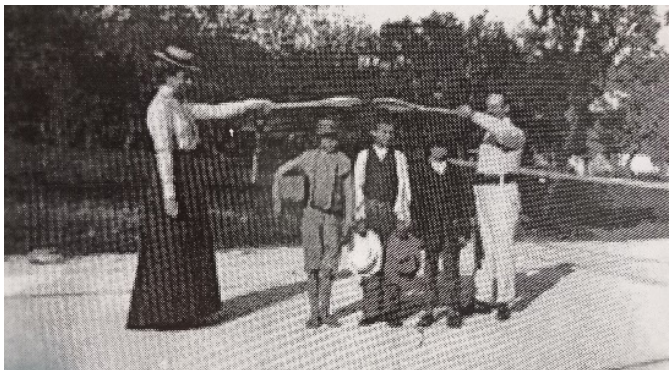


Figure 10. *Milica Juta Meklenburg with Austrian diplomat and ball collectors at the tennis court*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 10. *Milica (Juta) Meklenburg sa austrijskim diplomatom i sakupljačima lopti na teniskom terenu*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

Figure 11. *Princesses Milica, Natalia and Vjera after the finished tennis game accompanied by the Austrian diplomat and his wife*

/ Image taken from the monograph: Martinović, B. (1999). One hundred years of tennis in Montenegro 1894-1994 /

Slika 11. *Princeze: Milica, Natalija, Ksenija i Vjera nakon odigrane partije tenisa u pratnji austrijskog diplomate i njegove supruge*

/Slika preuzeta iz monografije: Martinović, B. (1999). Sto godina tenisa u Crnoj Gori 1894-1994./

Na Cetinju je 1891. godine formirano Društvo za gimnastiku, tociljanje i borenje. A to borenje se ustvari odnosilo na mačevanje. Dakle, rano se počelo sa organizovanjem mačevanja, preko odgovarajuće asocijacije. Tu sekciju su činili uglavnom oficiri (Crna Gora još nije imala stajaću vojsku), i studenti koji su se školovali na strani, po raznim evropskim zemljama. Tri godine kasnije osnovano društvo Gorski vijenac ima sekciju za mačevanje, Jovanović, 1994.

a faithful description of the ice rink left to us by the Norwegian Angell in his book Through Montenegro on Skis, Angel, 1991.

"Who would have believed that there will be a skating rink in Montenegro, and that is really great?" When you pass by the Court, and break through the really scary snowdrifts, and go a little more further along the path of the Prince Park, you first see the Prince Chapel with the old Monastery, and right next to it, on the field, a beautiful little skating rink. And what if there were no ice rinks here? It's cold enough and there are enough athletes, and the plumbing is the first class. Next to the rink is a changing room, as well as a buffet room for receptions, there is a new fire hose to pour ice every night, and oriental lamps and lanterns - and sometimes the prince's orchestra plays. It's hard to make a better rink. "

Soon, on October 30, 1892, the "Constitution of the Cetinje Skating Society" was adopted, which specifies the goals of the society, who can be a member, under what conditions, what are the obligations of a member, etc.

Kad je u pitanju pojava klizanja na ledu, sporta koji se u to doba naziva tociljanje citiraćemo vjeran opis klizališta koji nam je ostavio Norvežanin Angell u svoj knjizi Kroz Crnu Goru na skijama, Angel, 1991.

„Ko bi vjerovao da će se u Crnoj Gori naći klizalište, i to zaista izvrsno? Kad se prođe pokraj Dvora, i probije nekako između zbilja zastrašujućih smetova, i krene još malo stazom duž Kneževskog parka, prvo ugledate Kneževsku kapelu sa starim Manastirom, a odmah kraj nje, na poljani, predivno malo klizalište. A što da ovdje nema klizališta? Dovoljno je hladno i sportista ima dovoljno, a vodovod je prvoklasan. Uz klizalište je odaja za presvlačenje, kao i prostorija za bife kad su prijemi, tu je i novi vatrogasni šmrk da se poliva led svake večeri, pa orijentalne svjetiljke i luče - a ponekad svira i kneževski orkestar. Teško da se može napraviti bolje klizalište".

Ubrzo, već 30. oktobra 1892. godine donijet je "Ustav cetinjskog klizačkog društva", kojim se preciziraju ciljevi društva, ko može biti član, pod kojim uslovima, koje su obaveze člana itd.

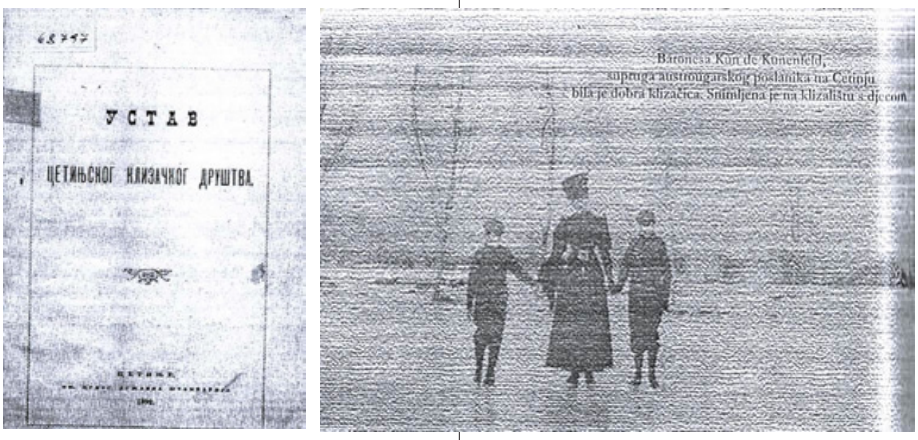


Figure 12. and Figure 13. *The Constitution of the ice skating society in Cetinje from 1892 and Baroness Kun de Kunenfeld with her children at the skating rink below Orlov Krš in Cetinje*

(https://montenegrina.net/nauka/istorija/crna-gora-u-xix-v/vladavina-knjaza-kralja-nikole/crna-gora-je-imala-klizaliste-prije-115-godina-branislav-borilovic/)

Slika 12. i Slika 13. *Ustav Cetinjskog klizačkog društva iz 1892.g. i Baronesa Kun de Kunenfeld sa svojom djecom na klizalištu ispod Orlovog Krša na Cetinju*

https://montenegrina.net/nauka/istorija/crna-gora-u-xix-v/vladavina-knjaza-kralja-nikole/crna-gora-je-imala-klizaliste-prije-115-godina-branislav-borilovic/

The first skis were brought to Montenegro by a Norwegian traveler, an adventurer, the aforementioned captain of the Norwegian Royal Army, Henrich Augusto Angell (Angel, 1995), who arrived in Kotor in January 1893 and then traveled via Njegusi to Cetinje by the usual route for foreigners. From Cetinje, still on skis, he continued his journey to the northwestern border of Montenegro. Along the way, he passed Rijeka Crnojevića, Podgorica, Danilovgrad and Nikšić and demonstrated the skill

Prve skije u Crnu Goru donio je norveški putnik, pustolov, već pomenuti kapetan norveške kraljevske vojske, Henrich Augusto Angell, (Angel, 1995) koji je januara 1893. godine stigao u Kotor, a zatim se, za strance uobičajenom maršrutom, uputio preko Njeguša za Cetinje. Sa Cetinja je, i dalje na skijama, nastavio put do sjeverozapadne granice Crne Gore. Usput je prošao Rijeku Crnojevića, Podgoricu, Danilovgrad i Nikšić i svuda demonstrirao vještinu skijanja, a to je imalo izvanredan

of skiing everywhere, and this was of great importance for the promotion of this sport, Jovanović, 1994. People began to wonder where to get skis; the first orders of unusual boards went from Montenegro to Vienna.

značaj za propagandu ovog sporta, Jovanović, 1994. Ljudi su se počeli naglo interesovati gdje se mogu nabaviti liže (skije); iz Crne Gore su u Beč pošle prve porudžbine neobičnih dasaka.

Figure 14. *Norwegian captain and travel writer Henrich Augusto Angell, the author of the book "Through Montenegro on Skis" originally written in Norwegian language and then translated*

(https://www.portalanalitika.me/clanak/292357--angel-crnogorci-se-isticu-u-odnosu-na-sve-narode-koji-ih-okruzuju)

Slika 14. *Norveški kapetan i putopisac Henrich Augusto Angell autor knjige" Kroz Crnu Goru na skijama" u orginalu napisana na norveškom jeziku pa prevedena.*

(https://www.portalanalitika.me/clanak/292357--angel-crnogorci-se-isticu-u-odnosu-na-sve-narode-koji-ih-okruzuju)

At the end of January 1893, Angell completed his mission in Montenegro, returned to Cetinje, and left a fond memory here - his skis.

At the end of this review of the influence of European diplomats on the development of sports in Montenegro until the beginning of the World War I, according to sports historian Jovanovic, 1994, it is important to mention A famous Montenegrin diplomat in Paris - Duke Gavro Vukovic, whose son Mihailo-Mišo Vuković in 1904 brought the first soccer ball to Cetinje, which contributed to the development of football in this area. According to the same source, the first Montenegrin football club was soon formed in Cetinje. Husein Tuzović, (Tuzović, 1986) quotes:

"The first ball was brought to Podgorica in 1909 by Aleksin Miller, a representative of a trading company from England. Miller played football and hockey. The playground was on the site where today there is the building of the Republic Health Insurance Association of Montenegro, near the current stadium of Budućnost. Soon, the first football matches began to be played in Podgorica as well."

At the end of this review of the development of sports in Montenegro from the acquisition of international legal sovereignty in the late nineteenth century to the beginning of the World War I, the opening of numerous embassies and the arrival of European diplomats, sports

Krajem januara 1893. godine Angell je završio svoju misiju po Crnoj Gori, vratio se na Cetinje, i ovdje je ostavio lijepu uspomenu - svoje skije.

Na kraju ovog pregleda uticaja evropskih diplomata na razvoj sporta u Crnoj Gori do početka prvog svjetskog rata prema pisanju istoričara sporta Jovanović, 1994. značajno je navesti i jednog poznatog crnogorskog diplomatu u Parizu - vojvodu Gavra Vukovića čiji je sin Mihailo-Mišo Vuković 1904. godine donio prvu fudbalsku loptu na Cetinje čime je doprinijeo razvoju fudbala na ovim prostorima. Prema istom izvoru, u Cetinju se ubrzo formira prvi fudbalski klub "Crnogorac".

Husein Tuzović, (Tuzović, 1986). navodi:

"Prvu loptu je u Podgoricu donio 1909. godine Aleksin Miler, predstavnik jedne trgovačke firme iz Engleske. Miler se bavio fudbalom i hokejom. Igralište je bilo na mjestu gdje se danas nalazi zgrada Republičke zajednice zdravstvenog osiguranja Crne Gore, u neposrednoj blizini sadašnjeg stadiona Budućnosti. Ubrzo su i u Podgorici počele da se igraju prve fudbalske utakmice.

Na kraju ovog prikaza razvoja sporta u Crnoj Gori od sticanja svog međunarodno-pravnog suvereniteta krajem devetnaestog vijeka pa do početka prvog svjetskog rata otvaranje brojnih poslanstava i dolazak evropskih diplomata, sportske aktivnosti u ovom periodu dobijaju preduslove za intenzivan razvoj koji je zatim i uslijedio. Izgradnja većeg broja teniskih terena, jednog golf terena i

activities in this period are prerequisites for intensive development that followed. The construction of a larger number of tennis courts, one golf course and skating rink, the emergence and development of other, hitherto lesser-known sports with the opening of numerous sports clubs made a significant contribution to the overall development of Montenegrin sports in that period, which significantly approached to the European sports trends.

klizališta, pojava i razvoj drugih, do tada manje poznatih sportova uz otvaranja brojnih sportskih klubova dalo je značajan doprinos ukupnom razvoju crnogorskog sporta u tom period, koji se time značajno približio evropskim sportskim trendovima.

References

Angel, H. (1991). *Kroz Crnu Goru na skijama*. Republički fond za fizičku kulturu Titograd. [in Montenegrian]
Glas Crnogorca, br.20 i br. 27, 1906.godine.
Jovanović, N. (1994). *Sport u Crnoj Gori do 1914.godine*. Izdavački centar Cetinje. Jas Promet – Cetinje. Str. 40. [in Montenegrian]
Laković, Đ. (2000). *Momačke viteške igre*. Ministarstvo sporta Vlade republike Crne Gore, Podgorica. [in Montenegrian]
Martinović, B. (1999). *Sto godina tenisa u Crnoj Gori*. Kulturno-prosvjetna zajednica Podgorica, Teniski savez Crne Gore. [in Montenegrian]
Matavulj, S., (1923). *Bilješke jednog pisca*, Beograd, izdavač: Vreme-Beograd.
Međunarodno priznanje Crne Gore (1999). *Zbornik radova sa naučnog skupa*, Nikšić 11-12 maj 1998.god. Podgorica. [in Montenegrian]
Nenadović, Lj. (1929). *O crnogorcima: pisma sa Cetinja 1878.godine.* Beograd, štamparija "Sveti Sava" str, 124 i 209. [in Montenegrian]
Radunović, R. (1980). Pojave i razvoj modernog sporta u Crnoj Gori do 1914.godine, *Fizička kultura, časopis za stručna i društvena pitanja*, Titograd, br.1/1980, str 109-116. [in Montenegrian]
Tuzović, H., Šest decenija titogradske "Budućnosti" -*Fizička kultura*, VII /1986. Br.1
Viala de Somier (1995). *Istorijsko i političko putovanje u Crnoj Gori.* CID Podgorica. [in Montenegrian]

Internet sources

https://montenegrina.net/nauka/istorija/crna-gora-u-xix-v/vladavina-knjaza-kralja-nikole/crna-gora-je-imala-klizaliste-prije-115-godina-branislav-borilovic/
/Accessed on: 12 March 2020/ [in Montenegrian]
https://www.portalanalitika.me/clanak/292357--angel-crnogorci-u-odnosu-na-sve-narode-koji-ih-okruzuju /Accessed on: 15 March 2020/ [in Montenegrian]

Primljen: 07. april 2022. / Received: April 07, 2022
Prihvaćen: 19. maj 2022. / Accepted: May 19, 2022

https://doi.org/10.7251/SSH2201058V
UDC: 797.253-053.4/.5
Short notice
Kratko saopštenje

Construction and Validation of Arm Wingate Test for Determination of Anaerobic Abilities in Water Polo Juniors

Konstrukcija i Validacija Ručnog Wingate Testa za Procjenu Anaerobnih Sposobnosti Vaterpolo Juniora

Dario Vrdoljak, Tea Kaić, Ognjen Uljević

Faculty of kinesiology, University of Split, Split, Repubic of Croatia

Correspondence:
Dario Vrdoljak
Faculty of kinesiology, University of Split, Republic of Croatia
dariovrdoljak24@gmail.com

Kineziološki fakultet, Univerzitet u Splitu, Republika Hrvatska

Korespondencija:
Dario Vrdoljak
Kineziološki fakultet, Univerzitet u Splitu, Republika Hrvatska
dariovrdoljak42@gmail.com

Abstract: *The Wingate test is a widely spread test of anaerobic endurance and power in most sports. However, the standard model of the test is based upon a bicycle ergometer for evaluation of lower extremities, therefore, is poorly used in sports that demand a high level of upper body power. This research aims to determine the metric characteristics of the newly constructed arm crank Wingate test. The sample of participants is junior water polo players of VK Mornar Brodospas from Split, Croatia. Mean chronological age is 17-19 years and all participants participated in the test voluntarily. Results are showing a satisfactory level of reliability, homogeneity, and sensibility of measuring instrument and good application in sports such as water polo. Further research should include a bigger sample of participants and athletes from different sports.*
Keywords: *metric characteristics, Wingate test, measuring instrument, hand ergometer.*

Sažetak: *Wingate test je široko rasprostranjeni test anaerobne izdržljivosti i snage u većini sportova. Međutim, standardni oblik testa se zasniva na bicikl ergometru za procjenu donjih ekstremiteta te je slabo primjenjiv u sportovima koji zahtijevaju visoku razinu snage gornjeg dijela tijela. Cilj rada je utvrditi metrijske karakteristike novo konstruiranog ručnog Wingate testa. Uzorak ispitanika predstavljaju juniorski vaterpolisti VK Mornar Brodospasa iz Splita, kronološke dobi 17-19 godina te su svi sudionici pristupili testiranju dobrovoljno. Rezultati prikazuju zadovoljavajuću razinu pouzdanosti, homogenosti i osjetljivosti mjernog instrumenta te dobru primjenu u sportovima kao što je vaterpolo. Daljnja istraživanja trebala bi uključivati veći broj sudionika te sportaša iz drugih sportova.*
Ključne reči: *Metrijske karakteristike, Wingate test, ručni ergometar.*

Introduction

Many sports are characterized as interval sports. Precisely, they possess multiple changes in maximal and submaximal intensity periods. Short periods of maximal intensity require a high level of anaerobic capacities from athletes. Anaerobic capacity is defined as the work of the body without oxygen and it depends on anaerobic systems of each athlete. Therefore, many studies suggest that qualitative evaluation of anaerobic endurance is necessary for success in stated sports (Al-Hazzaa, Almuzini, Al-Refaee, & et al., 2001; Hoffman & Maresh, 2000). Furthermore, the importance of evaluating anaerobic capacities in sport is noticed in the development of profile-specific physical profiles, evaluation of the training processes, and evaluation of physical demands in various sports (Kalinski, Norkowski, Kerner, & Tkaczuk, 2002).

Uvod

Vaterpolo je timski sport koji kombinira plivanje, šutiranje i hrvanje. Spada pod polistrukturalne, acikličke, konvencionalne sportove kao što su košarka i rukomet. Moderni vaterpolo je jako zahtjevna aktivnost koja kombinira intenzivan rad kojeg slijedi period manjeg intenziteta (Lozovina i Pavičic, 2004). Pored brojnih izmjena u ritmu igre, igrači imaju intenzivne periode međusobne kontakt igre. Zbog svoje specifičnosti vaterpolo zahtjeva od igrača veliku snagu i anaerobnu izdržljivost gornjeg dijela tijela posebno mišića ruku i ramenog pojasa. Međutim, u praksi je jako mali broj testova kojima se procjenjuje snaga i anaerobna izdržljivosti mišića ruku i ramenog pojasa.

Standardni Wingate test se zasniva na 30 sekunda cikličnog ergometra za evaluaciju izlazne snage pojedinca (Beneke, Pollmann, Leithe i Hutler, 2002; Wilson, Snyder

Water polo is a team sport that combines swimming, shooting, and wrestling. It is described as polystructural, acyclic, conventional sports such as basketball and handball. Modern water polo is a highly demanding activity that combines intensive work which is followed by periods of lower intensity (Lozovina & Pavicic, 2004). In addition to numerous changes in game rhythms, players have intensive periods of mutual contact. A high level of strength and anaerobic endurance of the upper body is needed because of specific demands in water polo. However, there is a small number of tests that determine the strength and anaerobic endurance of arms and shoulder girdle muscles.

Wingate test is based on 30 seconds of maximal effort to evaluate the output power of an individual (Beneke, Pollmann, Leithe & Hutler, 2002; Wilson, Snyder & Dorman, 2009) and it is a proven method for evaluation and prediction of lower body muscle extremities performances. Many test variants had been used previously, however, standard tests using bicycle ergometers (Lee, Oh, Gil, & Kim, 2021; Perez-Gomez, Rodriguez, Olmedillas, et al., 2008) and arm ergometers (Forbes, Kennedy & Bell, 2014; Kumar, Singh, Apte, & Kolekar, 2021) are mostly used methods. Namely, in sports that demand upper body strength usage of a bicycle-ergometer for the lower body isn't an applicable test. Therefore, the arm ergometer presents a good method to evaluate listed parameters for some sports.

Following that, this study aimed to determine the reliability and validity of the newly constructed arm Wingate test (AWT) for usage in specific sports.

Methods

Sample of participants

This study was conducted on a sample of participants of 7 junior water polo players from VK Mornar Brodospas, Split, Croatia. The chronological age of participants was 17-19 years and all of them were in good psycho-physical health. Mean body height was 187,00±5,23 and body mass 86,29±7,99. All participants volunteered for testing.

Sample of variables

A sample of variables was made of participants' anthropometric parameters: body mass (BM) and body height (BH). Furthermore, output parameters of AWT were used: Peak Power (PP), average power (AP), minimal power (MP,) and Power drop or, the difference between peak and minimal power (PD).

i Dorman, 2009). Test se izvodi 30 sekunda maksimalnog napora suprotstavljajući se konstantnom opterećenju. Opterećenje u testu iznosi 7,5% pojedinčeve tjelesne mase za muškarce (Bar-Or, 1987). Standardni test se izvodi na bicikl ergometru koristeći donje ekstremitete te je dokazana metoda za evaluaciju i predikciju performanse mišićnih skupina donjih ekstremiteta (Meckel, Atterborn, Grodjinovsky, Ben-Sira i Rotstein, 1995; Perez-Gomez, Rodriguez, Olmedillas et al., 2008). Većina istraživanja koja koriste Wingate test služe se standardnim modelom ergometra (Meckel, Atterborn, Grodjinovsky, Ben-Sira i Rotstein, 1995; Patton i Duggan, 1987; Legaz-Arrese, Munguia-Izguierdi, Carranza-Garcia i Torres-Davila, 2011) te je mali broj koji koristi ručni ergometar (Forbes, Kennedy i Bell, 2014; Guglielm i Denadai, 2000). Naime, u sportovima koji zahtijevaju snagu gornjih ekstremiteta korištenje bicikl-ergometra za donje ekstremitete nema korisnu primjenu. Stoga, ručni ergometar predstavlja dobru metodu kod evaluacije navedenih parametara za pojedine sportove. Prethodna istraživanja (Forbes, Kennedy i Bell, 2014), koriste ručni ergometar za procjenu opterećenja prema spolu. Najrasprostranjeniji model ručnog ergometra je sjedeća varijanta gdje ispitanik cikličkim pokretima izvodi test. Ovakav oblik testa može uključivati primjenu i drugih skupina mišića, od strane pojedinca, te ne izolira mišićne skupine ruku i ramenog pojasa. Ovaj problem nastaje primarno zbog položaja u kojem se ispitanik nalazi.

Slijedom navedenog, cilj ovog rada bio je utvrditi pouzdanost i valjanost novo konstruiranog Wingate ručnog testa za primjenu kod specifičnih sportova (u ovom slučaju, vaterpolo).

Metode

Uzorak ispitanika

Uzorak ispitanika sačinjava 7 juniorskih vaterpolista igrača VK Mornar Brodospasa, iz Splita. Kronološka dob ispitanika je 17-19 godina te su svi bili dobrog psiho-fizičkog zdravlja. Ispitanici su bili prosječne tjelesne visine 187,00±5,23 te prosječne tjelesne mase 86,29±7,99. Svi ispitanici su dobrovoljno sudjelovali u testiranju.

Procedura testiranja

Ispitanicima je izmjerena tjelesna masa (BM) koristeći digitalnu vagu u svrhu postavljanja valjanog opterećenja te tjelesna visina (BH) koristeći antropometar. Nakon mjerenja BM s ispitanicima je provedeno 15 minutno standardizirano zagrijavanje prije provođenja Wingate testa. Tijekom mjerenja koristio se Monark 894e bi-

Testing procedure

Participants' BM was measured using a digital scale for setting valid load, and BH was measured using the anthropometer. Participants did 15 minutes of standardized warm-up routine before executing AWT. Testing was done on the Monark 894e bicycle ergometer repurposed for this study, Monark Anaerobic Test Software was also used. Pedals of the ergometer were changed for arm usage and the bench was placed so that test could be done in a lying position.

The participant was positioned in a lying manner on the bench in front of the ergometer in the way that center of the shoulder girdle is at the same level as the center of the pedal rotation. The participant was fixed on the bench with adjustable slings so that (as much as it could be) muscles of the arms and shoulder girdle could be isolated during the test. Difference in the procedure of executing the leg Wingate test and AWT is in load which for AWT amounts to 2%BM. The retest was done seven days after the first testing session.

Statistical analysis

Examined metric characteristics of measuring instrument for evaluation of anaerobic abilities of upper extremities were following parameters: PP, AP, MP, and PD. Values are calculated for: the reliability-correlation test, sensitivity-Kolmogorov-Smirnov test, and homogeneity-T-test. All of the data was processed in the computer program software Statistica ver 13.00.

Results

Table 1. *Correlation analysis for assessment of reliability*

Variables	PP [W]1	PP [W/kg]1	AP [W]1	MP [W]1	MP [W/kg]1	PD [W]1
PP [W]	0.76					
PP [W/kg]	0.86	0.87				
AP [W]	0.33	-0.10	0.89			
MP [W]	0.43	0.01	0.98	0.87		
MP [W/kg]	0.57	0.31	0.82	0.72	0.82	
PD [W]	0.58	0.44	0.03	-0.35	-0.51	0.72

Table 1. shows correlation analysis for evaluation of the reliability of the measuring instrument.

Table 1. shows the results of correlation analysis between two trials, positive and significant correlations were obtained between variables.

Descriptive parameters of participants with the K-S test for determination of measuring instrument sensitivity are shown in table 2.

cikl ergometar prenamijenjen u svrhu istraživanja, kao i Monark Anaerobic Test Software. Pedale ergometra su zamijenjene za ručnu upotrebu te je postavljena klupica kako bi ispitanici mogli izvršiti testiranje u ležećem položaju.

Ispitanika se postavilo u ležeći položaj na prethodno namještenu klupicu na način da središte ramenog obruča bude u razini centra vrtnje pedala ergometra. Nakon što se ispitanik pravilno pozicionira podesivim trakama se stabilizira u navedeni položaj. Test započinje laganim kretanjem do postizanja 100 rpm (rpm – brzina obrtaja u minuti) nakon čega se ispitaniku daje znak za start te se otpušta opterećenje od 2% BM. Nakon otpuštanja opterećenja vrši se maksimalni napor suprotstavljanja opterećenju u trajanju od 30 sekunda. Ponovljeno testiranje ili retest se radio sedam dana nakon prvog testiranja.

Obrada podataka

U svrhu utvrđivanja metrijskih karakteristika mjernog instrumenta za procjenu anaerobnih sposobnosti gornjih ekstremiteta promatrani su parametri: Maksimalna snaga (PP), prosječna snaga (AP), Minimalna snaga (MP) i Power drop ili razlika između maksimalne snage i minimalne snage (PD). Izračunate su vrijednosti za: pouzdanost-test korelacije, osjetljivost-Kolmogorov-Smirnov test te homogenost-T-test.

Svi dobiveni podaci su obrađeni u kompjuterskom softwareu Statistica ver 13.00.

Rezultati i Diskusija

Tablica 1. *Korelacijska analiza za procjenu pouzdanosti*

Analizom dobivenih podataka vidljivo je da mjerni instrument ima zadovoljavajuću pouzdanost te se greška u mjerenju svela na minimum. Također, treba naglasiti kako su dobiveni rezultati izuzetno zadovoljavajući s obzirom na veličinu uzorka, jer je poznato kako se s povećanjem broja ispitanika povećava i pouzdanost testa.

Deskriptivni parametri ispitanika uz K-S test za procjenu osjetljivosti mjernog instrumenta prikazani su u tablici 2.

Table 2. *Descriptive analysis and Kolmogorov-Smirnov test for sensitivity assessment*

Variables	N	AS± SD	Min	Max	K-S/d
BH	7	187.00±5.23	180	195	0.14
BW	7	86.29±7.99	77	96	0.21
PP [W]	7	288.86±35.68	250.53	339.71	0.24
PP [W/kg]	7	3.36±0.37	2.78	3.75	0.26
AP [W]	7	172.01±18.57	140.36	195.53	0.18
MP [W]	7	104.20±22.42	77.54	137.85	0.16
MP [W/kg]	7	1.21±0.20	0.91	1.5	0.23
PD [W]	7	184.66±29.65	147.06	224.16	0.15
BH	7	187.00±5.23	180	195	0.14

Legend: *N-number of participants; AS±SD-arithmetic mean and standard deviation; Min-Minimum; Max-maximal; K-S/d-Kolmogorov-Smirnov test.*

Table 2. shows the results of descriptive statistics and values of the K-S test which indicate that tested sample has normal data distribution.

For homogeneity of the measuring instrument T-test analysis was used and is shown in table 3.

Table 3. *T-test for homogeneity assessment*

Variables	AS	SD	t	p
PP [W]	288.86	35.68		
PP [W]1	282.86	42.72	0.56	0.59
PP [W/kg]	3.36	0.37		
PP [W/kg]1	3.29	0.59	0.57	0.59
AP [W]	172.01	18.57		
AP [W]1	168.90	21.53	0.83	0.44
MP [W]	104.20	22.42		
MP [W]1	98.86	27.96	1.00	0.35
MP [W/kg]	1.21	0.20		
MP [W/kg]1	1.15	0.25	1.00	0.36
PD [W]	184.66	29.65		
PD [W]1	184.01	47.91	0.05	0.96

Legend: *AS- arithmetic mean; SD- standard deviation; t-T-test; p-level of statistically significant differences p<0,005.*

Analysis of Table 3. Indicate that significant differences were not found between variables of test and retest. Furthermore, by looking at the values of the test it can be said that the measuring instrument has good homogeneity.

Tablica 2. *Deskriptivna analiza i Kolmogorov-Smirnov test za procjenu osjetljivosti*

Legend: *N-broj ispitanika; AS±SD-aritmetička sredina i standrardna devijacija; Min-Minimalan rezulatat; Max-maksimalan rezultata; K-S/d-Kolmogorov-Smirnov test.*

Analizom dobivenih podataka vidljivo je kako mjerni instrument nema značajnih razlika te postoji normalna distribucija rezultata. Pretpostavlja se kako mjerni instrument posjeduje dobro razlikovanje ispitanika prema izlaznim parametrima testa zbog toga što niti jedna varijabla ne prelazi graničnu liniju upotrebom K-S testa (Max d za 0,05 iznosi 0,48).

T-testom procijenjena homogenost mjernog instrumenta vidljiva je u tablici 3.

Tablica 3. *T-test za procjenu homogenosti*

Legend: *Mean-srednja vrijednost; SD-standrardna devijacija; t-T-test; p-nivo statističke značajnosti razlika p<0,005.*

Analizom tablice 3 vidljivo je kako izračunati parametar značajnosti nema značajnu razliku u nijednom izlaznom parametru testa. Ovakvi podaci ukazuju kako primjena ovog mjernog instrumenta ima dobru homo-

Discussion

Results of correlation analysis (0,72-0,89) point out that the AWT test has satisfactory reliability. This implies that results derived from the test and retest are similar, respectively with small deviations. Also, it should be emphasized that results are exceptionally satisfactory taking into count the number of participants because it is known that with an increase of participants, the reliability of the test also increases. Furthermore, the distribution of the results of AWT is within borders of normal distribution (Max d for 0,05 amounts to 0,48) which implies that this test has satisfactory sensibility. The anthropometric characteristics of participants in our study are similar to previous studies (Uljević, Esco & Sekulić, 2014). Although this data is not directly connected with the aim of this study, it could be concluded that, despite the small number of participants, they are a representative sample. Also, the results of the T-test are not showing significant differences in all variables which implies that the measuring instrument has satisfactory homogeneity because it doesn't differ same participants in two trials.

Some previous studies (Guglielmo & Denadai, 2000; Bampouras & Marrin, 2009) show a deficiency in standard Wingate test in comparison to some specific anaerobic tests in sport. Therefore, it is possible that lying AWT has better pragmatism than the Wingate test, for which is necessary to compare newly constructed AWT with specific tests.

Conclusion

The aim of this study was the construction and validation of a lying version of the Wingate test for the evaluation of anaerobic endurance and upper extremities strength. Results are showing the three most important findings. First, the good reliability of the test is shown due to the small sample of participants. Second, tests have good sensitivity and normal result distribution. Third, between the two trials, there are no significant differences in results and confirm good homogeneity.

Also, this type of test could be applicable in sports similar to water polo, such as swimming, wrestling, or throwing athletic disciplines. The advantages of this test are noninvasive measurement of a great number of parameters for anaerobic endurance and strength analysis in athletes. Therefore, good isolation of the aforementioned muscle groups is possible. Future studies should include a larger sample of participants and athletes from other sports, as well as other metric characteristic dimensions such as pragmatic validity, etc.

genost te ne razlikuje ispitanike u mjerenjima na 1. i 2. provedenom testiranju.

Zaključak

Anaerobna izdržljivost i snaga gornjih ekstremiteta je od krucijalne važnosti za određene sportove kao što je vaterpolo, primarno zbog intenziteta i kontakta između sportaša. Stoga, testovi koji mjere navedene parametre bi trebali imati valjane metrijske karakteristike.

Novo konstruirani Wingate test prikazuje zadovoljavajuće metrijske karakteristike u dimenzijama pouzdanosti, homogenosti i osjetljivosti te je moguće prikazati stvarne rezultate u prethodno navedenim parametrima sportaša. Pouzdanost testa se očituje u zadovoljavajućoj raspodjeli rezultata između odabranih varijabli u oba testiranja ispitanika. Nadalje, homogenost je vidljiva u ne postojanju značajnih razlika između testa i retesta, dok je osjetljivost dokazana ne odstupanjem K-S testa od graničnih rezultata u nijednoj promatranoj varijabli.

Također, ovakav oblik testa moguće je primjenjivati na sportove slične vaterpolu kao što su: plivanje, hrvanje ili bacačke atletske discipline. Prednosti ovog testa su neinvazivno mjerenja velikog broja parametara za analizu anaerobne izdržljivosti i snage kod sportaša. Stoga, moguća je dobra izolacija navedenih mišićnih skupina od ostataka tijela. Daljnja istraživanja trebala bi uključivati veći broj sudionika te sportaša iz drugih sportova, kao i ostale dimenzije metrijskih karakteristika primjerice kao pragmatična valjanost itd.

References

Al-Hazzaa HM, Almuzini KS, Al-Refaee SA, Sulaiman MA, Dafterdar MY, Al-Ghamedi A, Al-Khuraiji KN. (2001). Aerobic and anaerobic power characteristics of Saudi elite soccer players. *Journal of Sports Medicine and Physical Fitness, 41*:54-61.

Bampouras, T. M., & Marrin, K. (2009). Comparison of two anaerobic water polo-specific tests with the Wingate test. *The Journal of Strength & Conditioning Research*, *23*(1), 336-340.

Beneke, R., Pollmann, C. H., Bleif, I., Leithäuser, R., & Hütler, M. (2002). How anaerobic is the Wingate Anaerobic Test for humans?. *European journal of applied physiology*, *87*(4), 388-392.

Forbes, S. C., Kennedy, M. D., Boule, N. B., & Bell, G. (2014). Determination of the optimal load setting for arm crank anaerobic testing in men and women. *International journal of sports medicine*, *35*(10), 835-839.

Guglielmo, L. G. A., & Denadai, B. S. (2000). Assessment of anaerobic power of swimmers: the correlation of laboratory tests on an arm ergometer with field tests in a swimming pool. *Journal of Strength and Conditioning Research*, *14*(4), 395-398.

Hoffman JR, Maresh CM. (2000). Physiology of basketball. In: Garrett Jr. WE, Kirkendall DT, editors. Exercise and sports science. Philadelphia: Lippincott Williams & Wilkins. p. 733-44.

Kalinski, M., Norkowski, H., Kerner, M., & Tkaczuk, W. (2002). Anaerobic power characteristics of elite athletes in national level team-sport games. *European Journal of Sport Science*, *2*(3), 1-21.

Kumar, A., Singh, R. K., Apte, V. V., & Kolekar, A. (2021). Comparison between seated medicine ball throw test and Wingate test for assessing upper body peak power in elite power sports players. *Indian Journal of Physiology and Pharmacology*, *64*(4), 286-291.

Lee, K. L., Oh, T. W., Gil, Y. C., & Kim, H. J. (2021). Correlation between muscle architecture and anaerobic power in athletes involved in different sports. *Scientific Reports*, *11*(1), 1-8.

Lozovina, V., & Pavicic, L. (2004). Anthropometric changes in elite male water polo players: survey in 1980 and 1995. *Croatian medical journal*, *45*(2), 202-205.

Perez-Gomez, J., Rodriguez, G. V., Ara, I., Olmedillas, H., Chavarren, J., González-Henriquez, J. J., ... & Calbet, J. A. (2008). Role of muscle mass on sprint performance: gender differences?. *European journal of applied physiology*, *102*(6), 685-694.

Uljevic, O., Esco, M. R., & Sekulic, D. (2014). Reliability, validity, and applicability of isolated and combined sport-specific tests of conditioning capacities in top-level junior water polo athletes. *The Journal of Strength & Conditioning Research*, *28*(6), 1595-1605.

Wilson, R. W., Snyder, A. C., & Dorman, J. C. (2009). Analysis of seated and standing triple Wingate tests. *The Journal of Strength & Conditioning Research*, *23*(3), 868-873.

Primljen: 13. mart 2022. / Received: March 13, 2022
Prihvaćen: 07. april 2022. / Accepted: April 07, 2022

https://doi.org/10.7251/SSH2201064V
UDC: 793.3.012.2:37.014.53
Short notice
Kratko saopštenje

Impact of Motor Learning on Overall Skill-Related Anxiety

Tihomir Vidranski[1], Ivana Klaričić[2], Dejan Dragić[1]
[1]Department of Social Sciences and Humanities, University of Slavonski Brod, Croatia
[2]Faculty of Kinesiology, University Josip Juraj Strossmayer Osijek, Croatia

Correspondence:
Tihomir Vidranski, Department of Social Sciences and Humanities, University of Slavonski Brod, Croatia
vidranskit@gmail.com

Abstract: *The aim of this research is to determine the differences in participants' overall anxiety and its factors before and after the motor skill learning process. A sample consisted of 96 examinees, college students who attended 3 learning sessions of a handspring vault in a crouch position. Students estimated their own anxiety by a questionnaire on a scale 1 – 4 at the beginning of the learning process and before the third session. Total anxiety is constructed of 3 factors: somatic, cognitive and self-confidence. The results showed that the highest manifestation of student's anxiety was in the self-confidence referring to the highest (the worst) result, then in cognitive factor and the lowest in somatic factor. The average overall student's anxiety reduced from 2.26 to 1.83, and the reduction (improvement) is manifested in all three anxiety factors. Anxiety reduction could be affected by adaptation processes, higher level of motor skill performance, controlled condition in the learning process, and interaction of all mentioned. The conclusion is that the motor learning can reduce the skill-related anxiety so it is recommended that high-anxiety participants are retained in the learning process.*

Keywords: *anxiety factors, college students, learning process, motor skill.*

Introduction

Anxiety is an emotional state that is manifested through irritability, tension, psychosomatic disorders, crying bursts, aggression, decision making difficulties, insomnia and depression (Lebedina Manzoni, 2007). It is also manifested through many physiological changes including increased heart frequency, increased blood pressure, and tension of the body all of which indicate the hyperactivity of the vegetative nervous system. Its possible cause is the human need for understanding, anticipating and controlling events in their own lives (Kelly, 1955, stated in Larsen & Buss, 2008). But as a result of the inability to understand and anticipate life events anxiety occurs. People become anxious when events are unpredictable, out of their control. On the other hand, because of uncertainty of anxiety, the person tries to materialize it by wrongly associating it with a particular object, situation or illness (Milivojević, 2010).

Symptoms of anxiety are manifested in 4 main areas: physical (somatic), emotional, cognitive and behavioral. During childhood anxiety generally increases with age (Achenbach, Howell, Quay, & Conners, 1991 stated in Oatley & Jenkins, 2007). Anxiety has many negative effects that can prevent normal functioning in different aspects of everyday life in various ways.

During school-age, school phobia or rejection of school occurs, which is an irrational fear of some aspects of school occasions. Physiological symptoms of anxiety or panic occur when offset becomes inevitable leading to partial or complete inability of school attendance (Wenar, 2002). Children and adolescents experience a great deal of stress, and as the most frequently mentioned source of stress in school age children is failure (Halstead, Cunningham, and Bennett Johnson, 1993 stated in Vizek Vidović, Rijavec, Vlahović-Štetić, & Miljković, 2014). Anxiety often occurs in situations where there are performance-related pressures, when failure has serious consequences and also when there is competition and comparison between students (Wigfield & Eccles, 1989, stated in Woolfolk, 2016). One of the occurring forms is test anxiety that causes a fall of success in the test situation. The reason is the action of two groups of factors: inadequate cognitive processes and elevated excitation of the autonomic nervous system (Liebert & Moriss, 1967 stated in Vizek Vidović et al., 2014). Highly test anxious students have a large number of distracting thoughts that hinder the recollection and problem solving. Their thoughts are directed to the possible negative consequences of failure in the test situation (Vizek Vidović et al., 2014).

Anxiety related to the motor activity is specific in relation to anxiety that is not related to motor activity (Bortoli,

& Robazza, 1995). Anxiety negatively affects performance at different levels of management, attention, interpretation but also the physical (motor) aspect (Nieuwenhuys & Oudejans, 2017). The same authors state that it also negatively affects the familiarity with situations and decision making referring to those situations. Furthermore, the feeling and perception of insecurity, anxiety and threat can interfere the motor learning and motor performance (Bortoli & Robazza, 1994). According to Ekornas, Lundervold, Tjus, and Heimann (2010), children with determined anxiety show impaired performance of motor skills and have a poor self-assessment of peer acceptance and body competence compared to the non-anxious children. In their research, Skirbekk, Hansen, Oerbeck, Wentzel-Larsen, and Kristensen (2012) determined that up to 19 children (46% of the sample) with established anxiety had results below the fifth percentile on the motor impairment test (M-ABC), indicating that motor function in anxious children is impaired to such an extent that they interfere with their everyday life activities.

According to Jones and Cale (1989), somatic anxiety is negatively related with the cognitive status ("digit span test"), while on the other hand, self-confidence and somatic anxiety are positively related with speed of motor performance. These findings suggest that somatic anxiety might be an important source of variation in motor performance. Anxiety is a factor that can also affect the reduced ability of motor visualization ("motor imagery"), which is an important factor in the motor learning process (Kahraman, Savci, Ozdogar, & Gedik 2018). Furthermore, Smith, Burwitz, and Jakeman (1988) determined that successful performance of motor tests in highly anxious conditions but only in front of spectators is increased. But, while evaluating the same performance under competitive conditions, performance was reduced. Likewise, anxiety also had an effect on cricket players in the way that they had less good contacts with the ball (Runswick, Oliver, Roca, Williams, & Bezodis, 2018).

There is a need to find a solution i.e. an answer to the question of how to reduce anxiety and thus its negative consequences. For example, Hordacre, Immink, Ridding, and Hillier (2016) determined that after simulated conditions of stress and anxiety, improved precision performance was achieved in the form of shorter performance time, retention of precision and lower variability. Also, training focused on improving work memory capacity and "quiet eye" training (observing the aim of performance) can significantly improve performance in high stress conditions (Ducrocq, Wilson M., Smith & Derakshan, 2017). Also, "quiet eye" training results in better external focus and also faster heart rate reduction and reduced muscular activity when shot-putting in golf compared to classic skill learning training (Moore, Vine, Cooke, Ring, & Wilson M.R., 2012). According to Oudejans, and Pijpers (2009), training in anxiety conditions can prevent the feeling of suffocation among elite athletes during motor performance due to adaptation on anxiety specific processes in human body. Mullen, Jones, Oliver, and Hardy (2016) state that the current research conducted on skilled but anxious athletes reported on the benefits of applying a "holistic approach" to achieving goals as compared to "segment approach" to avoid negative effects associated with conscious procession of task-related information.

For participants whose self-control strength was temporarily exhausted, the association between anxiety and performance was significant and negative. Raising the power of self-control can prevent the potentially negative effects of anxiety (Englert & Bertams, 2013). According to Stern, Cole, Gollwitzer, Oettingen, and Balcetis (2013), anxiety leads to excessive perception of distance which can impair the performance of the distance-related motor task. According to the same authors, intentional application can reduce the anxiety and thus lead to an appropriate perception of the distance of the target and thus successful performance. According to Mullen and Hardy (2000), explicitly (cognition during performance) learned motor skills are less susceptible to poor performance in stressful situations than implicitly (automatic performance) learned motor skill. An appropriate strategy needs to be planned for people so they could overcome inhibition and difficulties (Bortoli & Robazza, 1994).

The main aim of the research is to determine the differences in examinees' overall anxiety before and after the motor skill learning process. The partial aims are to determine the differences in partial indicators of overall anxiety.

Methods

Participants

96 students of the Faculty of Education in Osijek participated in the study, 10 males and 86 females, with an average age of 19.9 years (SD = 1,36). The study was approved by the Ethical Committee of Faculty of Education in Osijek, Croatia.

Measure

The variables in this study are three factors of anxiety, somatic factor, cognitive factor, self-confidence, and also the overall total anxiety. Anxiety is self-assessed by the Competitive State Anxiety Inventory - 2, CSAI-2 (Martens, Vealey, & Burton, 1990), which the author has adapted to the research and ultimately contains five particles/estimates for each of the three anxiety factors. Answers to all 15 claims are on a scale from 1 to 4 (1 – at least, 2 – little, 3 – enough, 4 – very high). Questions for the somatic factor were reversed, so these responses were adjusted to other factors before calculating the overall result. The result of the examinees in each factor is the arithmetic mean of the five questions and also the overall anxiety is the arithmetic mean of all three factors.

Test protocol

Handspring vault in a crouch position is a basic vaulting element in gymnastics. It is frequently included in Physical Education lessons because of its utility but also associated with a high level of participants' anxiety. Motor skill learning in this study will be conducted in three 90 minute sessions. The participants completed the questionnaire before the first and the third session of skill learning. The level of acquisition was assessed before and after the learning process on a scale from 1 to 5 (1 – the lowest, 5 – the highest). The questionnaire also contained a statement examining the initial state of skill acquisition. The participants who claim they can't perform a vault in any possible way were rated 0 and their initial level of acquisition was not assessed. Since 67 out of 96 students (70%) stated that they can't perform a vault, it can be concluded that the process of learning the motor skills in this research was related to the initial phases of skill acquisition.

Statistical analysis

The descriptive statistics were: arithmetic mean (Mean), standard deviation (σ), minimum (Min) and maximum (Max) for overall anxiety and its factors for both assessments. Correlation between variables was analysed by the Spearman's correlation rank. Wilcoxon matched pairs test was conducted to determine differences between the two assessments. The collected data were analysed with the computer program Statistica for Windows 13.3 (TIBCO Software Inc.).

Results

Table 1 shows descriptive parameters of overall anxiety and its factors for both assessments.

Table 1. *Descriptive parameters of overall anxiety and its factors.*

I. assessment	Mean	σ	Min	Max
Somatic factor	1.90	0.86	1.00	4.00
Cognitive factor	2.15	0.81	1.00	3.80
Self-confidence	2.72	0.92	1.00	4.00
Overall anxiety	2.26	0.78	1.00	3.93
II. assessment				
Somatic factor	1.47	0.70	1.00	4.00
Cognitive factor	1.69	0.70	1.00	3.60
Self-confidence	2.33	0.97	1.00	4.00
Overall anxiety	1.83	0.68	1.00	3.87

Mean – arithmetic mean, σ – standard deviation, Min – minimal score, Max – maximal score.

Considering that the higher score relates to a higher level of anxiety, the results from Table 1 show that the participants have the lowest results in the confidence factor, then in the cognitive factor and highest in the somatic factor. It is also noteworthy that after motor learning the overall anxiety and all three factors are reduced.

Table 2. *The coefficients of correlation between the overall anxiety and its three factors separately for each of the two assessments and between the overall anxiety in both assessments.*

		Somatic factor	Cognitive factor	Self-confidence	Overall anxiety
I.assessm.	Somatic factor	1.00			
	Cognitive factor	0.77	1.00		
	Self-confidence	0.74	0.70	1.00	
	Overall anxiety	0.89	0.90	0.91	1.00
II.assessm.	Somatic factor	1.00			
	Cognitive factor	0.70	1.00		
	Self-confidence	0.56	0.68	1.00	
	Overall anxiety	0.79	0.88	0.91	1.00
r (overall anxiety I. & II. assessment) = 0.73					

Correlation coefficients of all three anxiety factors between themselves are almost equal and range from 0.70 to 0.77 in the first assessment and 0.56 to 0.70 in the second one. That shows that each anxiety factor differentiates from the other two but all of them are also interdependent at the same time. The greatest change in correlation coefficients in the assessment conducted after the motor learning occurs between the somatic factor and self-confidence in the way that the correlation coefficient reduced from 0.74 to 0.56. The reason to that could be that the differences between the two assessment were the highest in somatic factor and the lowest in self-confidence (table 3). The coefficient of correlation between the overall anxiety in two assessments is 0.73.

Table 3. *Results of Wilcoxon matched pairs test in the overall anxiety and its factors between the two assessments.*

	N	T	Z	p
Somatic factor	72	196.00	6.27	0.00
Cognitive factor	78	329.00	6.03	0.00
Self-confidence	77	588.50	4.64	0.00
Overall anxiety	90	383.50	6.70	0.00

N – number of determined differences, T – value, Z – value, p – value

The results of the analysis of differences show that there has been a statistically significant reduction in both overall anxiety and all three of its assessed factors. The Z value of the test shows that the least improvement was found in the confidence factor from all three factors. It was self-confidence that had the lowest result and it had the least (but statistically significant) improvement.

Dicussion

As mentioned earlier, students have the highest anxiety in the confidence factor (2.72; 2.33), followed by the cognitive factor (2.15; 1.69) and finally the somatic factor (1.90; 1.47). Overall anxiety before the learning process on a scale of 1 to 4 was 2.26, which corresponds to 41.7 percentile of the scale. Overall anxiety after the learning process on a scale of 1 to 4 is 1.83, which corresponds to 27.7 percentile.

The correlation coefficient in the overall anxiety between the two assessments is 0.73. This shows that more anxious participants, after the process of motor learning still have a higher level of anxiety compared to less anxious participants despite the improvement. Correlation coefficients between all three factors of anxiety are approximately equal and range from 0.70 to 0.77. This shows significant but not total interdependence of all manifested factors of anxiety. There is enough space in the part of the uncommon variance of the factors to be manifested differently in different aspects of functioning. Thus, for example, Carzoli, et al. (2018) were trying to identify the association between cognitive and somatic factors with self-assessed 1 RM (maximum weight of one repetition). They determined that the cognitive factor was positively and significantly related to the difference between self-assessed and derived 1RM, the mentioned association with the somatic factor was not significant. That is, participants with higher cognitive anxiety

self-assess 1RM lower than it actually is. Jones and Cale (1989) also identified the functional diversity of anxiety factors. Somatic factor is negatively related with cognitive status of a person, while self-confidence and somatic factor are positively related to the speed of motor performance. According to the aforementioned authors, this finding suggests that the somatic factor of anxiety might be an important source of variation during motor performance.

Furthermore, the greatest change in correlation coefficients in assessment conducted after the motor learning occurs in the correlation of somatic factor and self confidence in the way that correlation reduced from 0.74 to 0.56. This change occurred because of the uneven improvement of three factors of anxiety. As already mentioned, the greatest improvement was determined in the somatic factor, and the least in self-confidence.

The results of the analysis of differences show that there was a statistically significant reduction in both overall anxiety and all three of its assessed factors. Dealing with source anxiety, in this case vaulting, under controlled conditions (expert supervision, minimal chance of injury) has resulted in its reduction. Stern et al. (2013) have also determined that intentional exposure to anxiety could reduce it and thus improve the performance. According to Hordacre et al. (2016) after the simulated conditions of stress and anxiety, there was an improvement in performance, in their case the improvement in precision. In this research the level of motor skills was assessed by only one surveyor just as a complementary variable because the level of acquisition was not the purpose of research. However, it is also important to point out that there was an improvement in the level of acquisition motor skills, the students' average grade at the end of the second lesson was 2.75 and at the end of the third lesson 3.23. The increased level of skill acquisition could also have a positive effect on the reduction of anxiety.

The Z values of the test show that the least improvement was found in self-confidence. Self-confidence was the factor that had the highest (worst) result and the least (statistically significant) improvement. The participants had the lowest manifestation of anxiety in the somatic factor, and the highest improvement. According to Oudejans and Pijper (2009), training in anxious conditions can prevent the feeling of suffocation (somatic anxiety) among elite athletes during motor performance due to their adaptation on specific physiological processes that accompany anxiety.

One of the causes of anxiety reduction can be the adaptive processes in the brain that take place during intentional exposure to the anxiety. On the other hand, the higher level of acquisition of motor skills could reduce the overall anxiety because of its relation to the skill. The purpose and the consequence of motor learning is the higher level of acquisition of motor skills. Thus, by a reversible reaction, it could reduce anxiety to a certain extent. Furthermore, controlled conditions can reduce anxiety by removing irrational thoughts about possible falls and injuries. As aforementioned, anxiety occurs as a consequence of the inability to understand and predict life events. Because of its uncertainty, in the attempt to make the anxiety concrete, people mistakenly link it to a particular object (situation, illness) (Milivojević, 2010).

The physical activity itself helps to reduce anxiety and its symptoms (Salmon, 2001, stated in Mišigoj-Duraković et al., 2018). It encourages positive aspects of physical excitation and enables to train the tolerance of such somatic symptoms. That provides the response in more adaptive way even when a person has only a perception of the threat. Because it induces sympathetic reactions and raises the excitation of the body in a similar way as the real threat.

From all the aforementioned facts, it is possible to recommend, even to highly anxious participants, the retention in the learning process as consequently the reduction of anxiety can be expected through these adaptation processes in the human body.

Conclusion

The purpose of this research is to determine if the process of learning the motor skills could reduce the skill-related anxiety. The results showed that students' highest anxiety manifestation is in the self-confidence factor, then the cognitive factor and the lowest in the somatic factor. The average overall anxiety of students reduced from 2.26 to 1.83 and the reduction was manifested in all three factors of anxiety. There are several factors that could explain the reduction of overall anxiety: adaptation processes, higher levels of motor skills acquisition, controlled conditions during learning process, or interaction of the aforementioned.

The conclusion is that the process of motor learning can reduce skill-related anxiety even in initial phases of acquisition. The intentional exposure to the anxiety in controlled conditions could be reduced because of the adaptive processes in the human body. Therefore, it is recommended that the highly anxious participants are maintained in the

skill learning process because the consequential improvement is expected. Personal experience of post-acquisition reduced anxiety could affect the initial state of skill-related anxiety in future similar situations. That could improve the overall satisfaction of the participants and consequently the effects of motor learning and exercising.

References

Bortoli, L., & Robazza, C. (1994). The motor-activity anxiety test. Relationships between scores on the motor activity anxiety test and the fear survey schedule. *Percept motor skill*, 79(1), 299-305.

Bortoli, L., & Robazza, C. (1995). Relationships between scores on the motor activity anxiety test and the fear survey schedule. *Percep motor skill*, 81(3), 1192-1194.

Carzoli, J. P., Haischer, M.H., Cooke, D.M., Shipherd, A.M., Johnson, T. K., Davis, E.P. & Zourdos, M.C. (2018). Acute Cognitive Anxiety is Positively Related to Maximal Strength Performance. *Med Sci Sports Exerc*, 50(5), 794.

Ducrocq, E., Wilson, M., Smith, T.J., & Derakshan, N. (2017). Adaptive Working Memory Training Reduces the Negative Impact of Anxiety on Competitive Motor Performance. *J Sport Exerc Psychol*, 39(6), 412-422.

Ekornas, B., Lundervold, A.J., Tjus, T., & Heimann, M. (2010). Anxiety disorders in 8-11-year-old children: Motor skill performance and self-perception of competence. *Scand J Psychol*, 51(3), 271- 277.

Englert, C., & Bertrams, A. (2013). Too Exhausted for Operation? Anxiety, Depleted Self-control Strength, and Perceptual-motor Performance. *Self Identity*, 12(6), 650-662.

Hordacre, B., Immink, M.A., Ridding, M.C., & Hillier, S. (2016). Perceptual-motor learning benefits from increased stress and anxiety. *Hum Mov Sci*, 49, 36-46.

Jones, J.G., & Cale, A. (1989). Relationships between multidimensional competitive state anxiety and cognitive and motor subcomponents of performance. *J Sports Sci*, 7(3), 229-240.

Kahraman, T., Savci, S., Ozdogar, A.T., & Gedik, Z. (2018). Effects of anxiety on motor imagery ability in patients with multiple sclerosis. *Turk J Physiother Rehabil*, 29(1), 19-26.

Larsen, R.J., & Buss, D.M. (2008). Psihologija ličnosti. Jastrebarsko: Naklada Slap.

Lebedina Manzoni, M. (2007). Psihološke osnove poremećaja u ponašanju. Jastrebarsko: Naklada Slap.

Martens, R., Vealey, R.S. & Burton, D. (1990). Competitive anxiety in sport. Champaign, IL: Human Kinetics.

Milivojević, Z., (2010). Emocije. Zagreb. Mozaik knjiga.

Mišigoj-Duraković, M., et al. (2018). Tjelesno vježbanje i zdravlje. Zagreb: Znanje.

Moore, L.J., Vine, S.J., Cooke, A., Ring C., & Wilson M.R. (2012). Quiet eye training expedites motor learning and aids performance under heightened anxiety: The roles of response programming and external attention. *Psychophysiology*, 49(7), 1005-1015.

Mullen, R., & Hardy, L. (2000). State anxiety and motor performance: Testing the conscious processing hypothesis. *J Sports Sci*, 18(10), 785-799.

Mullen, R., Jones, E.S., Oliver, S., & Hardy, L. (2016). Anxiety and motor performance: More evidence for the effectiveness of holistic process goals as a solution to the process goal paradox. *Psychol Sport Exerc*, 27(1), 142-149.

Nieuwenhuys, A., & Oudejans, R.R.D. (2017). Anxiety and performance: perceptual-motor behavior in high-pressure contexts. *Curr Opin Psychol*, 16(1), 28-33.

Oatley, K., & Jenkins, J.M. (2007). Razumijevanje emocija. Zagreb. Naklada Slap.

Oudejans, R.R.D., & Pijpers, J.R. (2009). Training with anxiety has a positive effect on expert perceptual-motor performance under pressure. *Q J Exp Psychol*,62(8), 1631-1647.

Runswick, O.R., Roca, A., Williams, A.M., Bezodis, N. (2018). The effects of anxiety and situation-specific context on perceptual-motor skill: a multi-level investigation. *Psychol Res*, 82(4), 708-719.

Skirbekk, B., Hansen, B.H., Oerbeck, B., Wentzel-Larsen, T., & Kristensen, H. (2012). Motor impairment in children with anxiety disorders. *Psychiatry Res*, 198(1), 135-139.

Smith, N.C., Burwitz, L., & Jakeman, P. (1988). Precompetitive anxiety and motor performance: A psychophysiological examination. *J Sports Sci*, 6(2), 115-130.

Stern, C., Cole, S., Gollwitzer, P.M., Oettingen, G., & Balcetis, E. (2013). Effects of Implementation Intentions on Anxiety, Perceived Proximity, and Motor Performance. *Pers Soc Psychol Bull*, 39(5), 623-635.

Vizek Vidović, V., Rijavec, M., Vlahović-Štetić, V., & Miljković, D. (2014). Psihologija obrazovanja. Zagreb. IEP-Vern.

Wenar, C. (2002). Razvojna psihopatologija i psihijatrija: od dječje dobi do adolescencije. Jastrebarsko. Naklada Slap.

Woolfolk, A. (2016). Edukacijska psihologija. Jastrebarsko. Naklada Slap.

Primljen: 05. januar 2022. / Received: January 05, 2022
Prihvaćen: 08. maj 2022. / Accepted: May 08, 2022

https://doi.org/10.7251/SSH2201070V
UDC: 572.512.087:796.41-053.4
Short notice
Kratko saopštenje

Relations Between Morphological Characteristics and the Motor Skill Handstand Against "A Vertical Surface in 11-Year-Old Female Pupils"

Povezanost morfoloških karakteristika i motoričkog znanja "stoj na rukama uz okomitu plohu kod jedanaestogodišnjih učenica"

Lidija Vlahović

Faculty of Humanities and Social Sciences, University of Split, Republic of Croatia

Correspondence:
Lidija Vlahović
Faculty of Humanities and Social Sciences, University of Split, Republic of Croatia, lidijav@ffst.hr

Filozofski fakultet, Sveučilište u Splitu, Republika Hrvatska

Korespondencija:
Lidija Vlahović
Filozofski fakultet, Sveučilište u Splitu, Republika Hrvatska
lidijav@ffst.hr

Abstract: *The aim of the conducted research was to determine correlation between morphological characteristics and the motor skill Handstand Against a Vertical Surface in fifth-grade primary-school female pupils from Split. In conformity with the set objective, on the sample of 152 primary-school female pupils from Split, Republic of Croatia, aged 11 (± 6 months), a set of 16 anthropometric measurements for assessment of morphological characteristics and the motor skill test Handstand Against a Vertical Surface, were applied. The results for multiple regression analysis indicated a statistically significant correlation between morphological characteristics and the motor skill Handstand Against a Vertical Surface in female students. The analysis of partial contribution of certain morphological variables on the significance of the regression model indicated a statistically significant contribution in the variables Abdomen Skinfold and Elbow Diameter. The research results provided useful information on morphological specification of the motor skill Handstand Against a Vertical Surface and thus its role in transformation of certain morphological characteristics for achieving desired final conditions in the process of planning and programming Physical Education classes. Moreover, they also imply which morphological characteristics should be considered in order for female pupils to achieve best possible results during the assessment process of this motor task.*

Keywords: *motor skills, motor learning, planning and programming, Physical Education, fifth-grade female pupils.*

Sažetak: *Cilj istraživanja bio je utvrditi povezanost između morfoloških karakteristika i motoričkog znanja „Stoj na rukama uz okomitu plohu" kod učenica petog razreda osnovnih škola u Splitu. Sukladno cilju istraživanja na uzorku od 152 učenice u dobi od 11 godina (± 6 mjeseci) primijenjen je skup od 16 antropometrijskih mjera za procjenu morfoloških karakteristika i test motoričkog znanja „Stoj na rukama uz okomitu plohu". Rezultati regresijske analize pokazali su statistički značajnu povezanost morfoloških karakteristika s motoričkim znanjem „Stoj na rukama uz okomitu plohu" kod učenica. Analiza parcijalnog doprinosa pojedinih morfoloških varijabli na značajnost regresijskog modela ukazala je kako statistički značajan doprinos imaju varijable Kožni nabor trbuha i Dijametar lakta. Rezultati istraživanja pružili su korisne informacije o morfološkoj specifikaciji motoričkog znanja „Stoj na rukama uz okomitu plohu" pa time i njegove uloge u transformaciji pojedinih morfoloških karakteristika za postizanje željenih finalnih stanja u procesu planiranja i programiranja u Tjelesnoj i zdravstvenoj kulturi. Također, ukazuju i na to koje morfološke karakteristike treba uvažavati kako bi u procesu praćenja i vrednovanja učenice postizale što bolje rezultate kod ocjenjivanja ovog motoričkog zadatka.*

Ključne reči: *motorička znanja, učenice petih razreda, Tjelesna i zdravstvena kultura.*

Introduction

Kinesiological motor skills represent motor structures of movement with the primary function of development of

Uvod

Kineziološka motorička znanja predstavljaju one motoričke strukture kretanja čija je primarna funkcija razvoj pojedinih dimenzija antropološkog statusa učenika, i to u prvom redu morfoloških i motoričkih obi-

individual dimensions of the anthropological status of pupils, and particularly of morphological and motor characteristics. Therefore, the primary value of the mentioned skills lies in the possibility that each anthropological characteristic of pupils changes according to a predefined desired objective (Babin, Bavčević and Prskalo, 2010).

According to Findak (2003) the quality of the process of kinesiological education depends on a whole range of factors, the crucial ones being knowing the current condition, abilities, characteristics and skills of pupils on one hand, and transformational values of individual kinesiological operators, that is the teaching content on the other. Motor skills in kinesiological education represent motor structures of movement aiming primarily to, besides acquiring certain skills, the development of individual dimensions of anthropological status, and first of all of morphological, motor and functional characteristics of pupils. Since the primary value of motor skills is their immediate impact on transformation of individual anthropometric characteristics, it is of crucial importance, through a right selection of motor skills during planning and programming of Physical Education classes, to ensure maximum changes in each anthropometric dimension of pupils to the level of achieving desired final conditions.

Gabard (1992) and Sanders (1992) pointed out that the set of motor skills should be given special attention during childhood, i.e. in preschool education and during the period of the youngest school age. Due to the mentioned, crucial role is played both by parents and all institutions that implement educational programmes, while the teachers of kinesiology play a particularly important role (Venetsanou and Kambas, 2009). Therefore, pupils must be provided with optimal conditions for meeting requirements for practicing all forms and types of motor skills, which must be taken into account when programming the teaching process in Physical Education (Gallahue and Ozmun, 1998).

Determining relations between morphological characteristics and motor skills has still been insufficiently investigated, but it has been an ongoing theoretical and practical problem that is of great importance, primarily due to the possibility of forming rational procedures for planning, programming, and monitoring or assessment in Physical Education, as well as for orientation and selection of young athletes, planning, programming and monitoring the training process, and effective monitoring of the development of relevant anthropological characteristics of athletes and pupils (Vlahović, 2012). When choosing teaching contents for teaching in Physical Education, it is necessary to consider the method of selection that would include dynamics and the level of development of those morphological characterlježja. Stoga je primarna vrijednost navedenih znanja u mogućnosti da se pojedina antropološka obilježja učenika mijenjaju prema unaprijed definiranom željenom cilju (Babin, Bavčević i Prskalo, 2010).

Prema Findaku (2003) kvaliteta procesa kineziološke edukacije ovisi o nizu čimbenika, a jedan od presudnih je poznavanje, kako aktualnog stanja, sposobnosti, osobina i znanja učenika, tako i transformacijskih vrijednosti pojedinih kineziooloških operatora, odnosno nastavnih sadržaja. Motorička znanja u kineziološkoj edukaciji predstavljaju motoričke strukture kretanja čija je osnovna zadaća, pored učenja određenih vještina, razvoj pojedinih dimenzija antropološkog statusa, a prije svega morfoloških, motoričkih i funkcionalnih obilježja učenika. Kako je primarna vrijednost motoričkih znanja njihov neposredni utjecaj na transformaciju pojedinih antropoloških obilježja od velike je važnosti pravilnim odabirom motoričkih znanja, kod planiranja i programiranja u nastavi Tjelesne i zdravstvene kulture, omogućiti maksimalne promjene pojedinih antropoloških obilježja učenika i to do razine poželjnih finalnih stanja.

Gabard (1992) i Sanders (1992) ističu kako skupu motoričkih znanja treba posvetiti posebnu pažnju tijekom djetinjstva tj. u predškolskom odgoju i najmlađem školskom uzrastu. Za navedeno, presudnu ulogu imaju kako roditelji tako i sve institucije koje ostvaruju odgojno-obrazovne programe, a posebno značajnu ulogu imaju nastavnici kineziologije (Venetsanou i Kambas, 2009). Učenicima se stoga moraju pružiti optimalni uvjeti za podmirenje potreba za uvježbavanjem svih oblika i vrsta motoričkog znanja, a o čemu se posebno mora voditi računa pri programiranju nastavnog procesa u Tjelesnoj i zdravstvenoj kulturi (Gallahue i Ozmun, 1998.

Utvrđivanje povezanosti morfoloških karakteristika s motoričkim znanjima još uvijek je nedovoljno istražen, ali veoma aktualan teorijski i praktični problem koji je od izrazitog značaja, prvenstveno zbog mogućnosti formiranja racionalnih postupaka za planiranje, programiranje te praćenje i vrednovanje u nastavi Tjelesne i zdravstvene kulture, kao i za orijentaciju i selekciju mladih sportaša, planiranje, programiranje i kontrolu trenažnog procesa te efikasno praćenje razvoja relevantnih antropoloških obilježja sportaša i učenika (Vlahović, 2012). Pri odabiru nastavnih sadržaja u nastavi Tjelesne i zdravstvene kulture potrebno je uvažavati način odabira koji bi sadržavao dinamiku i stupanj razvoja onih morfoloških karakteristika koje najviše doprinose usvajanju pojedinog motoričkog znanja te imati što više informacija o povezanost svih segmenata antropološkog statusa u postupku usvajanja motoričkih znanja učenika.

istics that contribute most to the acquisition of individual motor skill and that would provide as much information as possible on the relationship of all parts of anthropological status in the process of acquiring motor skills by pupils.

However, in order to adequately apply motor skills in kinesiological education, it is important to respect age, given that it must be based on the biological level of development of individual anthropological characteristics of pupils in each stage of growth and development. Only adequate motor skill can be effectively acquired, which is a prerequisite for it to simultaneously assume the function of an adequate kinesiological stimulus in the development of anthropological characteristics of pupils (Vlahović and Babin, 2018). It is also a prerequisite for a certain motor skill to acquire at the same time the activity of an appropriate kinesiological stimulus in order to reach the desired level of anthropological characteristics of female pupils.

Vlahović, Babin, B. and Babin, J. (2016). investigated relations between morphological characteristics and motor skills of representative teaching topics from the official Physical Education curriculum for primary-school fifth-grade female pupils. Thus, sixteen anthropometric measures for the assessment of morphological characteristics and seven tests of representative teaching topics for the assessment of motor skills were applied on a sample of 152 female pupils, aged eleven. The results of canonical correlation analysis, conducted between the system of morphological variables and the variables of motor skills of female pupils, showed that one pair of statistically significant canonical factors with a canonical correlation coefficient of 0.61 (p = 0.00) was isolated. The structure of relations of an isolated significant pair of a canonical root showed that female pupils who got better grades in motor skills tests *Up to 60 m Low Start Running*, *Handstand Against a Vertical Surface*, *High Jump Scissors Technique*, and *Over-Shoulder Forward Fall to the Dominant Side* also had lower values in measures of subcutaneous adipose tissue and of body voluminosity as well, and vice versa. Slightly lower, but also negative correlation values were shown by the remaining three tests of motor skills, *Basic Floor Shot* (handball), *Bounce from the Middle Position in Volleyball* (volleyball) and *One Hand Shot* (basketball). Redundancy indicators suggested that only 16.51% of the variance of a set of motor skills variables could be estimated with a set of variables of morphological characteristics, and vice versa, a set of variables of motor skills can estimate 21.57% of the variance of a set of variables of morphological characteristics. The obtained data suggested a conclusion that the endomorph body type of the subjects, which proved to be an extremely unfavourable factor, was undoubtedly responsible for a poorer performance of motor skills during this study.

Međutim, da bi adekvatno primijenili motorička znanja u kineziološkoj edukaciji bitno je respektirati i dob s obzirom na to da se ista moraju temeljiti na biološkom stupnju razvoja određenih antropoloških obilježja učenica u pojedinim etapama rasta i razvoja. Samo primjereno motoričko znanje moguće je djelotvorno usvajati, što je preduvjet da ono istodobno poprimi funkciju primjerenog kineziološkog stimulusa u razvoju antropoloških obilježja učenika (Vlahović i Babin, 2018). To je također i preduvjet da određeno motoričko znanje poprimi istodobno i djelovanje primjerenog kineziološkog stimulusa u cilju dostizanja poželjne razine antropoloških obilježja učenica.

Vlahović, Babin, B. i Babin, J. (2016). su istraživali povezanost morfoloških karakteristika i motoričkih znanja reprezentativnih nastavnih tema iz službenog plana i programa Tjelesne i zdravstvene kulture za učenice petih razreda osnovne škole. Tako je na uzorku od 152 učenice u dobi od jedanaest godina primjenjeno šesnaest antropometrijskih mjera za procjenu morfoloških karakteristika i sedam testova reprezentativnih nastavnih tema za procjenu motoričkih znanja. Rezultati kanoničke korelacijske analize, provedene između sustava morfoloških varijabli i varijabli motoričkih znanja učenica, pokazuju da je izdvojen jedan par statistički značajnih kanoničkih faktora s koeficijentom kanoničke korelacije od 0,61 (p=0,00). Struktura relacija izoliranog značajnog para kanoničkog faktora pokazala je da su učenice koje su pokazale bolje ocjene u testovima motoričkih znanja Brzo trčanje do 60 m iz niskog starta, Stoj na rukama uz okomitu plohu, Skok uvis prekoračnom tehnikom „škare" i Pad naprijed preko ramena u dominantnu stranu imale niže vrijednosti u mjerama potkožnog masnog tkiva i voluminoznosti tijela, i obrnuto. Nešto niže, ali također negativne vrijednosti korelacije pokazala su i preostala tri testa motoričkih znanja, Šut s tla osnovnim načinom (rukomet), Vršno odbijanje iz srednjeg odbojkaškog stava (odbojka) i Šut jednom rukom s prsiju iz mjesta (košarka). Pokazatelji redudancije sugeriraju da je skupom varijabli morfoloških karakteristika moguće procijeniti samo 16,51% varijance skupa varijabli motoričkih znanja i obrnuto, da je skupom varijabli motoričkih znanja moguće procijeniti 21,57% varijance skupa varijabli morfoloških karakteristika. Dobiveni podaci upućuju na zaključak da je za lošije izvođenje motoričkih znanja u ovom istraživanju nesumnjivo odgovorna endomorfna tjelesna građa ispitanica, koja se pokazala kao izrazito nepovoljan faktor.

Ovo istraživanje provedeno je s ciljem utvrđivanja povezanosti između varijabli morfoloških karakteristika i testa motoričkog znanja *Stoj na rukama uz okomitu plo-*

Curren research was conducted with the aim of determining relations between the variables of morphological characteristics and the motor skill test *Handstand Against a Vertical Surface* in primary-school female pupils attending fifth grade. Results of this research will help to understand better the specifications of morphological characteristics in relation to the motor skill *Handstand Against a Vertical Surface* for more efficient planning and programming, as well as monitoring and assessment in Physical Education.

Methods

The sample of subjects included 152 primary-school female pupils from Split, Republic of Croatia. The subjects were aged 11 (± 6 months), and they were all clinically healthy with no aberrations in behaviour.

Based on previous research (Vlahović et al., 2016; Mišigoj-Duraković, 2008; Mišigoj-Duraković, Matković and Medved, 1995) the measurements were taken by estimating four latent anthropometric dimensions of 16 anthropometric measures, measured by standardized procedures in accordance with the International Biological Survey Programme (IBM) (Weiner and Lourie, 1969). The set included following anthropometric measures:

Longitudinal skeleton dimensionality – 1. *Body height* (AVIS)*; 2. Leg length* (ADŽN)*; 3. Arm length* (ADŽR); *4. Foot length* (ADŽS);

Transversal skeleton dimensionality – *5. Knee diameter* (ADKL); *6. Elbow diameter* (ADLK); *7. Wrist diameter* (ADRZ); *8. Pelvis width* (AŠRZ);

Body volume and mass – *9. Body weight* (ATŽT); *10. Forearm girth* (AOPP); *11. Lower leg girth* (AOPT); *12. Central chest girth* (AOGK);

Subcutaneous fat tissue – *13. Upper arm skinfold* (AKNN); *14. Back skinfold* (AKNL); *15. Belly skinfold* (AKNT); *16. Lower leg skinfold* (AKNP).

Performance the test of the motor skill *Handstand Against a Vertical Surface* (Vlahović, 2012) was assessed by seven independent competent evaluators while directly observing the performance of pupils. Prior to the start of the research, the evaluators were additionally educated on the methods and coordination of the given assessment criteria, and the test was formed according to the following description:

Aids: Three mats, vertical surface (wall), picture of the task.

Performance venue: School gymnasium for Physical Education classes.

Task: The test was to perform a handstand by stepping out with one foot.

hu kod učenica petog razreda osnovne škole. Rezultati ovog istraživanja pomoći će boljem razumijevanju specifikacije morfoloških karakteristika u odnosu na motoričko znanje *Stoj na rukama uz okomitu plohu* za učinkovitije planiranje i programiranje te praćenje i vrednovanje u nastavi Tjelesne i zdravstvene kulture.

Metode

Uzorak ispitanika za potrebe ovog istraživanja sačinjavalo je 152 učenice petih razreda osnovnih škola u Splitu, Republika Hrvatska. Sve ispitanice bile su u dobi od 11 godina (± 6 mjeseci), klinički zdrave i bez aberantnih ponašanja.

Na osnovu dosadašnjih istraživanja (Vlahović i sur., 2016; Mišigoj-Duraković, 2008; Mišigoj-Duraković, Matković i Medved, 1995) mjerenja su izvršena tako da su procijenjene četiri latentne antropometrijske dimenzije od 16 antropometrijskih mjera izmjerenih standardiziranim postupcima koje propisuje Internacionalni biološki program (IBM) (Weiner i Lourie, 1969). Skup je formiran od sljedećih antropometrijskih mjera:

Longitudinalna dimenzionalnost skeleta – 1. *Visina tijela* (AVIS)*; 2. Duljina noge* (ADŽN)*; 3. Duljina ruke* (ADŽR); *4. Duljina stopala* (ADŽS);

Transverzalna dimenzionalnost skeleta – *5. Dijametar koljena* (ADKL); *6. Dijametar lakta* (ADLK); *7. Dijametar ručnoga zgloba* (ADRZ); *8. Širina zdjelice* (AŠRZ);

Volumen i masa tijela – *9. Težina tijela* (ATŽT); *10. Opseg podlaktice* (AOPP); *11.Opseg potkoljenice* (AOPT); *12. Srednji opseg grudnoga koša* (AOGK);

Potkožno masno tkivo – *13. Kožni nabor nadlaktice* (AKNN); *14. Kožni nabor leđa* (AKNL); *15. Kožni nabor trbuha* (AKNT); *16. Kožni nabor potkoljenice* (AKNP).

Izvođenje testa motoričkog znanja *Stoj na rukama uz okomitu plohu* (Vlahović, 2012) vrednovalo je sedam nezavisnih kompetentnih ocjenjivača neposrednim promatranjem izvedbe učenika. Ocjenjivači su prije početka istraživanja bili dodatno educirani o načinu i usuglašavanju zadanih kriterija ocjenjivanja, a test je formiran prema sljedećem opisu:

Pomagala: Tri strunjače, okomita ploha (zid), slika zadatka.

Mjesto izvođenja: Školska dvorana za tjelesnu i zdravstvenu kulturu.

Zadatak: Test je iskorakom jedne noge izvesti stoj na rukama.

Opis i pravilna izvedba testa: Ispitanik se nalazi na udaljenosti od dva koraka (1-1,5 m) od zida/stru-

Description and correct performance of the test: The subject is positioned two feet (1 – 1.5 m) away from the wall/mat which is set vertically and takes a staggered stance while balancing on the back foot, holding arms straight in line with the ears with palms facing forward. The subject takes a step with the front straight leg. Body weight is shifted to the front leg, the subject bends forward at the waist, keeps the arms in a straight position and places the palms on the ground in the shoulder width position. The palms are positioned at the distance of 50 – 60 cm from the forward leg. Taking an energetic swing with the front straight leg and kicking up from the back leg, the body is lifted in a handstand. While performing handstand, the body is positioned vertically, legs are straightened and gathered, feet are touching the wall/mat, the head is slightly tilted backwards, the view is oriented towards the point of kick-up, the back is in a straight position from the shoulders. The headstand is held for 3 – 4 seconds and after the hold the subject lands back to the ground, by putting down one leg at the time and pushing off with the palms to lift the body from the forward bend back to the standing stance with the arms straight in line with the ears.

Assessment: The subject performs the task once and is assessed on a 1-5 scale (Table 1).

njače postavljene vertikalno te zauzima stav koračni s osloncem na stražnjoj nozi i uzručenjem s dlanovima okrenutim prema naprijed. Izvodi iskorak prednoženom opruženom nogom prema naprijed. Težina tijela prenosi se na iskoračenu nogu, slijedi pretklon trupom prilikom kojeg ispitanik postavlja opružene ruke dlanovima na tlo u širini ramena na udaljenosti 50-60 cm od iskoračene noge. Energičnim zamahom opružene zamašne noge i odguravanjem od tla odrazne noge tijelo se podiže u stoj na rukama. Prilikom izvođenja stoja na rukama, tijelo se nalazi u okomici, noge su ispružene i skupljene, stopala se dodiruju zida/strunjače, glava je u laganom zaklonu s pogledom usmjerenim u mjesto oslonca, leđa su iz ramena izdužena prema gore. Stoj na rukama zadržava se 3-4 sekunde. Nakon izdržaja stoja na rukama ispitanik se jednom pa drugom nogom spušta na tlo, a istovremeno se odgurava rukama od tla i podiže tijelo iz pretklona do uspravnog stava koračnog s uzručenjem.

Ocjenjivanje: Ispitanik izvodi zadatak jednom i ocjenjuje se ocjenom 1-5 (Tablica 1).

Table 1. *Criteria for assessment of the motor skill Handstand Against a Vertical Surface*

MARK	DESCRIPTION OF THE PERFORMANCE OF THE MOTOR SKILL
5 (excellent)	The subject performs handstand without a mistake
4 (very good)	- insufficiently straightens the body from the shoulders in the handstand position - is insufficiently dynamic while kicking up from the bend (when returning to the finishing position) - the body is not straightened enough both in the initial and finishing position - body not sufficiently straightened while performing the task
3 (good)	- shows insecurity both in the initial and finishing position - lacks in having a dynamic kick off with the kick-off leg - has an incorrect palm position while handstands - slightly bends elbows while handstands - slightly bends the body while handstands - lacks in having a dynamic swing while lifting the body from the bend when returning to the finishing position
2 (sufficient)	- lacks in taking the initial and finishing positions - takes a short step forward ("underneath") - positions hands too close in front of the stepping leg - kicks off with the bent kick-off leg - back too bent while handstands - keeps the head tilted backwards too much while handstands - pushes the shoulders expressively forwards while handstands - lacks in having a dynamic swing while kicking off from the bent position and returning to the finishing position - notably unstable while holding the handstand position - bends elbows while handstands - is too loose while handstands
1 (insufficient)	The subject is not able to perform handstand independently

Tablica 1. *Kriteriji ocjenjivanja motoričkog znanja Stoj na rukama uz okomitu plohu*

OCJENA	OPIS IZVOĐENJA TESTA MOTORIČKOG ZNANJA
5 (odličan)	Ispitanik bez pogrešaka izvodi stoj na rukama
4 (vrlo dobar)	- nedovoljno izdužuje tijelo iz ramena u položaj stoja - je nedovoljno dinamičan pri podizanju tijela iz pretklona (kod vraćanja u završni položaj) - nije potpuno pruženog tijela u početnom i završnom položaju - je nedovoljno pruženog tijela prilikom izvođenja zadatka
3 (dobar)	- pokazuje nesigurnost u početnom i završnom položaju - nema dinamičan zamah zamašnom nogom - ima nepravilan položaj dlanova u položaju stoja - manje grči laktove u fazi stoja na rukama - je manje uvijenog tijela u položaju stoja - nema dinamično podizanje tijela iz pretklona prilikom vraćanja u završni položaj
2 (dovoljan)	- nema početni i završni položaj - ima kratak iskorak („pod sebe") - preblizu postavlja ruke ispred iskoračene noge - zamahuje pogrčenom zamašnom nogom - ima veliko uvinuće leđa u položaju stoja na rukama - ima jako zaklonjenu glavu u položaju stoja - izrazito istura ramena prema naprijed u položaju stoja - nema dinamičnosti pri podizanju tijela iz pretklona i vraćanja u završni položaj - vidljivo je nestabilan prilikom zadržavanja stoja - grči laktove u fazi stoja na rukama - je previše opušten „mlohav" kod izvođenja stoja na rukama
1 (nedovoljan)	Ispitanik nije u stanju samostalno izvesti stoj na rukama

The overall results of all measurements of morphological variables and the marks of seven evaluators who assessed the motor skill test were calculated by the use of the Burt's Simple Summation method, i.e. calculating the arithmetic mean of the obtained values, used for the analysis in this study.

In order to get an insight into the relations between the set of morphological variables and the variable of the motor skill *Handstand Against a Vertical Surface*, regression analysis was applied and following was calculated: coefficient of multiple correlation (R), coefficient of determination (R^2), standard error of the estimate (σ_e), F-test value (F), standardized regression coefficient (β), predictor variable linear correlation coefficient (r), t-test value (t) and the significance level (p). Software package Statistics for Windows 13.3 was used for analysis of the obtained data.

Results

Table 2 shows the results of the regression analysis of morphological variables as predictors and the criterion of the variable *Handstand Against a Vertical Surface* in female pupils.

Ukupan rezultat svih mjerenja morfoloških varijabli i ocjena sedmorice sudaca u vrednovanju testa motoričkog znanja izračunavao se Burtovom metodom jednostavne sumacije, tj. izračunavanjem aritmetičke sredine dobivenih vrijednosti te se takvim koristio u analizama ovog istraživanja.

Da bi se dobilo uvid u povezanost između skupa morfoloških varijabli i varijable motoričkog znanja *Stoj na rukama uz okomitu plohu* primijenjena je regresijska analiza te se izračunalo: koeficijent multiple korelacije (R), koeficijent determinacije (R^2), standardnu pogrešku prognoze (σ_e), vrijednost F-testa (F), standardizirani regresijski koeficijent (β), koeficijent linearne korelacije prediktorske varijable (r), vrijednost t-testa (t) i razinu značajnosti (p). Podaci su obrađeni softerskim paketom Statistica for Windows 13.3.

Rezultati

U tablici 2 prikazani su rezultati regresijske analize morfoloških varijabli kao prediktora i kriterijske varijable *Stoj na rukama uz okomitu plohu* kod učenica.

Table 2. *Regression analysis of the variable Handstand Against a Vertical Surface*

Tablica 2. *Regresijska analiza varijable Stoj na rukama uz okomitu plohu*

R = 0.53	R2 = 0.28	σe = 1.13	F = 3.28	p = 0.00
Variable	**β**	**r**	**t**	**p**
AVIS	0.14	0.05	0.54	0.59
ADŽN	-0.24	-0.10	-1.13	0.26
ADŽR	-0.07	-0.02	-0.28	0.78
ADŽS	0.08	0.05	0.54	0.59
ADKL	-0.13	-0.07	-0.76	0.45
ADLK	0.25	0.17	1.96	0.05
ADRZ	-0.02	-0.01	-0.13	0.90
AŠRZ	-0.06	-0.03	-0.34	0.73
ATŽT	-0.56	-0.11	-1.27	0.21
AOPP	0.43	0.15	1.79	0.08
AOPT	0.03	0.01	0.11	0.91
AOGK	0.36	0.13	1.56	0.12
AKNN	0.14	0.06	0.68	0.50
AKNL	-0.17	-0.08	-0.97	0.33
AKNT	-0.58	-0.26	-3.17	0.00
AKNP	0.05	0.02	0.27	0.79

Legend: *R – coefficient of multiple correlation; R2 – coefficient of determination; σe – standard error of the estimate; F –F-test value; β – standardized regression coefficient; r – predictor variable linear correlation coefficient; t –t-test value; p – the significance level; AVIS – body height; ADŽN – leg length; ADŽR – arm length; ADŽS – foot length; ADKL – knee diameter; ADKL – elbow diameter; ADRZ – wrist diameter; AŠRZ – pelvis width; ATŽT – body weight; AOPP – forearm girth; AOPT – lower leg girth; AOGK – central chest girth; AKNN – upper arm skinfold; AKNL – back skinfold; AKNT – belly skinfold; AKNP – lower leg skinfold.*

Legenda: *R – koeficijent multiple korelacije; R2 – koeficijent determinacije; σe – standardna pogreška prognoze; F – vrijednost F-testa; β – standardni regresijski koeficijent; r – koeficijent linearne korelacije prediktorske varijable; t – vrijednost t-testa; p – razina značajnosti; AVIS – visina tijela; ADŽN – dužina noge; ADŽR – dužina ruke; ADŽS – dužina stopala; ADKL – dijametar koljena; ADKL – dijametar lakta; ADRZ – dijametar ručnog zgloba; AŠRZ – širina zdjelice; ATŽT – težina tijela; AOPP – opseg podlaktice; AOPT – opseg potkoljenice; AOGK – srednji opseg grudnog koša; AKNN – kožni nabor nadlaktice; AKNL – kožni nabor leđa; AKNT – kožni nabor trbuha; AKNP – kožni nabor potkoljenice.*

The results of the regression analysis (Table 2) indicate a statistically significant relation between the predictor set of morphological variables and the criterion variable *Handstand Against a Vertical Surface*. The coefficient of multiple correlation (R = 0.53) confirmed that a significant part of the variability of the criterion variable can be explained by the impact of the predictor set of variables. The statistical significance of the regression model was confirmed by applying the F-test (F = 3.28; p = 0.00), so the defined regression model can be considered predictively valid. The value of the coefficient of determination (R^2 = 0.28) indicated a statistically significant amount of the common variance of the predictor set and the criterion variable. A high value of the standard error of the estimate (σ_e = 1.13), as an indicator of the standard deviation of scattering of the measured results around the regression line, indicated an unsatisfactory degree of representativeness of the regression model.

Rezultati regresijske analize (Tablica 2) ukazuju na statistički značajnu povezanost prediktorskog skupa morfoloških varijabli s kriterijskom varijablom *Stoj na rukama uz okomitu plohu*. Koeficijent multiple korelacije (R = 0,53) potvrđuje da je značajan dio varijabiliteta kriterijske varijable moguće objasniti utjecajem prediktorskog skupa varijabli. Statistička značajnost regresijskog modela potvrđena je primjenom F-testa (F = 3,28; p = 0,00), pa je definirani regresijski model moguće smatrati prediktivno valjanim. Vrijednost koeficijenta determinacije (R^2 = 0,28) ukazuje na statistički značajnu količinu zajedničke varijance prediktorskog skupa i kriterijske varijable. Visoka vrijednost standardne pogreške prognoze (σ_e = 1,13), kao pokazatelja standardne devijacije raspršenosti izmjerenih rezultata oko pravca regresije, ukazuje na nezadovoljavajući stupanj reprezentativnosti regresijskog modela.

The analysis of a partial impact of individual variables of the predictor set indicated a statistically significant contribution of the two variables in defining the significance of the regression model. The value of the standardized regression coefficient for the variable *Belly skinfold* (ACNT) (β = -0.58) indicated a significant impact of this variable in defining the value of the criterion variable. The analysed predictor variable showed a statistically significant contribution in defining the value of the criteria (r = -0.26). The obtained results were confirmed by the application of the t-test (t = -3.17; p = 0.00). The variable *Elbow diameter* (ADLK) also had a statistically significant impact on the results of the criterion variable, which confirmed the value of the corresponding standardized regression coefficient (β = 0.25). The observed predictor was correlated with a criterion variable with the coefficient value of 0.17 (r = 0.17). These results were confirmed by the application of the t-test (t = 1.96; p = 0.05).

Discussion and Conclusion

The results of the regression analysis showed a statistically significant correlation between the predictor set of morphological variables and the criterion variable *Handstand Against a Vertical Surface*. The highest correlation was shown by the variable *Belly Skinfold* (ACNT), which had the highest regression coefficient and partial correlation, but with a negative sign, and the variable *Elbow Diameter* (ADLK), which had slightly lower values. This indicates that female pupils with a larger amount of adipose tissue on the belly and smaller values in the elbow diameter got lowest marks, and it is likely that they are generally less kinesiologically active.

Therefore, the study conducted on 152 fifth-grade primary-school female pupils from Split showed that a significant amount of variance of the criterion variable *Handstand Against a Vertical Surface* can be attributed to the impact of the predictor set of morphological variables. The results of the regression analysis in this study showed which are the morphological characteristics and to what extent they are important for efficient performance of the motor skill test *Handstand Against a Vertical Surface* in eleven-year-old female pupils, as well as for the role of this motor skill in transforming individual morphological characteristics for achieving desired final conditions of female pupils in the process of planning and programming in kinesiological education. Also, the results indicated which morphological characteristics should be prioritized in order to achieve better results in the process of monitoring and assessment of pupils while assessing this motor skill, or the teaching content in

Analiza parcijalnog utjecaja pojedinih varijabli prediktorskog skupa, ukazala je na statistički značajan doprinos dviju varijabli u definiranju značajnosti regresijskog modela. Vrijednost standardiziranog regresijskog koeficijenta za varijablu *Kožni nabor trbuha* (AKNT) (β = -0,58) ukazuje na značajan utjecaj navedene varijable u definiranju vrijednosti kriterijske varijable. Analizirana prediktorska varijabla pokazuje statistički značajan doprinos u definiranju vrijednosti kriterija (r = -0,26). Dobiveni nalazi potvrđeni su primjenom t-testa (t = -3,17; p = 0,00). Statistički značajan utjecaj na rezultate kriterijske varijable ostvaruje i varijabla *Dijametar lakta* (ADLK), što potvrđuje vrijednost pripadajućeg standardiziranog regresijskog koeficijenta (β = 0,25). Promatrani prediktor korelacijski je povezan s kriterijskom varijablom s vrijednošću koeficijenta od 0,17 (r = 0,17). Navedeni nalazi potvrđeni su primjenom t-testa (t = 1,96; p = 0,05).

Diskusija i zaključak

Nalazi regresijske analize pokazali su statistički značajnu korelaciju prediktorskog skupa morfoloških varijabli i kriterijske varijable *Stoj na rukama uz okomitu plohu.* Najveću povezanost pokazale su varijable *Kožni nabor trbuha* (AKNT), koji ima najviši regresijski koeficijent i parcijalnu korelaciju, ali s negativnim predznakom te varijabla *Dijametar lakta* (ADLK), koja je nešto nižih vrijednosti. Znači, da su učenice s većom količinom masnog tkiva na trbuhu te manjim vrijednostima dijametra lakta imale i najslabije ocjene te je izgledno da su i općenito kineziološki manje aktivne.

Zaključno, istraživanje koje je provedeno na 152 učenice petih razreda osnovnih škola u Splitu pokazalo je da se značajnu količinu varijance kriterijske varijable *Stoj na rukama uz okomitu plohu* može pripisati utjecaju prediktorskog skupa morfoloških varijabli. Nalazi regresijske analize u ovom istraživanju pokazuju koje su morfološke karakteristike i u kojoj mjeri značajne za efikasno izvođenje testa motoričkog znanja *Stoj na rukama uz okomitu plohu* kod jedanaestogodišnjih učenica, a isto tako i uloge ovog motoričkog znanja u transformaciji pojedinih morfoloških karakteristika za postizanje željenih finalnih stanja učenica u procesu planiranja i programiranja u kineziološkoj edukaciji. Također, nalazi ukazuju na koje morfološke karakteristike prioritetno treba utjecati da bi u procesu praćenja i vrednovanja učenici postizali što bolje rezultate pri ocjenjivanju ovog motoričkog znanja, odnosno nastavnog sadržaja u Tjelesnoj i zdravstvenoj kulturi. Stoga se može zaključiti da programiranje prije početka školske godine, podnošenje planova i pro-

Physical Education. Therefore, it can be concluded that programming before the beginning of a school year, submitting plans and programmes of Physical Education at the mere beginning of a school year, applying regularities of programming, is simply not possible without initial verification of pupils at the beginning of a school year, and in this case, of their morphological characteristics. This is thus the first prerequisite for the development of a programme, i.e. the beginning of programming in Physical Education in order to get information about current state of anthropological characteristics of pupils.

Besides all previously mentioned, it should be added that programming actually comes down to an exact elaboration of a programme for each pupil individually and it will not be difficult to conclude that it is also a basic prerequisite for individualization of Physical Education classes. Namely, given the fact that programming involves a special, i.e. individual programme for each pupil, this means that in such situation there is not only need for a greater cooperation between pupils and teachers, but also a possibility for achieving a higher form of joint creativity (Findak, 1997). So, all this, as well as the fact that kinesiological science has more and more information about the values of certain kinesiological activities each day, and in this case of the motor skill *Handstand Against a Vertical Surface*, will help to impact the transformation of individual morphological characteristics of female pupils.

After all, it should be noted that this research is a unique attempt to determine the equation of the specification of the motor skill *Handstand Against a Vertical Surface* in kinesiological education and the results of this research cannot be compared to similar research. Therefore, researchers are invited to contribute to this segment, a very important one for kinesiological education, which would address programming as actually one of the basic prerequisites for satisfying authentic needs of female students.

In conclusion, the results of this research are directly applicable in teaching of Physical Education as a basis for understanding the specification models of individual kinesiological structures, and consequently a significant factor in optimizing planning and programming, as well as implementation and evaluation of kinesiological education (Vlahović et al., 2016).

grama tjelesne i zdravstvene kulture na samom početku školske godine, uz primjenu zakonitosti programiranja, jednostavno nije moguće bez inicijalne provjere učenika na početku školske godine. školske godine, au ovom slučaju i njihovih morfoloških karakteristika. To je dakle prvi preduvjet za izradu programa, odnosno početak programiranja tjelesne i zdravstvene kulture kako bi se dobile informacije o trenutnom stanju antropoloških karakteristika učenika.

Uz sve navedeno, treba dodati da se programiranje zapravo svodi na točnu razradu programa za svakog učenika pojedinačno te neće biti teško zaključiti da je ono i temeljni preduvjet za individualizaciju nastave Tjelesne i zdravstvene kulture. Naime, s obzirom na to da programiranje podrazumijeva poseban, odnosno individualni program za svakog učenika, to znači da u takvoj situaciji postoji ne samo potreba za većom suradnjom učenika i nastavnika, već i mogućnost za postizanje većeg oblika zajedničkog stvaralaštva. (Findak, 1997). Dakle, sve ovo, kao i činjenica da kineziološka znanost svakim danom ima sve više informacija o vrijednostima pojedinih kineziooloških aktivnosti, a u ovom slučaju motoričke vještine Stoj na okomitoj podlozi, pomoći će utjecati na transformaciju pojedinca. morfološke karakteristike učenica.

Uostalom, valja napomenuti da je ovo istraživanje jedinstveni pokušaj utvrđivanja jednadžbe specifikacije motoričke vještine Stoj na okomitoj podlozi u kineziološkoj edukaciji te se rezultati ovog istraživanja ne mogu uspoređivati sa sličnim istraživanjima. Stoga su istraživači pozvani da doprinesu ovom segmentu, vrlo važnom za kineziološku edukaciju, koji bi se bavio programiranjem kao zapravo jednim od osnovnih preduvjeta za zadovoljavanje autentičnih potreba studentica.

Rezultati ovog istraživanja direktno su primjenjivi u nastavi Tjelesne i zdravstvene kulture kao osnova razumijevanja specifikacijskih modela pojedinih kineziooloških struktura te posljedično značajan faktor u optimalizaciji planiranja i programiranja te provedbe i vrednovanja procesa kineziološke edukacije (Vlahović i sur., 2016).

References

Babin, J., Bavčević, T., & Prskalo, I. (2010). Comparative Analysis of the Specially Programed Kinesiological Activity on Motor Area Structural Changes of Male Pupils aged 6 to 8. *Odgojne znanosti, 12*(1), 79-96.

Findak, V. (2003). *Metodika tjelesne i zdravstvene kulture – priručnik za nastavnike tjelesne i zdravstvene kulture.* Zagreb: Školska knjiga. [in Croatian]

Findak, V. (1997). *programiranje u tjelesnoj i zdravstvenoj kulturi.* Zagreb: Školske novine. [in Croatian]

Gabbard, C. (1992). *Lifelong Motor Development.*brown: Dubuque.

Gallahue, L. D., & Ozmun, C. J. (1998). *Understanding motor development. Infants, children, adolescents, adults.* Boston: McGraw-Hill.

Mišigoj-Duraković, M. (2008). *Kinantropologija – biološki aspekti tjelesnog vježbanja.* Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu. [in Croatian]

Mišigoj-Duraković, M., Matković, B., & Medved, R. (1995). *Morfološka antropometrija u Sportu.* Zagreb: Kineziološki fakultet Sveučilišta u Zagrebu.

Sanders, S. W. (1992). *Designing Preschool Movement Program.* Champaign, IL: Human Kinetics.

Venetsanou, F., & Kambas, A. (2009). Environmental factors affecting preschoolers' motor development. *Early Childhood Education Journal, 37,* 319-327.

Vlahović, L., & Babin, B. (2018). Analiza povezanosti morfoloških karakteristika i motoričkih znanja kod jedanaestogodišnjih učenika. *Školski vjesnik, 67*(2), 227-238. [in Croatian]

Vlahović, L., Babin, B., & Babin, J. (2016). Relationship between Morphological Characteristics and Motor Knowledge in Eleven-year-old Female Pupils, *Croatian Journal of Education, 18*(1), 137-156. doi; 10.15516/cje.v18i1.1885

Vlahović, L. (2012). *Vrednovanje motoričkih znanja kod učenika petih razreda osnovne škole.* (Doktorska disertacija). Split: Kineziološki fakultet Sveučilišta u Splitu. [in Croatian]

Weiner, J. S., & Lourie, J. A. (1969). *International Biological Programme.* Oxford; Edinburgh: Published for the International Biological Programme by Blackwell Scientific.

Primljen: 07. mart 2022. / Received: March 07, 2022
Prihvaćen: 12. april 2022. / Accepted: April 12, 2022

https://doi.org/10.7251/SSH2201080A
UDC: 316.644:796/799]:613.9
Short notice
Kratko saopštenje

The Effectiveness of a Suggested Mentoring Program Using Cascading Relaxation and Recreational Sporting Activity to Reduce the Level of Aggressive Behavior Among Secondary School Students Ages 16 to 18 Years An Experimental Study on Male Students of Sidi Saada Secondary School, Relizane, Algeria

Gorine Ahmed[1], Djamel Mokrani[2], Ahmed Benklaouaz Touati[2]
[1]University Khmis Maliana, Algeria
[2]University Mostaganem, Algeria

Correspondence:
Gorine Ahmed, University Khmis Maliana, Algeria
a_gorine@univ-dbkm.dz

Abstract: *This study aims to find out the effectiveness of a psychological counseling program using sequential relaxation and recreational sports activity on reducing the level of aggressive behavior as a feature of both physical and verbal types among secondary school students. The study contained two homogeneous and equal groups, one experimental and one controlled, and the researchers applied the proposed program to the experimental sample of (35) students (males) first year secondary level while the control group underwent the regular program, the researchers used the experimental approach because it was appropriate for the nature of the study and its objectives. The duration of the program was limited to (08) weeks and 01 educational units per week, the duration of each unit (75 minutes) and included the units of the proposed program on (cascading relaxation exercises - recreational sports activities). The results of this study showed statistically significant differences in the post measurement between the members of the experimental sample and the control sample in the post measurement, where the level of aggressive behavior decreased in both physical and verbal types for the members of the experimental sample.*
Based on the results, it can be concluded that the increase in cholesterol triglycerides and some parameters of body structure affected the level of health status as well as body composition in students.

Keywords: *mentoring program, aggressive behavior, cascading relaxation, recreational sports activities.*

Introduction and research problem

The phenomenon of aggressive behavior is considered one of the most important phenomena that occupied the attention of workers in the educational field, and this is due to its wide spread in various educational stages, especially among secondary school students, and this requires great attention by researchers to study this phenomenon to provide scientific explanations for it, in order to find appropriate solutions to it. Samira Al-Badri defines "aggressive behavior as an attack directed at a person or thing, or it is a behavior that the aggressor intends to harm the other person, either verbally or physically, such as destroying property or physical beatings, or verbally such as defamation, belittling, stinging jokes, or vitriolic satire." (Samira Al-Badri, 2005, p. 117)

Adolescence is one of the most difficult and dangerous stages that an individual goes through during his life, due to the physical, physiological, mental, emotional and social changes that occur at this stage. Muhammad Iqbal Mahmud defines it as "the period after childhood, between sexual maturity and the age of majority." And in it changes occur in all aspects of physical, mental, social and emotional development, and these changes result in many and varied disorders and problems that need guidance and guidance by specialists, and this is so that the adolescent can overcome these problems. (Mohammed Iqbal Mahmoud, 2006, p. 9)

The researchers believe that the adolescent's aggressive behavior in the school environment has many negative consequences and damages, including disruption of the educational process, sabotage of the institution's property, high repetition rate and school dropout...etc.

The absence of psychological accompaniment for the adolescent and the failure to allocate enough time for him to vent and express his energies, talents and abilities, especially the physical ones, will make him vulnerable to psychological pressures and repeated frustrations that make him act aggressively towards everyone who stands in front of him and this is what made those who watched education intensify studies to investigate and analyze the psychological, social and behavioral phenomena that he is going through during this critical period.

Psychological counseling is one of the necessary services that should be available in educational institutions, in order to activate the learning process and reach the adolescent learner to an integrated growth in all aspects. Many countries of the world have been interested in preparing physical and psychological rehabilitation programs and stressed the importance of practicing them in various forms because of their positive impact on health and psychological well-being.

Relaxation exercises are one of the important rehabilitation programs concerned with mental health, as well as their ability to improve performance, which requires eliminating tension and stress, controlling emotions and not making excessive mental responses.

Shamoun (2001) stresses that relaxation is a mental skill that has an important role in helping the individual or player to control his emotions, not provoke negative responses, reduce anxiety, tension and negative behaviors, develop self-confidence, self-esteem, and a sense of calm and safety (Muhammad al-Arabi Shamoun, 2001, pp. 162 164).

In this regard, Jabali Radwan adds, "In order to deal positively with psychological stress and reduce the phenomenon of aggressive behavior in different circles, counseling psychologists have used a number of relaxation methods, including cascading relaxation where this method is considered one of the most effective strategies that work to alleviate psychological pressures, anxiety and tension, and control the level of emotional arousal. (Radwan Jabali, 2013, p. 3)

Recreational sports activity is a successful and purposeful treatment method rather than a waste of time and leisure. It gives the individual in general and the adolescent in particular experiences that help to enjoy life and get rid of the complex of feelings of inferiority and frustration.

In this regard, Kamal Darwish points out that practicing recreational skills works to link friendships that take the individual or adolescent out of his isolation and integrate him well into society, thus keeping him away from all violent and immoral behavior. (Darwish and Al-Hamami, 1997, p. 56)

Based on the foregoing, this study came in which we address the positive role that a counseling program can play using sequential relaxation exercises and a group of recreational sports activities as one of the solutions that will reduce or modify the phenomenon of aggressive behavior among secondary school students.

This is what leads us through this research to ask the following general question: How effective is the proposed counseling program (cascading relaxation and recreational sports activity) in reducing the level of aggressive behavior (physical verbal) among secondary school students?

Methodological procedures followed in the study

Research Methodology: The researchers used the experimental method due to its relevance to the nature and objectives of the study.

Appropriate experimental design: The researcher chose the experimental design with two equal groups (control and experimental).

Research community: The research community represents secondary school students aged between 16 and 19 years at the state of Relizane, Algeria for the 2019-2020 school season. The following table shows the size of the study population:

Table 1. *The population of the original research community*

Directorate of Education of Relizane State, Algeria	
1st year Secondary level (female, male)	9751
2nd year Secondary level (female, male)	8241
3rd year Secondary level (female, male)	9252
Total	27245

The main study sample: Because it was difficult to test all the students of the original community due to the effort, time and money that this requires, the researchers chose a limited sample of the original community, this sample consisted of 70 male students from the departments of the first-year secondary scientific stream of Sidi Saada High School, Relizane State. They were chosen in a deliberate way after they obtained a high level in the aggressive behavior scale (as a trait) by Hassan Allawi, where they were randomly divided into two equal and homogeneous groups with a rate of (35) students for each group (control, experimental), and the following table shows the sample size on which this study was established:

Table 2. *The size of the search sample*

Secondary school name	Year	Size	Gender	Sample type
Sidi Saada (Relizane)	1st year	35	Male	Control
		35	Male	Experimental
Total		70		

Data and information collection tools

Morphological measurements: (homogeneity and reward of the two research samples) in order to achieve this, the researcher performed parity between the two research groups, to adjust the following variables: (age, length, mass) and the following table show the specific results of the differences between these variables.

Table 3. *The specifications of the two search samples and the value (t) of age, length and mass variables*

Variables	Sample	arithmetic mean X	Standard deviation ± p	Value of "t"	Twisting factors
Age (year)	Control	16.51	1.06	0.66	0.53
	Experimental	16.62	1.05		0.43
Height (cm)	Control	170.65	6.50	0.93	0.45
	Experimental	170.50	6.80		0.35-
Mass (Kg)	Control	69.21	6.60	0.59	0.01-
	Experimental	68.30	6.30		0.71

Through the results shown in Table 3, we note that the two search samples are equal and homogeneous in age, height and mass variables.

Research tools

Aggressive behavior scale: designed by Muhammad Hassan Allawi to measure general aggression as a property. The scale consists of 04 dimensions of aggression (attack, verbal aggression, speed of arousal, indirect aggression) and 40 statements where each dimension is represented by 10 statements (06 positive, i.e. in the direction of the dimension, and 04 of them negative, i.e. opposite to the direction of the dimension). The students answer the scale statements based on a five-graded scale:(agree to a very large extent, agree to a large extent, agree to a moderate degree, agree to a small degree, agree to a very little degree)

Determining the levels of aggressive behavior among students:

The researchers identified three levels of aggressive behavior (low, medium, high), after which the results are addressed and discussed.

Table 4. *The levels of aggressive behavior of students*

levels of aggressive behavior	low	medium	high
Function values	From 36 to 84	From 85 to 132	From 133 to 180

Suggested indicative program

The content of the educational units of the proposed program

Introductory part: 20 minutes

It aims to prepare students psychologically, pedagogically and physically for the main part of the session and its duration is divided as follows:

- Administrative and educational procedures (calling - monitoring the suit - explaining the goal of the class and motivating students to achieve it - sports salute) and the duration of 05 minutes
- The physical and physiological preparation, public and private, of 15 minutes

Main part: 45 minutes

- Competitive and recreational 30-minute set of sports activities in different formations
- 15-minute cascade relaxation session

The concluding part: 10 minutes

- A group discussion on the content of the class and open the way for the students to express their opinions freely, and it lasts for 10 minutes

Cascade relaxation sessions: Researchers used cascade relaxation exercises from the series of psychiatrist Edmund Jacobson (1931) who first used this type of relaxation. It was called by this name due to the succession of contraction from one muscle group to another until it covers all the muscle groups in the body, and it included sequential relaxation exercises on the muscle groups (legs, abdomen, chest, back, arms, shoulders, neck, face), where the successive relaxation exercises were recorded on a CD with the researcher's voice for the experimental group members to listen to, apply and implement the instructions through collective counseling sessions .CDs that include cascading relaxation exercises were distributed to the experimental group members to be able to practice cascading relaxation on their own as homework. Where the students are asked to make contractions of a specific muscle group, followed by a complete relaxation of this muscle group. These exercises help students to identify the difference between the processes of tension and muscle contraction and relaxation and muscle relaxation Where the state of muscle tension lasts for a period of (5-7) seconds, then followed by the process of muscle relaxation of the same muscle group for a period of (5) seconds. Each exercise is repeated for a muscle group (3) times before moving to another muscle group, with a good focus on the exhalation process during breathing, the duration of the program took (08) weeks, with one session per week, the duration of each session (15) minutes.

Recreational sports activities: represented in a group of games known by the nature of competition and give enthusiasm and pleasure and help the vital body systems to work efficiently and regularly and accustom the individual to obedience and a sense of responsibility and cooperation in addition to its recreational benefits for the body and mind

Presentation and analysis of results

Presentation and analysis of the results of the first hypothesis:

Hypothesis text: There are statistically significant differences between the pre and post measurements of the experimental group members in the level of aggressive behavior (physical, verbal) and in favor of the post-measurement.

Table 5. *The calculation of the t-test for the significance of the differences between the means of pre and post measurements for the experimental group in the level of aggressive behavior*

Scale	Experimental sample	Sample size	Average	Standard deviation	Value of "t"	Degree of freedom	Level of significance	Statistical significance
Aggressive behavior	pre-measurement	30	161.87	8.66	46.88	29	0.01	Statistically significant
	post-measurement	30	75.60	10.49				

Through the results obtained and shown in Table No. 5, which represent the results of the comparison between the pre and post measurements of the experimental group at the level of aggressive behavior, the value of "t" is 46.88 at the degree of freedom of 28, which is statistically significant at the level of significance 0,01. This means that there are statistically significant differences between the pre and post measurements of the experimental group in the level of aggressive behavior (physical, verbal) and in favor of the post-measurement.

Presentation and analysis of the results of the second hypothesis:

Hypothesis text: There are statistically significant differences in the post measurements between the experimental and control sample members in the level of aggressive behavior in favor of the experimental group.

Table 6. *the calculation of the t-test for the significance of the differences between the means of the post-measurement of the two experimental and control groups in the level of aggressive behavior.*

Scale	Experimental sample	Sample size	Average	Standard deviation	Value of "t"	Degree of freedom	Level of significance	Statistical significance
Aggressive behavior	control sample	30	150.71	5.71	39.90	58	0,01	Statistically significant
	experimental sample	30	66.40	9.81				

It is evident from the results obtained and shown in Table No. (6), which represent the results of the comparison between the experimental group and the control group in the pre measurement of the level of aggressive behavior, where we note that the value of "t" is 39.90 at the degree of freedom of 58, which is statistically significant at the level of Significance 0.01.This means that there are statistically significant differences between the experimental and control groups in the level of aggressive behavior for the post-measurement in favor of the experimental group.

Discussing the results

Discussing the results of the first hypothesis

The researchers believe that these differences and the results obtained are due to the proposed indicative program. Its learning units included a set of sequential relaxation exercises for the different areas of the body in which tension is concentrated and which were referred to by some previous references and studies, such as the areas of (neck, face, shoulders, arms, abdomen, back, legs). Which had a significant effect in reducing the tension and the level of emotional arousal for the teenager.

This was indicated by Mustafa Kamel Rateb (1995) that the individual is prepared for psychological stress that comes as a result of internal and external factors, and through training in relaxation skills, he can fill his physical and mental energy and reduce the level of tension, anxiety and excessive excitement to the appropriate level. (Rateb, 1995, p. 271).

The results of this study agree with some previous studies, such as the study (Beni Youssef, 2005), whose results indicated that muscle relaxation training programs are one of the important therapeutic methods that work to alleviate some behavioral disorders. It also helps to control and manage psychological stress and reduce the level of stress and anxiety, which in turn contributes to maintaining the mental health of individuals.

The researchers also attributed a decrease in the level of aggressive behavior among the members of the experi-

mental group to the effect of recreational sports, which were also included in the learning units of the proposed counseling program, which contributed to alleviating the aggressive behavior of the teenager student. This was pointed out by Mouna Abdel Halim 2009, who believes that recreation with sports is one of the methods of psychological and physical therapy, which includes the safety of bodies and minds from fatal diseases, especially in the modern era, which is characterized by lack of movement in view of the technological development taking place in all areas of life. Sports are among the heart-loving activities that develop the quality of sportsmanship, love of the group, lack of introversion and social isolation, which result in a number of psychological and social problems that lead the individual to engage in abnormal and immoral behaviors. (Mouna Abdel Halim, 2009, p. 115).

This is consistent with the results of the study of Si Al-Arabi Al-Sharif 2016, whose results were yellow, indicating that the experimental group to which the recreational sports program was applied decreased its aggression to a significant degree. This means that it is possible through recreational sports to modify aggressive behavior to socially acceptable behavior in this critical age stage (adolescence). (Si Al-Arabi, 2016, p. 223).

Accordingly, it can be said that the first hypothesis, which states that there are statistically significant differences between the pre and post measurements of the experimental sample in the level of aggressive behavior, has been achieved.

Discussing the results of the second hypothesis

The researchers attribute these differences to the proposed counseling program, where its educational units include successive relaxation exercises. It is considered one of the best relaxation techniques that are used in most counseling programs, by trying the individual or the player to contract his muscles and then relax them in a sequential manner. As the muscle contraction for a few seconds and then the muscle relaxation for a double seconds makes the muscles in a state of relaxation, thus feeling a high degree of psychological comfort and reassurance. This was confirmed by Allawi (2002) that relaxation helps reduce the effect of the stress response and help reach the optimal level of stress. And that relaxation exercises help to increase focus, get rid of stress, develop and activate the powers of mental perception, as well as increase the ability to work for long periods in addition to many physical and psychological benefits. (Allawi 2002, p. 217)

Clayton (1974) added in this regard that the various relaxation methods help the individual to get rid of tension, eliminate fatigue and stress, preserve his energies, and improve the efficiency of the respiratory circulatory system while developing the individual's ability to use the necessary muscle groups and relax the unnecessary groups. (S & other, 1974, p. 93)

These results agree with the study (Sulaiman, Thamer, 2010), whose results indicated that the use of mental skills training programs, including sequential relaxation, is highly effective in modifying some psychological disorders such as exam anxiety and raising the level of academic qualifications for gymnastics. (Akla 2010, pp. 186-208)

The researchers also attributed a decrease in the level of aggressive behavior (physical, verbal) among the members of the experimental group to the effect of recreational sports, which were also included in the proposed counseling program in alleviating the phenomenon of aggressive behavior in its four dimensions.

What Taha Abdel Rahim (2006) indicated is that the practice of recreational activities provides its practitioners with opportunities to raise the level of mental health and balance between independence and dependence and helps to develop emotional maturity and develop social qualities such as cooperation and the desire to help others. (Taha Abdel Rahim Taha, 2006, p. 26).

This is also consistent with the study of Hafsawi bin Youssef (2007), whose results indicated that the proposed program for kinetic games effectively contributed to reducing the degree of aggression among the members of the experimental group.

Accordingly, it can be said that the second hypothesis which states that there are statistically significant differences in the post measurements between members of the experimental and control group in the level of aggressive behavior and in favor of the experimental group has been achieved.

Overall conclusions

- The experimental group outperformed the control group in decreasing the level of aggressive behavior, after completing the application of the proposed indicative program.

- The efficacy of successive relaxation exercises in reducing the level of aggressive behavior of the experimental sample members.
- The efficacy of recreational sports activities in reducing the level of aggressive behavior of the experimental sample members

Future suggestions and hypotheses:

In light of the findings and conclusions reached by the researchers, we suggest the following:

- Inclusion of cascading relaxation exercises in the final part of the physical and sports education class for secondary students for the purpose of alleviating psychological stress and the phenomenon of aggression within the school environment.
- Inclusion of recreational activities in physical and sports education curricula to reduce aggressive behaviors and promote mental health in secondary school adolescents.
- Conduct training courses for physical and sports teachers to understand various relaxation techniques and recreational sports activity.

References

Jabali Radwan. (2013). The effect of relaxation techniques in managing psychological stress among elite Algerian football referees and competition anxiety among the experimental group. *Unpublished PhD thesis, ed. University of Algiers, Algeria*

Kamal Darwish and Muhammad Al-Hamami. (1997). A modern vision of recreation and leisure (Version 1). *Al-Rafidain Journal of Sports Science. Volume 16(53).*

Mouna Abdel Halim. (2009). *An introduction to mental health in the sports field (concepts and applications)* (2nd ed.). Alexandria, Egypt: Dar Al-Wafaa for printing and publishing.

Mohamed Mahmoud Beni Youssef. (2005). The effect of muscle relaxation techniques in reducing post-traumatic stress disorder symptoms among a sample of Jordanian university students. *Journal of Human and Social Sciences Studies, Volume 32(3).*

Muhammad al-Arabi Shamoun. (2001). *Mental training in the sports field* (2nd ed.). Cairo, Egypt: Arab Fikr House.

Muhammad Al-Dulaimi Abdul Razzaq. (2012). *The media and the child*. Amman, Jordan: Dar Al Masirah.

Muhammad Hassan Allawi. (2002). *The psychology of sports training and competition*. Cairo, Egypt: Book Center for Publishing.

Muhammad Iqbal Mahmoud. (2006). *Adolescence*. Amman, Jordan: Arab Society Library for Publishing and Distribution.

Osama Kamel Rateb. (1995). *Training of psychological skills in the sports field*. Cairo, Egypt: Arab Fikr House.

Samira Al-Badri. (2005). *Educational and psychological terms*. Amman, Jordan: House of Culture for Publishing and Distribution.

Taha Abdel Rahim Taha. (2006). *Introduction to Recreation*. Alexandria, Egypt: Dar Al-Wafaa Printing and Publishing.

Si Al-Arabi Charef. (2016). The importance of recreational sports activity in reducing the aggressive behavior of high school students. *Unpublished PhD thesis, University of Mostaganem. Algeria.*

Primljen: 14. jul 2021. / Received: July 14, 2021
Prihvaćen: 11. februar 2022. / Accepted: February 11, 2022

https://doi.org/10.7251/SSH2201087L
UDC: 796.412.24:796.012.1
Professional paper
Stručni rad

Dalcroze Method and Its Impact to Motor, Locomotor Status and Movement Aestethic

Dalkroz metoda i njen uticaj na motoriku, lokomotorni aparat i estetiku pokreta

Svetlana Lazić

Preschool Teachers Training College Novi Sad, Republic of Serbia

Correspondence:
Svetlana Lazić
Preschool Teachers Training College Novi Sad, Republic of Serbia
pedagogns@gmail.com

Visoka škola strukovnih studija za obrazovanje vaspitača Novi Sad, Srbija

Korespondencija:
Svetlana Lazić
Visoka škola strukovnih studija za obrazovanje vaspitača Novi Sad, Srbija, pedagogns@gmail.com

Abstract: *Dalcroze method presents the process of linking the sound into the body action in which musical skills can overcome through kinaesthetic exercises. The emphasis is on attention focused and directed to movement realisation, which is why the conscious attention between body and mind arise. The natural body movement, supported by musical content is mastering into organised act, by which body becomes an instrument and transfer certain parts of music in the movement. The author offers the review of researches about Dalcroze method contribution to every age of life, concluding that it presents a good strategy for every day's life monitoring, the way of integrative learning and melodic fulfilment of physical exercises. It doesn't know the age restrictions and is applicable through the whole life.*

Keywords: *Dalcroze method, body, movement, music, rhythm, improvisation.*

Sažetak: *DDalkroz metoda predstavlja proces prevođenja zvuka u telesnu akciju u kojoj se muzičke veštine savladavaju preko kinestetičkih vežbi. Akcenat je na fokurisanoj pažnji koja se posvećuje realizaciji pokreta, zbog čega se stvara svesna veza između uma i tela. Prirodni pokret tela se uz muzički sadržaj prevodi u organizovani akt, čime se telo pretvara u instrument i prenosi određene delove muzike u pokret. Autorka u radu nudi pregled istraživanja o doprinosima Dalkroz metode svakom životnom uzrastu, zaključujući da predstavlja dobru strategiju upravljanja svakodnevnim životom, načinu integrisanog učenja i melodičnu dopunu fizičkom vežbanju. Ne poznaje uzrasna ograničenja zbog čega je primenjiva tokom čitavog života.*

Ključne reči: *Dalkroz metoda, telo, pokret, muzika, ritam.*

Introduction

While Émile Jaques-Dalcroze (1865-1950), Swiss composer and outstanding pedagogic watched the way of classical musical education, he noticed that it is based on mechanical interpretations and does not improve creativity. Sentences like: "This is a quarter note; usually it is black, but here on the blackboard it is white" are not strange to today's students, and they were present 100 years ago (Juntunen, Hyvönen, 2004; Kim, 2014). By this sentence Dalcroze's standpoint was confirmed. He claimed that pure hearing musicality is non complete musicality and must be improved by the senses in body, actually it is important for person to have intrinsic feeling for musical harmony (Flohr, Persellin, 2011; Martinović, 2015; Nelson, 1955; Steiner, 2004). Those experiences make influence to fulfillment the feeling for music and its understanding. Because of this it is

Uvod

Posmatrajući realizaciju klasičnog muzičkog obrazovanja, Emil Žak Dalkroz [Émile Jaques-Dalcroze, 1865–1950], švajcarski kompozitor i istaknuti pedagog, uvideo je da se ono zasniva na mehaničkim interpretacijama i ne doprinosi kreativnosti. Rečenice poput: „Ovo je četvrtina note; obično je crne boje ali pošto je na tabli onda je bela" nisu strane učenicima, a postojale su i pre 100 godina (Juntunen, Hyvönen, 2004; Kim, 2014). Time se potvrđuje stanovište samog Dalkroza da je čisto slušna muzikalnost nekompletna muzikalnost i da se mora dopuniti osećajem u telu, odnosno da je potrebno posedovati unutrašnji osećaj za muzičku harmoniju (Flohr, Persellin, 2011; Martinović, 2015; Nelson, 1955; Steiner, 2004). Ova iskustva zajedno utiču na puniji osećaj za muziku i njeno razumevanje, zbog čega je i razumljivo da se

understandable that rhythm, musical phrase and dynamics can be easily mastered through the body movement.

He noticed that pupils and students react to the sound and rhythm by "unwilling movements of some parts of bodies (head, legs, arms), from where it can be concluded that there must be a connection between sound and central nervous system" (Dalkroz, 1971 acc: Martinović, 2015: 115). Based on that he concluded that music should be experienced in physical, mental and spiritual way with the goal to develop the inside hearing and making the conscious connection between body and mind. The idea of new approach has grown to the motion which has become a formal school in 1910 (Galikowska-Gajewska, 2014) and very soon a holistic method of exploring the rhythmic and dynamic musical possibilities of human body (Franco, 2005), which is present today too.

The meaning and significance of the Dalcroze method

Dalcroze method in practice is very frequently equated with the term *eurhythmics*. *Eurhytmics is the unique method of linking the sound into the body action in which musical skills can be mastered by kinaesthetically exercises*. It is applicable in lectures of musical education, culture and education in general and include the rhythmical activities and movements, solfeggio and improvisation, with the goal of musical development in wider sense (Juntunen, Hyvönen, 2004). Maurice Merleau-Ponty developed Dalcroze's ideas. He supported and followed the existentialist and phenomenological philosophy and appreciated human experience and its authenticity. Merleau-Ponty refused to divide human to subject and object, to dichotomy of mind and body, so he put the special emphasis to body experience. He thought that body can't be object and person can't be split from it. Because of that each person is a being in its body (Juntunen & Hyvönen, 2004; Merleau-Ponty, 1968; Toadvine, 2016). Thanks to him, researches in humanities and art contributed to generation of two ideas in close time interval: *embodied mind* – body is the base of experience and has crucial role in the whole development and *tacit knowledge* – person understands and feels training and skills of other's movements (Johnson, 1987; Lakoff & Johnson, 1980; Polanyi, 1966; Varela, Thompson, & Rosch, 1993). Transferred to the personal level, the movement exercise can be achieved by focusing attention to body parts that are important at that moment. Competence is achieved when person is able to understand and feel movements and doesn't have to pay more attention to them, unlike a beginner (Lazić, Matović, & Janković, 2022).

ritam, muzička fraza i dinamika lakše savladavaju kroz pokret.

Primetio je da učenici i studenti na zvuk i ritam reaguju „nevoljnim pokretima pojedinih delova tela (glava, noge, ruke), odakle se može zaključiti da mora postojati veza između zvuka i centralnog nervnog sistema" (Dalkroz, 1971 prema: Martinović, 2015: 115). Na osnovu toga je zaključio da je muziku potrebno iskusiti fizički, mentalno i duhovno sa ciljem razvijanja unutrašnjeg sluha i stvaranja svesne veze između uma i tela. Ideja o novom pristupu pretvorila se u pokret koji je 1910. godine prerastao u školu (Galikowska-Gajewska, 2014) i ubrzo u svestranu metodu istraživanja ritmičkih i dinamičkih muzičkih mogućnosti ljudskog tela (Franco, 2005) koja je i danas prisutna.

Smisao i značaj Dalkroz metode

Dalkroz metoda se u praksi često izjednačava sa terminom *euritmija* koja se razume kao *jedinstvena metoda prevođenja zvuka u telesnu akciju u kojoj se muzičke veštine savladavaju preko kinestetičkih vežbi.* Neretko se u literaturi pojavljuje i kao Dalkroz euritmija. Primenjiva je u nastavi muzičkog vaspitanja, kulture i obrazovanja i u sebe uključuje ritmičke aktivnosti i pokrete, solfeđo i improvizaciju, sa ciljem ravzoja muzikalnosti u širem smislu (Juntunen, Hyvönen, 2004). Dalkrozove ideje je razvijao Moris Merlo-Ponti (Maurice Merleau-Ponty), pristalica egzistencijalističke i fenomenološke filozofije, koji je cenio ljudsko iskustvo i njegovu autentičnost. Odbijao je podelu na subjekat i objekat, na podvojenost uma i tela, te je poseban naglasak pridavao telesnom doživljaju i iskustvu. Smatrao je da telo ne može biti objekat i da se osoba ne može odvojiti od njega. Stoga je svaka osoba biće u svetu preko svog tela (Juntunen & Hyvönen, 2004; Merleau-Ponty, 1968; Toadvine, 2016). Zahvaljujući njemu, istraživanja u humanističkim naukama i umetnosti doprinela su nastanku dva pojma koja su se pojavila u sličnom vremenskom periodu: ***telesni um*** (embodied mind) – telo je osnova iskustva i ima krucijalnu ulogu u celovitom razvoju i ***prećutno znanje*** (tacit knowledge) – osoba razume i oseća uvežbanost i veštinu tuđih pokreta (Johnson, 1987; Lakoff & Johnson, 1980; Polanyi, 1966; Varela, Thompson, & Rosch, 1993). Preneto na lični nivo, uvežbanost pokreta se postiže fokusiranjem pažnje na delove tela koji su u tom trenutku bitni. Kompetentnost se postiže kada se osoba saživi sa pokretima i ne mora da im se posvećuje u većoj meri, za razliku od početnika (Lazić, Matović, & Janković, 2022).

Prema Dalkrozu, razumevanje tela u muzičkom izvođenju ima za cilj da razvije poznavanje tela i svest o

According to Dalcroze, the body understanding in musical perform has the idea to improve the conscience of physical requirements in musical interpretation and realisation (Juntunen, 2002). Therefore, Martinovic (2015) claims that eurhythmics, solfeggio and interpretation are present as the main aspects of musical creativity. In other words, those are rhythm, movement, dance and improvisation (Table 1):

Table 1: *Aspects of musical creativity according to Dalcroze*

Eurhythmics / dance, movement	Eurhythmics trains the body of child / student to consciously feel muscle reaction on time and energy in space. Body becomes the instrument and transfers the certain parts of music.
Solfeggio / rhythm	It improves the inner hearing and is based at connection of physical and hearing experiences. Dalcroze has fulfilled the traditional solfeggio with skills of singing, hearing and writing the music by the concepts of rhythm and space.
Improvisation	The goal is to motivate the pupil to express her/his own musical ideas through the movement and stimulate the power of concentration, capacity of hearing and imagination. Pupil feels very nice, successful and in the same time she/he proves understanding of music ant its essence.

When they are in ascending line, all three aspects emphasize the idea that body skills are developed and that body exercise helps the person to be more successful in coordination of her/his musical and performing arts. Therefore, it is important to educate the body and muscles in a rhythmic sense in order to regulate the coordination of movement and rhythm in a way that simultaneously harmonizes with the attention that show that it is registered at the moment (Lazić, Matović, & Janković, 2022). The process of understanding of body itself also refers to the sense which person knows herself / himself in the whole, which is a kind of necessity for all the musical knowledge and self-sense (Stubley, 1999). It is not accident that performing the fine music "should reflect the inner sense of time, space and energy relation in music" (Jaques-Dalcroze, 1921/1980: 38), because of what kinaesthetically feeling has the central, organizing role in body perception as a whole (Sheets-Johnstone, 1999). Sensibility to kinaesthetic sensations means that person should listen and observe her/his own movements.

Researches about Dalcroze method

Movement implemented in Dalcroze methods improves the process of understanding the elements of musical perform (Juntunen, 2002). Therefore, Martinovic (2015) claims that eurhythmics, solfeggio and interpretation are present as the main aspects of musical creativity. In other words, those are rhythm, movement, dance and improvisation (Table 1):

Tabela 1. *Aspekti muzičkog stvaralaštva prema Dalkrozu*

Euritmija / ples, pokret	Vežba telo deteta / učenika da svesno oseća reakciju mišića na vreme i energiju u prostoru. Telo se pretvara u instrument i prenosi u pokrete određene delove muzike.
Solfeđo / ritam	Razvija unutrašnji sluh i zasniva se na povezivanju fizičkih i slušnih iskustava. Tradicionalni solfeđo je upotpunio veštinom pevanja, slušanja i beleženja muzike konceptima ritma i prostora.
Improvizacija	Ima za cilj da motiviše učenika da izrazi sopstvene muzičke ideje kroz pokret i na taj način stimuliše moć koncentracije, slušne kapacitete i maštu. Učenik ima osećaj zadovoljstva i uspeha, a istovremeno dokazuje da je razumeo muziku i savladao njenu suštinu.

Kada su u uzlaznoj liniji, sva tri aspekta potenciraju ideju da su razvijene telesne veštine a da osobi telesno vežbanje pomaže da uspešnije koordinira svojim pokretima u muzičkoj i izvođačkoj umetnosti. Stoga je nužno obrazovanje tela i mišića u ritmičkom smislu kako bi se regulisala koordinacija pokreta i ritma na način da se simultano usklade sa pažnjom koja mora da pokaže da je registrovana u trenutku (Lazić, Matović, & Janković, 2022). Razumevanje svog tela se odnosi i na osećaj kojim osoba poznaje sebe u celosti, što je neophodan okvir za svo muzičko znanje i osećaj sopstva (Stubley, 1999). Nije slučajno što izvođenje lepe muzike „treba da reflektuje unutrašnji osećaj odnosa vremena, prostora i energije u muzici" (Jaques-Dalcroze, 1921/1980: 38), zbog čega kinestetički osećaj ima centralnu, organizujuću ulogu u percepciji tela kao celine (Sheets-Johnstone, 1999). Osetljivost na kinestetičke senzacije znači slušanje i posmatranje sopstvenih pokreta.

Istraživanja o Dalkroz metodi

Pokret primenjen u Dalkroz metodi pomaže razumevanju elemenata muzičke strukture jer se uz njega razvijaju kognitivni, afektivni i psihomotorni aspekti ličnosti; razvija se motorika, koordinacija, koncentracija (Petrović, 2015). Muzika je osnova za jednostavnu i brzu

sical structure, since cognitive, affective and psychomotor aspects of person are developing alongside; motor coordination and concentration are developed too (Petrović, 2015). Music is the base for simple and speed communication between all movement and thinking centers, and visualisation emphasises musical concept and its presenting by symbols and enable to subjects an authentic interpretation (Roels & Van Petegem, 2014). Body can be appropriate instrument for rhythm interpretation and connection the body reaction with feelings. Human body acts repetitive in movements during experiencing non pleasant emotion and/or fear, since it is open while joy is present and movements are wide, long, with tendency of time extending. Polyvagal theory offers significantly more information about this (Porges, 2011).

Researches at this topic has shown that Dalcroze method, due to its close connection with the nature of learning and its potentials, can be implemented at all ages, lasts a lifetime and does not asks any special prior knowledge for learning process (Matović, Lazić, Radovanović, 2022).

Preschool teacher's educators emphasized that in creation of musical experience they mostly work with children in routines, rituals and authentic situations in kindergarten (practical living activities) and join an open (free) play to this. Both of this present suitable sources for connecting play and movement in work with children. Realization depends of children age. Among early age children in nurseries movement is mostly present, since it offers wealth repertoire of nonverbal signs (*Osnove programa predškolskog vaspitanja i obrazovanja*, 2018). With older children preschool teachers have possibilities to implement new, complex ways of their introduction to musical note values. In those situations, they usually start form quarter note which is used for walk (step), eighth note which gives the rhythm for run, eighth with dot and sixteenth note for jump (Lazić, Matović, & Vuković, 2021; Martinović, 2015; Petrović, 2015). Experience that preschool teachers have enabled them to more affirm some complex moves and movement, in other words, exercises for coordination and balance development and affirm music in the sense of its rhythm, dynamics and phrase. The outcomes of this approach make positive changes in improvement of neuropsychological maturity of children who showed larger abilities of motor activities control and decreasing the tendency of attention deficit (Bogdanowicz, 2016; Calle et al., 2021; Sutela, Juntunen, & Ojala, 2020).

Among population of children and youth in primary and secondary schools it is noticed that linear progresija, sklad razvoja duha i tela, proširili su se aspekti neverbalne komunikacije i društvenih sposobnosti (Gruhn et al., 2012). Potencijal prelivanja Dalkroz metode na druge oblike delovanja u formalnom obrazovanju je evidentan. Fizičko vaspitanje doprinosi ce-

komunikaciju između svih centara pokreta i mišljenja a vizuelizacija muzičkog koncepta i njenog predstavljanja simbolima i omogućava subjektima autentičnu interpretaciju (Roels & Van Petegem, 2014). Telo može da bude pogodan instrument za ritmičku interpretaciju i povezivanje telesnih reakcija sa osećanjima. Ljudsko telo je repetitivno u pokretima prilikom iskušavanja neprijatnih emocija i/ili straha, dok je otvoreno kada je prisutna radost i pokreti su široki, dugi, uz tendenciju produženja trajanja. Polivagalna teorija nudi značajno više informacija o tome (Porges, 2011).

Istraživanja rađena na ovu temu pokazala su da je Dalkroz metoda, upravo zbog bliske povezanosti sa prirodom učenja i njegovim potencijalima, primenjiva na svim uzrastima, traje tokom čitavog života i ne traži posebno predznanje za početak učenja (Matović, Lazić, Radovanović, 2022).

Vaspitači u predškolskim ustanovama su naglasili da rad sa decom u kreiranju doživljaja muzike u najvećoj meri ostvaruju kroz rutine, rituale i autentične situacije u vrtiću (životno praktične situacije), čemu pridružuju otvorenu igru. Oni zajedno predstavljaju izvore pogodne za povezivanje igre i pokreta u radu sa decom. To se ostvaruje različito u odnosu na uzrast dece, pa je u jaslenom uzrastu najviše prisutan pokret koji nudi bogat repertoar neverbalnih znakova (*Osnove programa predškolskog vaspitanja i obrazovanja*, 2018). Što su deca starija, to otvara mogućnosti novih, složenijih upoznavanja sa notnim vrednostima, pri čemu se u kretnim aktivnostima polazi od četvrtine koja se koristi za hod (korak), osmine koja daje ritam za trčanje, osmine sa tačkom i šesnaestine za skok (Lazić, Matović, & Vuković, 2021; Martinović, 2015; Petrović, 2015). Iskustvo koje poseduju u u povezivanju muzike i pokreta omogućilo je vaspitačima da više afirmišu složene pokrete i kretanje, odnosno vežbe za razvoj koordinacije i ravnoteže i više afirmišu muziku u smislu njenog ritma, dinamike i fraze. Ishodi ovakvog pristupa ostvaruju pozitivne promene na unapređivanje neuropsihološke zrelosti kod dece koja su pokazala veću sposobnost kontrole motoričkih aktivnosti i smanjenje sklonosti odvlačenja pažnje (Bogdanowicz, 2016; Calle et al., 2021; Sutela, Juntunen, & Ojala, 2020).

Među populacijom dece i mladih osnovnog i srednjoškolskog uzrasta primećeno je da se postigla linearna

gression, harmonised body and mind development are achieved and some aspects of nonverbal communication are expended and social competences too (Gruhn et al., 2012). Health patterns of behaviour in every day's life offer opportunities for recognizing and implementing the competences for democratic culture in the real program. Among them there are competences in attitudes, skills, values and critical understandings. All of them can be equally and synchronously implemented in physical education and musical culture acceptance (*Aktivna* škola, 2019; *Referentni okvir kompetencija za demokratsku kulturu,* 2020). In higher education students experienced spontaneous, holistic and creative judgement what lead them to better understanding of elementary musical terms like rhythm and melody (Van der Merwe, 2015). In the same research it is also mentioned that students enjoyed in their participation and had fun. The same was confirmed in very recent study in Serbia about ranges and limitations of eurhythmics (Lazić, Matović, & Janković, 2022).

Among working age population the implementation of Dalcroze method has shown that it can be understood as a good strategy for stress management in work context, because of what it can be seen as rhythm therapy. It improved to better mood of employees and removing the tension, depression, rage and fatigue (Herrera & Vargas, 2019). The Dalcroze method has found its implementation within population of old people and has confirmed as melodic supplement to physical exercising (Lazić, Matović, & Janković, 2022). After rhythm, dance, movement and improvisation implementation, some positive changes have been notices like postural stability in the sense of falls decreasing and bones fractures (Cavanagh et al., 1998). After six months of implementing the musical programs exercising according to Dalcroze method some performances of walk and balance among old people have been improved (Trombetti et al., 2011). In some other situation of implementing the Dalcroze method with people of working age and old, participants were asked to move in one direction, to listen musical tones, to act quickly, change movement direction, develop predictability and cherish their own group cohesion (Dalcroze Eurhythmics Skipping Game with Greg Ristow, 2014). In some other organization Dalcroze method exercise, it is shown that participants should be ready to stop in the moment, to count the rhythm, to move very quickly, to use intuition and 'read' the music (Dalcroze Eurhythmics Stopping-Starting Quick Reaction with Greg Ristow, 2014). There is a lot of useful and widely applicable Dalcroze method exercises. For the purposes of this paper,

lovitom razvoju ličnosti učenika, zadovoljava prirodnu potrebu deteta / učenika za kretanjem i igrom i utiče na stvaranje zdravije populacije koja će se, zahvaljujući motoričkim znanjima i sposobnostima, lakše uključiti u sve segmente društvenog života (Gardašević, 2021: 164). Primena zdravih obrazaca u svakodnevnom životu nudi priliku za prepoznavanje i primenu kompetencija za demokratsku kulturu u realnom programu među kojima se nalaze kompetencije u stavovima, veštinama, vrednostima i kritičkom razumevanju koje se podjednako i sinhronizovano mogu primeniti u procesu fizičkog vaspitanja i sticanju muzičke kulture (*Aktivna škola*, 2019; *Referentni okvir kompetencija za demokratsku kulturu*, 2020). U visokom obrazovanju studenti su iskusili spontano, holističko i kreativno rasuđivanje, što je dovelo do lakšeg razumevanja osnovnih muzičkih pojmova kao što su ritam i melodija (Van der Merwe, 2015). U pomenutoj studiji je takođe navedeno da su studenti uživali u učešću tokom aktivnosti i da im je bilo zabavno. Isto je potvrđeno i u Srbiji, u vrlo svežem istraživanju o dometima i ograničenjima euritmije (Lazić, Matović, & Janković, 2022).

Među radno sposobnim stanovništvom, primena Dalkroz metode je pokazala da se može razumeti kao dobra strategija upravljanja stresom na radnom mestu, zbog čega se vidi i kao terapija ritmom. Doprinela je poboljšanju raspoloženja zaposlenih i otklanjanju napetosti, depresije, besa i umora (Herrera & Vargas, 2019). Dalkrozova metoda je pronašla svoju primenu i kod populacije starih i starijih lica i potvrdila se kao melodična dopuna fizičkom vežbanju (Lazić, Matović, & Janković, 2022). Pozitivne promene koje su primećene nakon primene ritma, plesa, pokreta i improvizacije su pozitivni uticaj na posturalnu stabilnost, u smislu smanjenja padova i preloma kostiju (Cavanagh et al., 1998). Nakon šestomesečne primene muzičkih programa vežbanja prema Dalkrozovoj metodi kod starijih osoba su se poboljšale performanse hoda, kao i ravnoteža (Trombetti et al., 2011). U drugoj prilici primene Dalkroz metode u radu sa osobama zrele i starije životne dobi od učesnika se tražilo da se kreću u jednom smeru, osluškuju tonove, brzo reagiju, menjaju smer kretanja, razvijaju predvidivost i neguju grupnu koheziju (*Dalcroze Eurhythmics Skipping Game with Greg Ristow*, 2014). Drugačije organizovana primena Dalkroz metode pokazala je da je potrebno biti spreman zaustaviti se u trenutku, brojati ritam, brzo se pokrenuti, koristiti intuiciju i 'čitati' muziku (*Dalcroze Eurhythmics Stopping-Starting Quick Reaction with Greg Ristow*, 2014). Postoje brojne vežbe primene Dalkroz metoda koje su se pokazale korisne i široko primenjive. Za potreve ovog

only two are presented that can more fully understand the pattern of actions and work.

Conclusion

Limitation of participants' life age isn't recognized in Dalcroze method. On contrary, it sees them as challenges. After implementation changes which become visible can be understood as qualitative step out in motor capabilities, locomotor status and movement aesthetics. Thus, the changes in motor skills can be seen most in strength, speed, coordination, balance, endurance, flexibility and precision. Strength can be developed through jumps and leaps that can be indicators of changes in musical dynamics, pause and tonality. Since eurhythmic exercises do not last long and are not hard, endurance doesn't have to be developed in special. Improvement in organization of the locomotor status is seen in stronger bones, joints and muscles. Finally, the movement aesthetic is present in almost every move during the process of implementation the Dalcroze method or movement activities. Participant herself/himself can follow, support it, and qualitatively changes and improve it. Besides the contributions mentioned in lines above, it is important to emphasize that Dalcroze method is still not an integral part of official educational programs in Serbia in any formal educational level. It confirms its place in the form of an alternative learning, offering encouraging results.

rada su prikazane samo dve kojima se može potpunije razumeti obrazac postupanja i rada.

Zaključak

Dalkroz metoda ne poznaje ograničenost životne dobi učesnika već ih vidi kao izazove. Promene koje se pojavljuju nakon primene mogu se razumeti kao kvalitativni iskoraci u motoričkim sposobnostima, lokomotornom aparatu i estetici pokreta. Tako se promena motoričkih sposobnosti vidi najviše u snazi, brzini, koordinaciji, ravnoteži, izdržljivosti, gipkosti i preciznosti. Snaga se razvija kroz skokove i poskoke koji mogu biti pokazatelj promene u muzičkoj dinamici, pauzi i tonalitetu. Izdržljivost ne mora posebno da se razvija u Dalkroz metodi jer euritmičke vežbe nisu dugotrajne ni naporne da bi se izdržljivost posebno razvijala. Napredak u organizaciji lokomotornog aparata se ogleda u ojačanim kostima, zglobovima i mišićima. I na kraju, estetika pokreta je prisutna u gotovo svakom pokretu tokom primene Dalkroz metode, odnosno kretnih aktivnosti, a sam učesnik je u prilici da je prati, kvalitativno menja i unapređuje. Valja napomenuti da i pored navedenih doprinosa sagledavanih u celini, Dalkroz metoda u Srbiji još uvek nije sastavni deo zvaničnih obrazovnih programa ni na jednom nivou obrazovanja. Svoje mesto potvrđuje u vidu alternativne škole, nudeći rezultate koji ohrabruju.

References:

Aktivna škola*. Priručnik za direktore. Demokratija u* školama*. EDC/HRE*. (2019). Strasbourg: Council of Europe Publishing.

Bogdanowicz, E. (2016). Dalcroze Eurhythmics in therapy for children with Attention Deficit Hyperactivity Disorder (ADHD) symptoms. Approaches: *An Interdisciplinary Journal of Music Therapy, Special Issue* 8(2), 134-146.

Calle, J. C. C., Garay, J. P. P., Esquivel-Ynjante, O. R., Alarcon-Diaz, H. H., Yabar-Miranda, P. S., Menacho-Vargas, I., & Taboada, M. A. R. (2021). Neuropsychological Maturity in Pre-school Children. *NeuroQuantology*, 19(5), 1-9.

Cavanagh, P., Evans, J., Fiatarone, M., Hagberg, J., McAuley, E., & Startzell, J. (1998). Exercise and physical activity for older adults. *Med Sci Sports Exerc*, 30(6), 1-29.

Dalcroze Eurhythmics Skipping Game with Greg Ristow. (2014). Available at: https://www.youtube.com/watch?v=UWif5Xss_Ec

Dalcroze Eurhythmics Stopping-Starting Quick Reaction with Greg Ristow. (2014). Available at: https://www.youtube.com/watch?v=zsROX7pQdZM

Flohr, J. W., & Persellin, D. C: (2011). Applying Brain Research to Children's Musical Experiences Classes. In: S. Burton & C. Taggart (eds.), *Learning from young children: Research in early childhood music* (pp. 3-22). Lanham, MD: Rowman & Littlefield.

Franco, S., (2005). Working with the body, the body at work, Eurythmics in art., Teaching and the medical sciences. Émile Jaques-Dalcroze: music in movement. Exhibition book. Geneva: Institut Jaques-Dalcroze.

Galikowska-Gajewska, A. (2014). Music in motion. In M. Petrović (ed.), *Proceedings of the 16th Pedagogical Forum of Performing Arts*. (pp. 157-165). Belgrade. FMU.

Gardašević, N. (2020). Analiza izvještaja eksterne evaluacije za fizičko vaspitanje u osnovnoj školi. *Vaspitanje i obrazovanje,* 45(4), 151-167. [in Serbian]

Gruhn, W., Haußmann, M., Herb, U., Minkner, C., Röttger, K., & Gollhofer, A. (2012). The development of motor coordination and musical abilities in pre-school children. *Arts BioMechanics*, 1(2), 89.

Herrera, M. B., & Vargas, P. C. (2019). The Effect of One-Session Rhythm Therapy on Mood States in Female and Male Corporate Employees. *Retos: nuevas tendencias en educación física, deporte y recreación*, (36), 273-277.

Jaques-Dalcroze, E. (1921/1980). *Rhythm, Music and Education*. London: The Dalcroze Society Inc. (prevod Helena Rubinštajn).

Johnson, M. (1987). *The Body in the Mind: The Bodily Basis of Meaning, Imagination, and Reason*. Chicago: University of Chicago Press.

Juntunen, M. L. (2002). The practical applications of Dalcroze Eurhythmics. *Nordic Research in Music Education Yearbook*, 6, 75–92.

Juntunen, M-L., Hyvönen, L. (2004). Embodiment in musical knowing: how body movement facilitates learning within Dalcroze Eurhythmics. British Journal of Music Education. 21, (2/2004), str. 199-214. DOI: 10.1017/S0265051704005686

Kim, J. (2014). "Boundaries" and "thresholds": Conceptual models of the musical mind in the history of music psychology. Psychology of

Music. 45, (2/2014), str. 671-691. DOI: 10.1177/0305735613487093
Lakoff, G., & Johnson (1980). *Metaphors We Live By*. Chicago: University of Chicago Press.
Lazić, Matović, & Vuković, S. (2021). Dalkroz metoda: Elementi integracije muzike i pokreta. *Vaspitanje i obrazovanje,* 66(2), str. 103-112. [in Serbian]
Lazić, S., Matović, M., & Janković, M. (2022). *Euritmija i holistički razvoj deteta: dometi i ograničenja.* Novi Sad: Visoka škola strukovnih studija za obrazovanje vaspitača. [in Serbian]
Martinović, V. (2015). Značaj i mogućnosti muzičkog obrazovanja u predškolskom uzrastu. *Krugovi detinjstva*, 3(2), 114-117. [in Serbian]
Matović, M., Lazić, S., & Radovanović, T. (2022). Music in Movement: Dalcroze Method in Serbian Preschool Educational System – Two Studies Perspective. In: Robert Celec (ed.). *Contemporary Issues in Education 2021*. Hamburg: Verlag dr Kovač GMBH (pp. 77-94).
Merleau-Ponty, M. (1968). *The Visible and the Invisible*. Evanston: Northwestern University Press.
Nelson, M. J. (1955). Music in Early Childhood. In: Constance Carr (Ed.), *Music for children's living* (pp.10-18). Washington: Association for Childhood Education International.
Osnove programa predškolskog vaspitanja i obrazovanja. (2018). Službeni glasnik Republike Srbije – Prosvetni glasnik broj 16. [in Serbian]
Petrović, M. (2015). Interdisciplinarni pristup u početnoj nastavi muzike. *Krugovi detinjstva*, 3(2), 118-126. [in Serbian]
Polanyi, M. (1966). *The Tacit Dimension*. Garden City, NY: Doubleday & Company.
Porges, S.W. (2011). *The Polyvagal Theory: Neurophysiological Foundations of Emotions, Attachment, Communication, and Self-regulation*. New York: WW Norton.
Referentni okvir kompetencija za demokratsku kulturu. (2020). Strasbourg: Council of Europe Publishing (Savet Evrope).
Roels, J. M., & Van Petegen, P. (2014). The integration of visual expression in music education for children. *British Journal of Music Education*, 31(3), 297-317.
Sheets-Johnstone, M. (1999). *The Primacy of Movement*. Amsterdam: John Benjamins Publishing Company.
Steiner, R. (2004). *Human values in education* (Vol. 20). Great Barrington, MA. SteinerBooks.
Sutela, K., Juntunen, M. L., & Ojala, J. (2020). Applying music-and-movement to promote agency development in music education: a case study in a special school. *British Journal of Music Education*, 37(1), 71-85.
Toadvine, T. (2016). "Maurice Merleau-Ponty". In Edward N. Zalta (Eds.) *The Stanford Encyclopedia of Philosophy (Winter 2016 Edition).*
Trombetti, A., Hars, M., Herrmann, F. R., Kressig, R. W., Ferrari, S., & Rizzoli, R. (2011). Effect of music-based multitask training on gait, balance, and fall risk in elderly people: a randomized controlled trial. *Archives of internal medicine*, 171(6), 525-533.
Van der Merwe, L. (2015). The first experiences of music students with Dalcroze-inspired activities: A phenomenological study. *Psychology of Music*, 43(3), 390-406.
Varela, F. J., Thompson, E., & Rosch, E. (1993). *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge: MIT Press.

Primljen: 08. maj 2022. / Received: May 08, 2022
Prihvaćen: 15. maj2022. / Accepted: May 08, 2022

https://doi.org/10.7251/SSH2201094M
UDC: 613.25:159.943.072-053.2
Professional paper
Stručni rad

Prevalence of Overweight and Obesity Among Adults In Kosovo

Besnik Morina, Shqipe Bajçinca Brestovci
Faculty of Physical Education and Sport, University of Pristina, Kosovo

Correspondence:
Besnik Morina, Faculty of Physical Education and Sport, University of Pristina, Kosovo
besnik.morina@uni-pr.edu

Abstract: *Purpose: Monitoring overweight and obesity is important for evaluating targeted interventions, preventing or reducing overweight and obesity. The purpose of this research was to confirm the hypothesis H: A if there are or not statistically significant differences between the socio-demographic characteristics of the participants and the weight status of the respondents in Kosovo. Methods: Participants were 200 male-female persons, of which 100 male-female persons were from urban areas, 100 male-female persons were from rural areas, the material was collected during March 2021. Body mass index (BMI) was calculated from self-reported height and weight. Results: The results show that the percentage of underweight was 1.2%, normal weight 30.8%, overweight 46.5%, and obesity included 21.5% of respondents. More males than females were overweight (54.6% vs 37%) of the women surveyed. Category >60 years - older people were significantly more overweight (53.4%) and obese (34.1%) of respondents than middle-aged and younger adults. Retired people make up a larger share of overweight and obesity (82.0%) of respondents, compared to employees, unemployed and students. People from urban areas were significantly more overweight than people in rural areas (49.3 vs 33.3%) and obese (23.3 vs 13.3%). Conclusion: In accordance with the research objective and hypotheses, we also obtained the research results show that the hypothesis H: A is proved which shows that there are statistically significant differences between the socio-demographic characteristics of the participants and the weight status of the respondents in Kosovo.*

Keywords: *BMI, overweight, obesity, socio-demographic characteristics, Kosovo.*

Introduction

In recent years, the prevalence of overweight and obesity among children has been reported (Olds et al., 2011; Marques & de Matos, 2016; Who, 2020), and adults (Rokholm et al., 2010; Sundquist et al., 2010) in different countries of the European Union. The prevalence of overweight and obesity is still high and is negatively affecting human health worldwide (Finucane et al., 2011; Ng et al., 2014). Overweight and obesity are the result of energy imbalance over a long period of time. The prevalence of overweight and obesity reduction is worrying (Branca et al., 2007; Khan et al., 2009). Studies have shown that the prevalence of overweight and obesity is high in various European countries. The prevalence of overweight in Europe is estimated to be approximately 50% (Peytremann-Bridevaux et al., 2007), and the prevalence of obesity is about 16% (Berghöfer et al., 2008). Moreover, a recent report by the OECD (Organization for Economic Co-operation and Development) shows that obesity increased from 11% in 2000, 16% in 2014, and 59% in 2022, across the various countries of the European Union (OECD, 2016; Who, European regional obesity report, 2022). Thus, monitoring overweight and obesity is very important for assessing the condition and for the interventions we intend to make in preventing the spread of overweight and obesity.

So the purpose of this paper is to prove the prevalence of overweight and obesity in adults in Kosovo.

Methods

Data collection was done through a standard questionnaire, a questionnaire which called prevalence of weight status according to socio-economics characteristics, questionnaire was used in various countries of the European Union (Marques et al., 2018). The questionnaire was translated and adapted by a professional team of translators in collaboration with the professors of the faculty of physical education and sports. The research included a group of 200 persons male and female, of which 100 male-female persons were from urban areas, and 100 male-female persons were from rural areas. The participants were treated according to Helsinki Declaration. The protocol was approved by the project evaluation

commission of Faculty of Physical Education and Sport, Pristina, approval number 04-438, 2021. The material was collected during March 2021. Respondents stated their gender and age. Using the reported age, respondents were categorized into three age groups (18–39, 40–59) and ≥60 years). Based on the International Standard Classification of Education(UNESCO, 2012), participants are grouped into three categories of education level: groups with primary, secondary, and higher education. Respondents were asked to report whether they are employed, students, ie unemployed, retired. To determine their place of residence, we asked respondents to report whether they live in urban or rural areas. We asked respondents to state whether they are married or unmarried. Regarding body mass index, body mass index is calculated from self-reported heightand measured and by weight (kg / m2) which is measured by us. BMI (Body mass index) categories are calculated in accordance with the guidelines of the World Health Organization (WHO Consultation on Obesity (1999: Geneva, Switzerland) & World Health Organization, 2000): underweight <(18.5 kg / m2), normal weight (18.5–24.9 kg / m2), overweight (25-29.9 kg / m2) and obese (30 kg / m2).Regarding the prevalence of weight status, according to socio-demographic characteristics and by countries, the percentage was calculated, with a 95% confidence interval (CI). The differences between participants' socio-demographic characteristics and weight status were tested by Chi-square test. Data analysis was performed using SPSS Statistics version 22.

Results

Table 1 presents the participants characteristics. For the total sample, the average BMI was 26.8 ±3.66. The proportion of underweight was only 1.2%, and 30.8% for normal weight. Overweight was 46.5%and obese accounted for 21.5%. The prevalence of weight status according socio-demographic characteristics is presented.

Table 1. *Participants' characteristics*

Socio-demographic variable	
Sex	
Male	54.2%
Female	45.8%
Age group	
18–39 years old	32.7%
40-59 years old	33.5%
> 60 years	33.8%
Education level of education	
Primary school	17.7%
High school	40.0%
the faculty	42.3%
Employment status	
Employed	51.2%
Unemployed	28.5%
Student	1.2%
In retirement	19.2%
Place of residence	
Urban area	50.0%
Rural area	50.0%
Marital status	
Married	82.7%
Not married	17.3%
BMI category	
Underweight	1.2%
Normal weight	30.8%
Overweight	46.5%
Obese	21.5%

(BMI, body mass index)

Table 2 Significantly more men than women were underweight (1.4%, 95% CI: 0-3.5% vs. 0.8%, 95% CI: 0-2.5). Also, more men than women were overweight (54.6%, 95% CI: 46.8-62 vs. 37%, 95% CI: 28.6-46.2%). Older adults were significantly more overweight (53.4%, 95% CI: 42-65.9%) and obese (31.1%, 95% CI: 23.9-43.2%) than middle age and younger adults. Perhaps related with age, students people account for a greater proportion of overweight (66.7%, 95% CI: 0-100%), when compared with employed, unemployed and retire. People from urban areas were significantly more overweight (49.3%, 95% CI: 41.9-55.8% vs. 33.3%, 95% CI: 20-46.7%) and obese (23.3%, 95% CI: 17.7-29.3% vs. 13.3%, 95% CI: 4.4-22.2%) than those who lived in rural areas. 49% (95% CI: 41.9-55.8) of those who live without a partner were overweight compared with 33.3% (95% CI: 31.5–34.2%

Table 2. *Prevalence of weight status according to socioeconomic characteristics*

	(95% CI) %				
	Underweight	**Normal**	**Overweight**	**obese**	**P**
Sex					0.001
Male	1.4 (0, 3.5)	31.2 (24.1, 39)	54.6 (46.8, 62.4)	12.8 (7.1, 18.4)	
Females	0.8 (0, 2.5)	30.3 (21.8, 38.7)	37 (28.6, 46.2)	31.9 (23.5, 40.3)	
Age group					0.000
18–39 years old	1.2 (0, 3.5)	49.4 (38.8, 60)	37.6 (27.1, 48.2)	11.8 (5.9, 18.8)	
40-59 years old		33.3 (23, 43.7)	48.3 (37.9, 59.7)	18.4 (10.3, 26.4)	
> 60 years	2.3 (0, 5.7)	10.2 (4.5, 17)	53.4 (42, 65.9)	34.1 (23.9, 43.2)	
Education level of education					0.000
Primary school	2.2 (0, 6.5)	8.7 (2.2, 17.4)	37 (23.9, 52.2)	52.2 (37, 67.4)	
High school	1 (0, 2.9)	30.8 (21.2, 39.4)	50 (40.4, 58.7)	18.3 (10.6, 26)	
the faculty	0.9 (0, 2.7)	40 (30.9, 50)	47.3 (38.2, 57.3)	11.8 (6.4, 18.2)	
Employment status					0.001
Employed	0.8 (0, 2.3)	30.1 (22.6, 38.3)	53.4 (45.1, 61.7)	15.8 (10.5, 22.5)	
Unemployed		43.2 (32.4, 55.4)	36.5 (25.7, 48.6)	20.3 (12.2, 29.7)	
Student		33.3 (0, 100)	66.7 (0, 100)		
In retirement	4 (0, 10.0)	14 (6.0, 24.0)	42 (28.0, 56.0)	40 (28.0, 54.0)	
Place of residence					0.285
Urban area	0.9 (0, 2.3)	26.5 (20.9, 32.6)	49.3 (41.9, 55.8)	23.3 (17.7, 29.3)	
Rural area	2.2 (0, 6.7)	51.1 (37.8, 66.7)	33.3 (20, 46.7)	13.3 (4.4, 22.2)	
Marital status					0.009
Married	0.9 (0.0, 2.3)	26.5 (20.5, 32.1)	49.3 (41.9, 55.8)	23.3 (18.1, 29.3)	
Not married	2.2 (0.0, 6.7)	51.1 (35.6, 66.6)	33.3 (20.0, 46.7)	13.3 (4.4, 24.4)	

Differences between weight status and socio-demographic characteristics were tested by Chi-square

Discussion

This research provides us with current data regarding the prevalence of overweight and obesity in adults in Kosovo. The prevalence of overweight and obesity in 2014 in the European Union was 53.1%, but overweight and obesity in recent years has healthy lifestyle programs, especially in relation to diet and physical activity. The results show that over half of the population in our country and also in more than half of the European population is in the category of overweight and obesity (Guh et al., 2009; Dixon, 2010; Herrera et al., 2011).

This study strengthens the thoughts and claims of an epidemic of overweight and obesity that is emerging in our country as well as in most countries of the European Union. There increased and especially in our country, the results show that the percentage of overweight and obesity has increased to 68.0%. In the countries of the European Union the highest prevalence of overweight and obesity is presented in the countries of Eastern Europe when compared to the countries of Central and Northern Europe. Social and economic characteristics have been shown to be associated with the prevalence of overweight and obesity. Prevalence in women was lower than in men, and this has

been confirmed in our recent research (Manios et al., 2005; de Salas et al., 2016), and such a thing is presented in our country where the percentage of overweight in men is presented to 54.6% of respondents, while in women it is presented to 37% of respondents, but obesity is more pronounced in women in 31.9% of respondents as opposed to men to 12.8% of respondents. Also, overweight and obesity were more prevalent in adults aged >60 years, overweight at this age was reported in 53.4% of respondents, while obesity was reported in 34.1% of respondents, these results are similar to other studies in different countries of the European union showing an increase in overweight and the prevalence of overweight that manifests with increasing age-years of life. Regarding the level of education, the highest percentage of overweight is presented to persons with secondary education, which includes 50.0% of respondents, while obesity is more pronounced in persons with primary education, which includes 52.2% of respondents. It is interesting the result of the appearance of overweight in terms of employment status where the highest percentage of overweight is presented to students which include 66.7% of respondents, while obesity is more displayed in people who are retired which include 40% of respondents. Respondents living in urban areas showed a higher prevalence of overweight and obesity, the prevalence of overweight included 49.3% of respondents in urban areas, while the prevalence of obesity included 23.3% of respondents in urban areas., socio-economic status and geographical position (Sarlio-Lähteenkorva et al., 2006; De Salas et al., 2016). The prevalence of overweight and obesity varied in different countries of the European Union, from approximately 32-45% for overweight and 11-20% for obesity (Cohen et al., 2017). Regarding marital status, the highest percentage of overweight is presented to married persons, which includes 49.3% of respondents, and also obesity is more pronounced in married persons, which includes 23.3% of respondents. Kosovo as a country lying in southeastern Europe is presented with a higher prevalence of overweight and obesity, the prevalence of overweight is presented to 46.5% of respondents while the prevalence of obesity is presented to 21.5% of respondents. However, other factors may also explain this variation on the continent of different European Union countries: urban countries, healthy eating habits and ways, physiological and genetic changes (Murtagh & Murphy, 2015; Blundell et al., 2017). It is interesting that the prevalence of overweight and obesity is higher in Eastern European countries (Blundell et al., 2017). Since the countries of Eastern Europe are known for a lower economic situation than the countries of Central and Northern Europe (Stepaniak et al., 2016). Thus, it is important to develop effective are several risk factors for obesity to appear to have become universal, transcending national boundaries. Therefore, there is a need for a better approach in trying to manage overweight and obesity, preparing and applying appropriate programs in physical activity and public health policies, sports and health care professionals should advise people and their patients and explain the importance of engaging in physical activity and maintaining a healthy weight. People should keep in mind that weight loss (approximately 5% of initial weight) is associated with significant improvements in the health of each person, and that this also reduces the cost to the health care system and society at large (Wilkinson et al., 2014; NCD Risk Factor Collaboration, 2016).

Conclusion

This research was conducted on purpose to verify the prevalence of overweight and obesity in adults in Kosovo. The results show that over half of the population in Kosovo and also in more than half of the European population is in the category of overweight and obesity, this study strengthens the thoughts and claims of an epidemic of overweight and obesity that is appearing in our country as well as in most countries of the european union. In accordance with the research objective and hypotheses, we also obtained the research results shows that the hypothesis H: A is proved which shows that there are statistically significant differences between the socio-demographic characteristics of the participants and the weight status of the respondents in Kosovo.

References

Berghöfer, A., Pischon, T., Reinhold, T., Apovian, C. M., Sharma, A. M., &Willich, S. N. (2008). Obesity prevalence from a European perspective: a systematic review. *BMC public health*, *8*, 200. https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-8-200

Blundell, J. E., Baker, J. L., Boyland, E., Blaak, E., Charzewska, J., de Henauw, S., Frühbeck, G., Gonzalez-Gross, M., Hebebrand, J., Holm, L., Kriaucioniene, V., Lissner, L., Oppert, J. M., Schindler, K., Silva, A. L., & Woodward, E. (2017). Variations in the Prevalence of Obesity Among European Countries, and a Consideration of Possible Causes. *Obesity facts*, *10*(1), 25-37. https://www.karger.com/Article/FullText/455952

Branca, F., Nikogosian, H., & Lobstein, T. (2007). *The challenge of obesity in the WHO European Region and the strategies for response.* Denmark: WHO Regional Office for Europe Scherfigsvej 8 DK-2100 Copenhagen Ø, Denmark.
https://www.euro.who.int/__data/assets/pdf_file/0008/98243/E89858.pdf

Cohen, S. A., Cook, S. K., Kelley, L., Foutz, J. D., &Sando, T. A. (2017). A closer look at rural-urbanhealth disparities: Associations between obesity and rurality vary by geospatial and socio demographic factors. *The Journal of Rural Health, 33*(2), 167-179.
https://pubmed.ncbi.nlm.nih.gov/27557442/

De Salas, M. M., Martín-Ramiro, J. J., & Juárez Soto, J. J. (2016). Sociodemographic characteristics as risk factors for obesity and overweight in Spanish adult population. *Medicina clinica*, *146*(11), 471-477.
https://www.sciencedirect.com/science/article/abs/pii/S0025775316300124?via%3Dihub

Dixon, J. B. (2010). The effect of obesity on health outcomes. *Molecular and cellular endocrinology*, *316*(2), 104-108.
https://www.sciencedirect.com/science/article/abs/pii/S0303720709003645?via%3Dihub

Finucane, M. M., Stevens, G. A., Cowan, M. J., Danaei, G., Lin, J. K., Paciorek, C. J., Singh, G. M., Gutierrez, H. R., Lu, Y., Bahalim, A. N., Farzadfar, F., Riley, L. M., Ezzati, M., & Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Body Mass Index) (2011). National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9·1 million participants. *Lancet (London, England)*, *377*(9765), 557–567.
https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(10)62037-5/fulltext

Guh, D. P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C. L., & Anis, A. H. (2009). The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC public health*, *9*, 88.
https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-9-88

Herrera, B. M., Keildson, S., & Lindgren, C. M. (2011). Genetics and epigenetics of obesity. *Maturitas*, *69*(1), 41-49.
https://www.maturitas.org/article/S0378-5122(11)00079-X/fulltext

Khan, L. K., Sobush, K., Keener, D., Goodman, K., Lowry, A., Kakietek, J., Zaro, S., & Centers for Disease Control and Prevention (2009). Recommended community strategies and measurements to prevent obesity in the United States. *MMWR. Recommendations and reports:Morbidity and mortality weekly report. Recommendations and reports*, *58*(RR-7), 1–26.
https://www.cdc.gov/mmwr/pdf/rr/rr5807.pdf

Manios, Y., Panagiotakos, D. B., Pitsavos, C., Polychronopoulos, E., & Stefanadis, C. (2005). Implication of socio-economic status on the prevalence of overweight and obesity in Greek adults: the ATTICA study. *Health Policy,74*(2), 224-232.
https://pubmed.ncbi.nlm.nih.gov/16153482/

Marques, A., & de Matos, M. G. (2016). Trends in prevalence of overweight and obesity: are Portuguese adolescents still increasing weight? *International Journal of Public Health*,*61*(1), 49-56.
https://pubmed.ncbi.nlm.nih.gov/26542954/

Marques, A., Peralta, M., Naia, A., Loureiro, N., & de Matos, M. G. (2018). Prevalence of adult overweight and obesity in 20 European countries, 2014. *European journal of public health*, *28*(2), 295-300.
https://academic.oup.com/eurpub/article/28/2/295/4210290

Murtagh, E. M., Murphy, M. H., Murphy, N. M., Woods, C., Nevill, A. M., &Lane, A. (2015). Prevalence and correlates of physical inactivity in community-dwelling older adults in Ireland. PLoS ONE *10*(2). 0118293.
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0118293

NCD Risk Factor Collaboration (NCD-RisC) (2016). Trends in adult body-mass index in 200 countries from 1975 to 2014: a pooled analysis of 1698 population-based measurement studies with 19·2 million participants. *Lancet (London, England)*, *387*(10026), 1377-1396.
https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)30054-X/fulltext

Ng, M., Fleming, T., Robinson, M., Thomson, B., Graetz, N., Margono, C., … Gakidou, E. (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet (London, England)*, *384*(9945), 766–781.
https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(14)60460-8/fulltext

OECD / European Union (2016). *Health at a Glance: Europe 2016: State of Health in the EU Cycle*, OECD Publishing, Paris.
https://www.oecd-ilibrary.org/social-issues-migration-health/health-at-a-glance-europe-2016_9789264265592-en

Olds, T., Maher, C., Zumin, S., Péneau, S., Lioret, S., Castetbon, K., Bellisle, de Wilde, J., Hohepa, M., Maddison, R., Lissner, L., Sjöberg, A., Zimmermann, M., Aeberli, I., Ogden, C., Flegal, K., & Summerbell, C. (2011). Evidence that the prevalence of childhood overweight is plateauing: data from nine countries. *International journal of pediatric obesity : IJPO: an official journal of the International Association for the Study of Obesity*, *6*(5-6), 342-360. https://informahealthcare.com/doi/abs/10.3109/17477166.2011.605895

Peytremann-Bridevaux, I., Faeh, D., & Santos-Eggimann, B. (2007). Prevalence of overweight and obesity in rural and urban settings of 10 European countries. *Preventive medicine*, *44*(5), 442-446. https://www.sciencedirect.com/science/article/abs/pii/S0091743506005032?via%3Dihub

Rokholm, B., Baker, J. L., & Sørensen, T. I. (2010). The levelling off of the obesity epidemic since the year 1999--a review of evidence and perspectives. *Obesity reviews : an official journal of the International Association for the Study of Obesity*, *11*(12), 835-846. https://onlinelibrary.wiley.com/doi/10.1111/j.1467-789X.2010.00810.x

Sarlio-Lähteenkorva, S., Silventoinen, K., Lahti-Koski, M., Laatikainen, T., & Jousilahti, P. (2006). Socio-economic status and abdominal obesity among Finnish adults from 1992 to2002. *International journal of obesity (2005)*, *30*(11), 1653-1660. https://www.nature.com/articles/0803319

Stepaniak, U., Micek, A., Waśkiewicz, A., Bielecki, W., Drygas, W., Janion, M., Kozakiewicz, K., Niklas, A., Puch-Walczak, A., & Pająk, A. (2016). Prevalence of general and abdominal obesity and overweight among adults in Poland. Results of the WOBASZ II study (2013-2014) and comparison with the WOBASZ study (2003-2005). *Polskie Archiwum Medycyny Wewnetrznej*, *126*(9), 662–671.
https://www.mp.pl/paim/issue/article/3499/

Sundquist, J., Johansson, S. E.,&Sundquist, K. (2010). Levelling off of prevalence of obesity in the adult population of Sweden between 2000/01 and 2004/05. *BMC Public Health*, *10*(119).
https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-10-119

UNESCO (2012). *International Standard Classification of Education ISCED 2011. Montreal: United Nations Educational, Scientific and Cultural Organization.* Canada: UNESCO Institute for Statistics, P.O. Box 6128, Succursale Centre-Ville Montreal, Quebec H3C 3J7.
http://uis.unesco.org/sites/default/files/documents/international-standard-classification-of-education-isced-2011-en.pdf

WHO Consultation on Obesity (1999: Geneva, Switzerland)" & World Health Organization. (2000)". Obesity: preventing and managing the global epidemic: report of a WHO consultation. World Health Organization.
https://apps.who.int/iris/handle/10665/42330

WHO. (2022). *EUROPEAN REGIONAL OBESITY REPORT.* Denmark: World Health Organization Regional Office for Europe.
https://apps.who.int/iris/bitstream/handle/10665/353747/9789289057738-eng.pdf

WHO. (9 June 2021). *Obesity and overweight.* Geneva, Switzerland: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

*WHO, Obesity and Owerweight. Aviable from:*https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

Wilkinson, M. L., Brown, A. L., Poston, W. S., Haddock, C. K., Jahnke, S. A., & Day, R. S. (2014). Physician weight recommendations for overweight and obese firefighters, United States, 2011-2012. Preventing chronic disease, 11, E116.
https://www.cdc.gov/pcd/issues/2014/14_0091.htm

Primljen: 16. april 2022. / Received: April 16, 2022
Prihvaćen: 19. maj 2022. / Accepted: May 19, 2022

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