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Pere Krece 13, 78000 Banja Luka,
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fax +387 (0) 51 430 921
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Pan-European University "Apeiron"
Pere Krece 13, 78000 Banja Luka,
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Sadržaj / Contents

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Dear readers,

Another issue of the Journal "Sports Science and Health" is in front of you. In this issue as well, the interest of authors in publishing works in our Journal is great, which further encourages us to progress and raise the Journal of "Sports Science and Health" to an even higher standard.

In this issue, we have 14 works by authors from Bosnia and Herzegovina, Serbia, North Macedonia, Indonesia, Algeria, and Malaysia. The topics of the papers are quite diverse and interesting: the development of Mawashigeri for children aged 10-12 years in karate, the effects of a six-week preparatory period on the transformation of speed and agility ability in senior female soccer players, increasing the effectiveness of shadow training by applying badminton steps in increasing footwork agility in badminton, impact of the complex lumbopelvic hip exercises on the range of motion, strength among the student population, the prevalence of high blood pressure and its association with obesity in children in North Macedonia aged 6, technological readiness and mental state as factors of academic success of students, the impact of training programs on the relaxation of young gymnasts aged 10 and 11 years, the relationship between hand grip balance and body balance in archery, the basis of the value of angular difference and angular velocity according to the steps of rotation in the triple jump, the influence of the level of physical activity on the symptoms and duration of recovery from the disease Covid 19, the sociological perspective of transhumanism through the prism of the sports-marketing industry, physical the activity of students, the relationship between physical dimensions and the specifics of the motor skills of volleyball players in relation to the playing position, the specifics of the realization of health-recreational goals at school in nature.

The editorial board of the Journal, as always, would like to thank all the authors, as well as the reviewers, who improve and improve the quality of the Journal itself with their participation. We invite you to continue to send your works to our address www.siz-au.com in order to contribute as much as possible to the development of both the Journal and science in general.

The most beautiful thing we can experience is that which is mysterious. It is a fundamental feeling that stands at the core of every art and science.

Albert Einstein

Dragi čitaoci,

Pred vama je još jedan broj Časopisa ''Sportske nauke i zdravlje". I u ovom broju zainteresovanost autora za objavljivanje radova u našem Časopisu je velika, što nas dodatno podstiče da napredujemo i dižemo Časopis ''Sportske nauke i zdravlje" na još veći standard.

U ovom broju imamo 14 radova, autora iz Bosne i Hercegovine, Srbije, Sjeverne Makedonije, Indonezije, Alžira, Malezije. Tematika radova je dosta raznovrsna i zanimljiva: razvoj Mawashigeri za djecu uzrasta 10 – 12 godina u karateu, efekti šestonedeljnog pripremnog perioda na transformaciju brzine i agilnosti kod fudbalerki seniorki, povećavanje efikasnosti treninga sjene primjenom badmitonskih koraka u povećanju agilnosti rada nogu u badmintonu, uticaj kompleksa vježi lumbopelvičnog kuka na raspone pokreta, snagu među studentskom populacijom, prevalacija visokog krvnog pritiska i povezanost sa gojažnošću djece u Sjevernoj Makedoniji uzrasta 6 godina, tehnološka spremnost i psihičko stanje kao faktori akademskog uspjeha učenika, uticaj programa trening na opuštawe mladih gimnastičarki uzrasta 10 i 11 godina, odnos ravnoteže stiska šake i ravnoteže tijela u streličarstvu, osnos vrijednosti ugaone razlike i ugaone brzine prema koracima rotacije u troskoku, uticaj nivoa tjelesne aktivnosti na simptome i trajanje oporavka od bolesti Covid 19, sociološku persprektivu transhumanizma kroz prizmu sportsko-marketinške industrije, fizička aktivnost studenata, relacije tjelesnih dimenzija i specifičnosti motoričkih sposobnosti odbojkašica u odnosu na igračku poziciju, specifičnosti realizacije zdravstveno-rekreativnih ciljeva u školi u prirodi.

Uredništvo Časopisa kao i svaki put do sada želi da se zahvali svim autorima, ali i recenzentima koji svojim učešćem unapriđuju i poboljšavaju kvalitet samog Časopisa. Pozivamo vas i dalje da na našu adresu www.siz-au.com i daje šaljete svoje radove, kako bi što više doprineli razvoju kako Časopisa, tako i nauke uopšteno.

Najljepše što možemo doživjeti je ono što je tajanstveno. To je temeljni osjećaj koji stoji u zamjetku svake umjetnosti i nauke.

Alber Ajnštajn

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Circuit Game Development Mawashigeri Based on CGFU-PM 515 for Children Aged 10-12 Years in Karate Sports

Widha Srianto Siswantoyo[1], Rumpis Agus Sudarko[1], Muhammad Wahyu Arga[1], Yuyun Farida Susanto[2]
[1]Sport Science Study Program, Faculty of Sport Science, Yogyakarta State University, Indonesia.
[2]Sayyid Ali Rahmatullah State Islamic University Tulungagung, Tulungagung, Indonesia.

Correspondence:
Widha Srianto, Faculty of Sports Science, Universitas Negeri Yogyakarta, Indonesia
widhasrianto.2021@student.uny.ac.id

Abstract: *Understanding of basic movements is often a major problem in the field, so there is a need for guidance from an early age on basic movements or correct basic techniques for children. The lack of a game-based training model to make children easily bored so that it has an impact on the quality of technique when they become professional athletes. The purpose of this study was to produce a mawashigeri circuit game training model based on CGFU-PM 515 for children aged 10-12 years in karate. The research design used in this research is research and development (RnD). The procedure used uses a 4 D model which consists of define, design, development, and dissemination. Data analysis technique uses the V-Aiken formulation. Based on the validation test, data were generated 1) conformity to the actual technique has a high level of validity with a score of 0.96, 2) critical points have a high level of validity with a score of 0.91, 3) encouraging curiosity has a high level of validity with a score of 0, 93. Based on the practicality assessment, an index of 98% was obtained in the very practical category, that the model developed was easy to do, fun, easy to understand, and could train mawashigeri techniques. In this study, it was concluded that the product in the form of a mawashigeri circuit games model based on CGFU-PM 515 for children aged 10-12 years, the sport of karate has a high level of validation and practicality value in the very practical category. The product developed consists of 5 stations, namely station 1 for lightning kicks, station 2 for flying bottles, station 3 for crossing mountains, station 4 for delivering boxes, station 5 for flying cones.*
Keywords: *CGFU-PM 515, Circuit Game, Karate, Mawashigeri.*

Introduction

The guidance and development of sports at the basic level carried out by the Ministry of Education and Culture of the Republic of Indonesia is one part of the four pillars of the national education development policy which includes, exercise the heart or heart, exercise the senses, exercise the mind, and exercise. The grand design of national sports or what is called DBON is mandated by Presidential Regulation Number 86 of 2021 as a step to improve national sports governance. One of the goals is the realization of world sports achievements through a systematic, tiered, sustainable long-term athlete development program based on sports science and technology supported by qualified sports personnel from 2021 to 2045 in order to achieve the target of ranking 5th in the The Olympics and karate are among the sports that are prioritized because they are included in the sports that are contested in the Olympics (Carvalho Rodrigues, et. al.) Achievement development is a complex process and takes a long time using effective and efficient steps arranged in sports training methodologies (Bompa & Buzzichelli, 2019). The involvement of children is an important momentum in preparing for the DBON program, understanding basic movements is often a major problem in the field, so there is a need for guidance from an early age regarding correct basic movements or techniques for children.

The importance of planning an exercise program for children is to improve basic techniques so that they have good movement quality so that when they become athletes they are able to perform techniques perfectly. Researchers uncovered several literacy concepts for training and planning exercise programs for children. Forms of sports in children are directed at recognizing and mastering the skills of a basic technique of a sport in order to develop skills and physicality in general (Sitepu, 2018). The concept of training programs for children must be carried out in the form of games and carried out with pleasant feelings and avoid specialization stages because the specialization stages are given to professional athletes (Ropret & Jevtić, 2019), (Perreault & Gonzalez, 2021), because if children are given training programs like professional athletes they will impact on growth, development, psychological, and impact on the risk of injury athletes (Ropret & Jevtić, 2019), (Khodabandelou & Salehian, 2023). Several studies mention the importance of playing methods for children, game models can explore both qualitatively and quantitatively, game

designs designed by coaches encourage children to have positive social interactions, have a sense of togetherness, foster a sense of brotherhood, and positive interactions for children. children (Gray, Robertson, Manches & Rajendran, 2019). The game has a meaning that can foster a conscious and responsible attitude, has significant pedagogical strengths, the game also develops moral traits such as discipline, justice and patience (Pérez Fernández, Ferrer Colin & Liz López, 2017). The game-based training model contributes to overall development and the competitive nature of games encourages children to realize their abilities to the fullest (Marchenko& Satdyiev, 2021).

An explanation of the basic concepts of training these children is a reference for researchers to explore potential problems in the field, in research it is stated that the karate training model for children is directly confronted one by one, there is no clear motivation for children in applying the kumite technique, and the process of hitting, kicking and parrying technique training is not packaged in the form of game practice (Susila & Prastya, 2019), while another problem is that the ability of kicking techniques is still in the low category, following data in several studies that the effectiveness of hitting techniques for male athletes is 18% and women are 13% %, the effectiveness of the male kick technique is 5% and the female is 2% (Fendrian & Nurzaman, 2016). The percentage of kicking techniques in the match is as follows: maegeri technique 1%, mawashigeri 11%, ushiro mawashigeri 0%, yoko geri 0% (Fandayani & Sagitarius, 2019). In sea games, Indonesian male athletes have a successful percentage of hitting techniques of 44% and 8% of kick techniques, Indonesian male athletes have a successful percentage of hitting 13% and kicking 11% (Zebua, 2021).

Based on the background of these problems, the researcher tried to develop a training model in the form of circuit games to practice the mawashigeri kick technique or often called circle kick (Marchenko & Taranenko, 2020), (Szczęsna, Błaszczyszyn & Pawlyta, 2021). The form of circuit game training was chosen so that children would not get bored doing it quickly (Yachsie, Graha & Hartanto, 2023). Mawashigeri circuit game training is carried out using the concept of Coaching Game for Upgrading Performance Model 515 (CGFU-PM 515). CGFU-PM 515 is a creative, innovative, not boring, and futuristic training model solution by utilizing the development of information technology towards an educational model in the industrial era 4.0, the CGFU-PM 515 concept is high order thinking skills (high order thinking skills). HOTS), namely remembering, understanding, applying, analyzing, evaluating, and creating [18] (Zaini & Salimin, 2020), (Sriwahyuniati, 2019). The game innovation developed is the mawashigeri circuit game based on CGFU-PM 515 which consists of 5 game stations as an alternative trainer in preparing karate training programs for children. The following describes the types of games and critical points in table 1.

Table 1. *Types of games and Critical points*

Game	Game description	Critical point
Station 1. Lightning Kick	The child tries to put the ball into the goal, by kicking the ball from a side position.	When the child kicks the ball from the side according to the motion pattern of the mawashigeri technique.
Station 2. Flying Bottles	The child kicks the bottles arranged on the cardboard, kicks technique with a circular kick, after kicking the bottle runs then runs.	When the child kicks the bottle arranged on top of the bottle according to the mawashigeri motion pattern
Station 3. Crossing the Mountain	5 children line up and bend over, then one of the children lifts and rotates the leg over the back of each child who bends	On lifting the legs and turning across the backs of the children who bend their bodies according to the mawashigeri motion pattern
Station 4. Deliver Cardboard	The child runs to move the cardboard from point A to point B, after moving the cardboard then lifts and rotates his feet on the cardboard which are arranged using the right and left feet	When the child lifts and rotates his feet on the cardboard according to the mawashigeri motion pattern
Station 5. Flying Cone	The child moves the cone into a cardboard box that is arranged with a height of 50-70 cm. Moves the cone by pinching the cone with his toes into the cardboard.	When the child lifts and rotates the leg to move the cone into the box according to the mawashigeri motion pattern

Method

The research design used in this research is research and development (RnD). The procedure used uses the 4 D model from the theory of Thiagarajan et al. 1974 consisting of define, design, development, and dissemination

(Bakri, Ambarwulan & Muliyati, 2018), (Widayanti, 2021). This method and model were chosen to produce a basic mawashigeri technique training product based on CGFU-PM 515 in karate. In this study, validity and practicality tests were carried out to produce a training model that was feasible to use.

Statistic analysis

The data analysis technique used in this research is quantitative analysis. Quantitative data is analyzed using the V-Aiken formulation. The V-Aiken value range is 0 to 1. – 0.8 in the medium category, if the value of V > 0.8 is in the high category (Arthur, Rouf, Rahmayanti & Maulana, 2019). The following is the V-Aiken formula (Nengsih & Mawardi, 2021):

$$V = \frac{\sum s}{n(c-1)}$$

Figure 1. *V-Aiken Formula*

v: the Aiken scale to find the value for
s: the reduction result of the validator value with the lowest value
n: the number of validators
c: the highest validity value

Results

This research resulted in a training model called circuit game mawashigeri, a series of game activities consisting of 5 stations. The advantage of this circuit game is when the children play the game without realizing that the children are practicing the mawashigeri technique. Each station has game activities that are adapted to movements in actual techniques, where the game aims to train mawashigeri techniques. After developing the CGFU-PM 515-based circuit game model, the researchers carried out expert validation tests, namely material experts and media experts. In addition, researchers also conducted practicality tests on the activities developed

Table 2. *Expert Judgment's assessment of the developed model*

grain	Expert														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Conformity to actual technique	3	4	4	4	4	4	4	4	4	4	4	4	4	3	4
Critical point	4	4	3	4	4	4	4	4	3	4	3	4	4	4	3
Encourage curiosity	4	4	4	4	3	4	3	4	4	4	4	4	4	3	4

After conducting expert validation, the next step is to validate using V-Aiken, in table 3.

Table 3. *Validation using V-Aiken*

s															∑s	n(c-1)	V	Information
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
2	3	3	3	3	3	3	3	3	3	3	3	3	2	3	43	45	0,96	TALL
3	3	2	3	3	3	3	3	2	3	2	3	3	3	2	41	45	0,91	TALL
3	3	3	3	2	3	2	3	3	3	3	3	3	2	3	42	45	0,93	TALL

The assessment of the developed model was carried out by 15 expert judgments consisting of 5 expert judgments in the academic field of karate sports science, namely 1 expert judgment with a professor degree, 1 expert

judgment with a doctorate degree, 3 expert judgments with a master degree, and 10 expert judgments for practitioners of karate sports, namely karate coaches. who has a karate coaching license. Based on the results of expert judgment then analyzed using the V-Aiken formulation to produce the following data: 1) the suitability of the actual technique has a high level of validity with a score of 0.96, 2) critical points have a high level of validity with a score of 0.91 , 3) encouraging curiosity has a high level of validity with a score of 0.93. The following is the practicality test assessment in table 4.

Table 4. *Practicality test assessment [25]*

QUESTION	ANSWER CHOICES WEIGHT SCORE				ANSWER CHOICES WEIGHT SCORE				WEIGHT
	SS	S	KS	TS	4	3	2	1	
Is the game easy to do	13	2	0	0	52	6	0	0	58
Is a fun game	13	2	0	0	52	6	0	0	58
Is the game easy to understand	14	1	0	0	56	3	0	0	59
Is the game able to train mawashigeri techniques	15	0	0	0	60	0	0	0	60

Average weight = ∑x/n
Average weight score = 58+58+59+60/4 = 58.7
Interpretation of calculation scores
Maximum Value (Y) = Highest Value x Number of Respondents
Minimum Value (X) = Lowest value x Number of respondents
Index formula (%) = Total score/Y x 100
Index = 58.7/60 x 100 = 97.8 or 98%

Table 5. *Practicality Value Criteria [25]*

Practical Value %	Category
86 – 100	Very Practical
76 – 85	Practical
60 – 75	Pretty Practical
55 – 59	Less Practical
< 54	Impractical

Based on the practicality assessment, an index of 98% was obtained in the very practical category. It can be concluded that the mawashigeri circuit game model based on CGFU-PM 515 for children aged 10-12 years in karate sports is easy to do, fun, easy to understand, and can train mawashigeri techniques.

Discussion

The basic concept of developing CGFU-PM 515 was initiated by Siswantoyo where 515 is defined by the letters SIS as the initials of the initiator [18], the CGFU-PM 515 concept is based on the concept of teaching games for understanding (TGfU) which has developed in physical education (Arias-Estero, Jaquero, Martínez-López & Morales-Belando, 2020), (Gil-Arias, et. al., 2021). CGFU-PM 515 is a training stage concept which consists of four stages, namely innovation games, natural games action, coaching approach, and performance & skill assessment. The following is a picture of the CGFU-PM 515 concept stages:

Figure 2. *CGFU-PM 515 stages [18]*

This research only focuses on the innovation games stage, the stage where the coach develops a game model by considering the critical points in the mawashigeri technique. The critical point in question is developing a game model that is adapted to the movement pattern of the mawashigeri technique. The training model was made with the circuit games model which has 5 game stations consisting of station 1 playing lightning kicks, station 2 flying bottles, station 3 crossing mountains, station 4 delivering boxes, station 5 flying cones. The use of circuit game models is also quite effective in improving athlete fitness (Susanto, Siswantoyo, Prasetyo & Putranta, 2021).

After the training model is made, the next step is to carry out an analysis test with a validity test and a practicality test. The results of the validity test produced data 1) conformity to the actual technique has a high level of validity with a score of 0.96, 2) critical points have a high level of validity with a score of 0.91, 3) encouraging curiosity has a high level of validity with score 0.93. The practicality test produced index data of 98% in the very practical category, namely the mawashigeri circuit game model based on CGFU-PM 515 which is easy to do, fun, easy to understand, and can train mawashigeri techniques.

Conclusion

This study concluded that the validity test results were in the high category and the practicality test data at the 98% index were in the very practical category. The product is a mawashigeri circuit game model based on CGFU-PM 515 for children aged 10-12 years in the karate sport that can be used by coaches to train mawashigeri techniques for children. The circuit game consists of station 1, a lightning kick game, station 2, a flying bottle game, station 3 game across the mountain, station 4 game delivery cardboard, station 5 game cone drift.

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The Effects of a Six-Week Preparatory Period on the Transformation of Speed and Agility Ability in Senior Female Soccer Players

Efekti šestosedmičnog pripremnog perioda na transformaciju sposobnosti brzine i agilnosti kod nogometašica seniorki

Enes Šunje[1], Ekrem Čolakhodžić[2], Alma Isaković[3], Irena Bjelica[3]

[1]Kinesiology Doctoral Degree Program at the Džemal Bijedić University of Mostar Faculty of Education, Bosnia and Herzegovina
[2]Faculty of Education Džemal Bijedić University of Mostar, Bosnia and Herzegovina
[3]Women's Soccer Team"Emina" Mostar, Bosnia and Herzegovina

Correspondence:
Ekrem Čolakhodžić
Faculty of Education Džemal Bijedić University of Mostar, Bosnia and Herzegovina
ekrem.colakhodzic@unmo.ba

[1]Doktorski studij iz oblasti kineziologije Nastavnički fakultet Univerzitet Džemal Bijedić u Mostaru, Bosna i Hercegovina
[2]Nastavnički fakultet Univerzitet Džemal Bijedić u Mostaru, Bosna i Hercegovina
[3]ŽN/FK „Emina" Mostar, Bosna i Hercegovina

Korespondencija:
Ekrem Čolakhodžić
Nastavnički fakultet Univerzitet Džemal Bijedić u Mostaru, Bosna i Hercegovina
ekrem.colakhodzic@unmo.ba

Abstract: *The aim of this research was to determine the effects of a six-week preparatory period on the development of speed and agility in female soccer players of "Emina" Women's Soccer Team of Mostar (n=18), who competed in the Premier League of Bosnia and Herzegovina in the season 2021/22. In the research, variables were applied to determine the basic characteristics of female soccer players: Age (years), Height (cm), Mass (kg), BMI (kg/m2), to assess speed ability: Sprint 5m (s), 10m (s), 20m (s) and agility: 10x5 m test (s), Zig-Zag test (s) and 505 test (s). The average age of female soccer players was 21.27 ± 4.57 years, average height 167.2 cm ± 5.82 cm and average weight 60.4 kg ± 7.36 kg. The dependent samples T-test was run to determine the statistical significance of the differences in arithmetic means between the initial and final measurements. The reported results of the T-test showed that after the six-week preparatory period, the test subjects had a lower mass (t=3.027; df=17; sig.= 0.008; p≤ 0.05) and BMI (t=2.253; df=17; sig.= 0.038; p≤ 0.05). Statistically significant differences at the level of p≤ 0.05, after the program had been completed, were reported for the agility tests 10x5m (t=3.125; df=17; sig.=0.006) and 505 test (t=3.028; df=17; sig.= 0.008). In other variables, positive changes were reported, but they were not statistically significant at the p≤ 0.05 level. We concluded that the six-week preparatory period program produced statistically significant changes in the area of agility and that the training should focus more on improving speed and speed endurance in the given sample of female football players.*

Keywords: *women's soccer, agility, speed, training, preparatory period.*

Apstrakt: *Cilj ovog istraživanja bio je utvrditi efekte šestosedmičnog pripremnog perioda na razvoj brzine i agilnosti kod nogometašica ŽN/FK Emina iz Mostara (n=18), koje se takmiče u Premijer ligi Bosne i Hercegovine u sezoni 2021/22. U istraživanju su primijenjene varijable za utvrđivanje osnovnih obilježja nogometašica: Starost (godine), Visina (cm), Masa (kg), BMI (kg/m2), za procjenu sposobnosti brzine: Sprint 5m (s), 10m (s), 20m (s) i agilnosti: test 10x5 m (s), test Cik-Cak (s) i test 505 (s). Nogometašice su prosječne starosti 21,27 ±4,57 godina, visine 167,2 cm ±5,82cm i mase 60,4 kg ±7,36 kg. Za utvrđivanje statističke značajnosti razlika aritmetičkih sredina između inicijalnog i finalnog mjerenja korišten je T-test za zavisne uzorke. Rezultati T-testa pokazuje da su ispitanice nakon šestosedmičnog pripremnog perioda imale manju masu (t=3,027; df=17; sig.= 0,008; p≤ 0,05) i BMI (t=2,253; df=17; sig.= 0,038; p≤ 0,05). Statistički značajne razlike na nivou od p≤ 0,05, nakon provedenog programa imamo kod testova agilnosti 10x5m (t=3,125; df=17; sig.=0,006) i testa „505" (t=3,028; df=17; sig.= 0,008). Kod ostalih varijabli imamo pozitivne promjene ali one nisu statistički značajne na nivo p≤ 0,05. Zaključujemo da je šestosedmični program rada u pripremnom periodu proizveo statistički značajne promjene u prostoru agilnosti i da trenažni proces treba više usmjeriti na poboljšanje brzine i brzinske izdržljivosti kod datog uzorka nogometašica.*

Ključne reči: *ženski nogomet, agilnost, brzina, trening, pripremni period.*

Introduction

Women's football all around the world, including in Bosnia and Herzegovina, is becoming increasingly popular and it is undergoing through a great expansion and development, recording constant growth both in participation and in increased investments and financial assistance from national football associations and organizations (Randell, Clifford, Drust, Moss, Unnithan, De Ste Croix, Datson, Martin, Mayho, Carter, & Rollo, 2021). Financial support to national football associations from the Association of European Football Associations (UEFA) has tripled (UEFA, 2015). Football is the most popular sport not only according to fans but also according to those who train this sport, and in addition to the large number of boys, the number of girls is also increasing, so that the participation of women in football has tripled in the last 10 years (Manson, Brughelli, Harris, 2014; Pfister and Pope, 2018). The World Football Federation - FIFA has committed to increase the number of female football players worldwide from 13.3 million in 2019 to 60 million by 2026 (FIFA, 2019). Unlike men's football, women's football has not been researched to the same extent and science has not been able to keep pace to provide the profession with the necessary scientifically proven data that would be useful in many ways when it comes to the development of young football players (Okholm Kryger, Wang, Mehta, Impellizzeri , Massey and McCall, 2022). With the popularization of women's football, the number of researches that treat female football players all around the world and in Bosnia and Herzegovina is constantly increasing. By objectively collecting data on the anthropological status of football players at our disposal, as well as new data obtained by researching the impact of certain training programs, optimally planned and programmed training, all coincidences and deviations from optimal and model values should be minimized. We are witnesses that today's football is characterized by increased game intensity, universalization of players, technical-tactical rationality, which results in a higher level of fitness of players (Čolakhodžić, Đedović, Skender, Novaković and Popo, 2017; Čolakhodžić, Rađo and Alić, 2016). Modern football requires from the players the synchronization of all their characteristics and abilities that distinguish them. From a biomechanical point of view, the football game is defined by a complex motor structure, composed of various movements of a cyclic and acyclic nature. Quick and unexpected changes in the game situation are frequent, which requires quick and unexpected reactions from the players in order to achieve the desired effect. The fitness and physical aspects of elite football players have been extensively studied, while there is less information on the same requirements

Uvod

Ženski nogomet u svijetu, pa i u Bosni i Hercegovini je sve popularniji i nalazi se u velikoj ekspanziji i razvoju, bilježi konstantan rast kako u sudjelovanju tako i u povećanim ulaganjima i finansijskoj pomoći od nacionalnih nogometnih saveza i ogranizacija (Randell, Clifford, Drust, Moss, Unnithan, De Ste Croix, Datson, Martin, Mayho, Carter i Rollo, 2021). Finansijska podrška nacionalnim nogometnim asocijacijama od Evropske asocijacije nogometnih saveza (UEFA) se utrostučila (UEFA, 2015). Nogomet je najpopularniji sport ne samo prema obožavateljima već i prema onima koji treniraju ovaj sporta, a osim velikom broja dječaka, povećava se i broj djevojčica, tako da se češće žena u nogometu utrostručilo u posljednjih 10 godina (Manson, Brughelli, Harris, 2014; Pfister i Pope, 2018). Svjetska nogometna federacija - FIFA se obavezala da će širom svijeta povećati broj nogometašica sa 13.3 miliona u 2019. godini na 60 miliona do 2026 godine (FIFA, 2019). Za razliku od muškog nogometa, ženski nogomet nije do sada u istoj mjeri istraživan i nauka nije mogla održati korak da obezbijedi struci neophodne naučno dokazane podatke koji bi u mnogo čemu koristili kada je u pitanju razvoj mladih nogometašica (Okholm Kryger, Wang, Mehta, Impellizzeri, Massey i McCall, 2022). Popularizacijom ženskog nogometa, broj istraživanja koja tretiraju nogometašice i u svijetu i BiH je u stalnom porastu. Objektivnim prikupljanjem podataka o antropološkom statusu nogometašica kojima raspolažemo, kao i novim podacima koji se dobijaju istraživanjem uticaja određenih trenažnih programa, optimalno planiranim i programiranim treningom sve slučajnosti i odstupanja od optimalnih i modelnih vrijednosti trebalo bi svesti na minimum. Svjedoci smo, da nogomet današnjice, karakteriše povećan intenzitet igre, univerzalizacija igrača, tehničko – taktička racionalnost, što ima za posljedicu viši nivo kondicione sposobnosti igrača (Čolakhodžić, Đedović, Skender, Novaković i Popo, 2017; Čolakhodžić, Rađo i Alić, 2016). Savremeni nogomet, zahtjeva od igrača usklađenost svih njegovih osobina i sposobnosti koje ga odlikuju. Sa biomehaničke tačke gledišta, nogometnu igru definiše složena motorička struktura, sastavljena od različitih kretanja cikličnog i acikličnog karaktera. Brze i neočekivane promjene situacije u igri su česte, što zahtjeva i brze i neočekivane reakcije od igrača da bi se postigao željeni efekat. Fitnes i fizički aspekti kod elitnih nogometaša su opsežno proučavani, dok postoji manje informacija o istim zahtjevima nogometašica. Mohr, Krustrup i Bangsbo (2003) navode da se količina trčanja većim brzinama tokom nogometnih utakmica nogo-

of female football players. Mohr, Krustrup, and Bangsbo (2003) reported that the amount of runs at higher speeds during football matches of football players continuously increases with a high level of performance. There is a general opinion that sprinting skills in all forms are becoming more and more important in modern football (Haugen, Tonnessen, Hisdal and Seiler, 2014). According to several studies of top football matches, sprinting makes up 1%-11% of the total distance covered in the match, which corresponds to 0.5%-3.0% of the effective playing time, i.e. time when the ball is in play (Bangsbo, Nørregaard, Thorsøe, 1991; O'Donoghue, 2001; Bangsbo, 1992). According to Reilly and Thomas (1976) a sprint in a football match occurs approximately every 90 seconds and each one lasts an average of 2-4 seconds (Bangsbo, Nørregaard and Thorsøe, 1991). In comparison to men's football, in women's football the tempo of the game is slower, thus the intensity is lower, but still intense enough considering the endurance of women. Sekulić, Spasić, Mirkov, Čavar and Sattler (2013) tested both male and female players in five agility tests and proved that men are better in all tests, and it can be concluded that men's football is faster and therefore more intense in comparison with women's football, as indicated by the research of Mara, Thompson, Pumpa and Ball, (2015), Mohr, Krustrup, Andersson, Kirkendal and Bangsbo, (2008), Ramos, Nakamura, Penna, Mendes, Mahseredjian, Lima, Garcia , Prado and Coimbra (2021), Okholm Kryger, Wang, Mehta, Impellizzeri, Massey, and McCall (2022). Analysis of the effects of differently dimensioned and programmed training is one of the basic issues of training technology. The specificity of managing the training process consists in acting on the athlete with suitable training content, whose reactions are usually unknown, which means that applying one and the same action, you cannot always get the same feedback. For these reasons, the feedback from the athlete to the one managing the process, information about the subject's behavior, as well as information about the immediate, prolonged or cumulative effect of exercise are very important. In order to manage training technology and processes as successfully as possible, it is very important what kind of training content should be chosen, how to apply it and what kind of workload to apply. In this research, the focus is on the speed and agility abilities of senior football players in Bosnia and Herzegovina, based on testing, measurement and analysis of data collected during the six-week preparatory period. In accordance with this, the aim of this research was to determine the effects of the six-week preparatory period on speed and agility in senior female football players in Bosnia and Herzegovina.

metaša neprestano povećava uz visok nivo performansi izvedbe. Postoji općenito mišljenje da sprinterske vještine u svim oblicima postaju sve važnije u savremenom nogometu (Haugen, Tonnessen, Hisdal i Seiler, 2014). Prema više istraživanja vrhunskih nogometnih utakmica sprint čini 1% –11% ukupne udaljenosti pređene na utakmici, što odgovara 0,5% – 3,0% efektivnog vremena igranja - tj. vrijeme kada je lopta u igri (Bangsbo, Nørregaard, Thorsøe, 1991; O'Donoghue, 2001; Bangsbo, 1992). Prema Reilly i Thomas (1976) sprint u nogometnoj utakmici se događa otprilike svakih 90 sekundi i svaki traje u prosjeku 2- 4 sekunde (Bangsbo, Nørregaard i Thorsøe, 1991). U odnosu na muški nogomet u ženskom nogometu tempo igre je sporiji, time je intenzitet manji, ali ipak dovoljno intenzivan s obzirom na izdržljivost žena. *Sekulić, Spasić, Mirkov, Čavar i Sattler (2013)* testirali su tako muške i ženske igrače u pet testova agilnosti i dokazali da su muškarci u svim testovima bolji, te se može zaključiti da je muški nogomet brži, a samim time i intezivniji u odnosu na ženski nogomet., na što nam ukazuju i istraživanja Mara, Thompson, Pumpa i Ball, (2015), Mohr, Krustrup, Andersson, Kirkendal i Bangsbo, (2008), Ramos, Nakamura, Penna, Mendes, Mahseredjian, Lima, Garcia, Prado i Coimbra (2021), Okholm Kryger, Wang, Mehta, Impellizzeri, Massey i McCall (2022). Analiza efekata različito dimenzionisanih i programiranih treninga jedno je od osnovnih pitanja tehnologije trenažnog rada. Specifičnost upravljanja trenažnim procesom sastoji se u djelovanju na sportistu odgovarajućim trenažnim sadržajima, čije su reakcije najčešće nepoznate, što znači, da primjenjujući jedno te isto djelovanje, ne mogu se dobiti uvijek iste povratne reakcije. Iz tih razloga su veoma važne povratne veze koje idu od sportiste ka onome koji upravlja procesom, informacije o ponašanju subjekta, kao i informacije o trenutnom, prolongiranom ili kumulativnom efektu vježbanja. U cilju što uspješnijeg upravljanja trenažnom tehnologijom i procesima, veoma je važno kakve trenažne sadržaje treba odabrati, na koji ih način primijeniti i pri tome kakvo opterećenje dati. U ovom istraživanju u fokusu su sposobnosti brzine i agilnosti nogometašica seniorki u BiH, na temelju testiranja, mjerenja i analize prikupljenih podataka u toku šestosedmičnog pripremnog perioda. U skladu sa ovim, cilj ovog istraživanja bio je utvrđivanje efekata provedenog šestosedmičnog pripremnog perioda na brzinu i agilnost kod nogometašica seniorki u Bosni i Hercegovini.

Research Method

The research is a longitudinal study with the aim of determining the state of the test subjects at two points in time, at the beginning and after the 6-week preparatory period. The testing was carried out at the stadium of FC Velež, which has artificial grass, is flat, spacious enough, and well lit. All measurements were made in the afternoon hours, and were carried out by experienced researchers from the Faculty of Teaching - Department of Sport and Health, University of Džemal Bijedić in Mostar, at the same time, with the same instruments and the same technique. Before the actual testing, the procedure for conducting the tests and what is expected of them was explained to the test subjects. Only the results of the test subjects where the entire program was implemented were taken into the final processing. An anthropometer with an accuracy of 0.1 cm, a digital scale with an accuracy of 0.01 kg (Tanita SC-330 s) was used to determine the anthropological status of football players. To test speed and agility, wireless photocells were used, the Microgate Witty system (Photocells, Microgate R, Bolzano, Italy), which enables extremely precise registration of the time it takes the subject to run a given section. The system consists of three pairs of photo booths with accompanying technical equipment (laptop, tripods, cables, connectors, etc.). The system records the time elapsed from the start signal to the intersection of the infrared beam that transmits and receives a pair of photocells.

Respondents sample

The sample of respondents was represented by female football players of the ŽN/FK "Emina" from Mostar who compete in the highest ranking competition in Bosnia and Herzegovina, the Premier Women's League of Bosnia and Herzegovina in the 2021/22 season. In the final processing of the results, only those female football players who participated in the initial measurement, who underwent the entire preparatory program that lasted six weeks and who participated in the final measurement (n=18) were included. The average age of the subjects was 21.27 ± 4.57 years, the average height was 167.2 cm ± 5.82 cm, and the average body weight was 60.4 kg ± 7.36 kg.

Variables sample

The following variables were used to determine the anthropological characteristics of the subjects: body height (cm), body mass (kg), Body mass index (kg/m2). The following variables were tested to determine motor speed ability: Sprint 5m (s), Sprint 10m (s), Sprint 20m (s), and to determine agility ability the following variables were tested: agility test 10x5 m (s); agility test Zig-

Metod istraživanja

Istraživanje predstavlja longitudinalnu studiju sa ciljem utvrđivanja stanja ispitanica u dvije vremenske tačke, na početku i nakon provedenog pripremnog perioda u trajanju od 6 sedmica. Testiranje je sprovedeno na pomoćnom stadionu FK „Velež", koji je sa umjetnom travom, ravan, dovoljno prostran, te dovoljno osvjetljen. Sva mjerenja su vršena u poslije podnevnim satima, a provedena su od strane iskusnih istraživača Nastavničkog fakulteta – Odsjek sport i zdravlje Univerziteta Džemal Bijedić u Mostaru, u isto vrijeme, istim instrumentima i istom tehnikom. Prije samog testiranja ispitanicama je objašnjena procedura provođenja testova i šta se od njih očekuje. U konačnu obradu uzeti su samo rezultati ispitanica na kojima je sproveden čitav program. Za utvrđivanje antropološkog statusa nogometašica korišten je antropometar s tačnošću od 0,1 cm, digitalna vaga s tačnošću od 0,01 kg (Tanita SC-330 s). Za testiranje brzine i agilnosti korištene su bežične fotoćelije, sistem Microgate Witty (Photocells, Microgate R, Bolzano, Italy) koji omogućava izrazito preciznu registraciju vremena koje je ispitaniku potrebno da istrči zadanu dionicu. Sistem se sastoji se od tri para fotostanica s pratećim tehničkim sredstvima (prijenosno računalo, stativi, kablovi, konektori i sl). Sistem bilježi vrijeme proteklo od startnog signala do presijecanja infracrvene zrake koja odašilje i prima par fotostanica.

Uzorak ispitanika

Uzorak ispitanica predstavljale su nogometašice ŽN/FK „Emina" iz Mostara koje se takmiče u najvećem rang takmičenja u Bosni i Hercegovini, Premijer ženska liga BiH u takmičarskoj 2021/22. U konačanu obradu rezultata uzete su samo one nogometašice koje su pristupile inicijalnom mjerenju, na kojima je sproveden čitav pripremni program u trajanju od šest sedmica i koje su pristupile finalnom mjerenju (n=18). Ispitanice su prosječne starosti od 21,27 ±4,57 godina, prosječne visine 167,2 cm ±5,82cm i prosječne tjelesne mase 60,4 kg ±7,36 kg.

Uzorak varijabli

Za utvrđivanje antropoloških karakteristika ispitanica korištene su sljedeće varijable: tjelesna visina (cm), tjelesna masa (kg), Body mas index (kg/m^2). Za utvrđivanje motoričke sposobnosti brzine testirane su sljedeće varijable: Sprint 5m (s), Sprint 10m (s), Sprint 20m (s), a za utvrđivanje sposobnosti agilnosti testirane su sljedeće varijable: test agilnosti 10x5 m (s); test agilnosti Cik-Cak (s) i test agilnosti „505" (s). Testovi brzine i agilnosti izvođeni su na otvorenom, na umjetnom travnjaku FK

Zag (s) and agility test "505" (s). The speed and agility tests were performed outdoors, on the artificial turf of FK Velež Mostar, where female football players play their championship matches.

Testing method and tests description

Sprint speed tests 5 m, 10 m and 20 m

The speed tests were tested by placing a target line at distances of 5m, 10m and 20m from the starting line, and at each distance a pair of photocell systems (Figure 1) with a measurement accuracy of 0.001 s was placed (Sinclair, Edmundson, Metcalfe, Bottoms , Atkins and Bentley, 2021). The results of the time for which the sections of 5m, 10m and 20m were run in hundredths of a second for all three measurements are entered, and the best result is taken as a meritorious result.

Velež Mostar na kojem nogometašice igraju svoje prvenstvene utakmice.

Način testiranja i opis testova

Testovi brzine sprint 5 m, 10 m i 20 m

Testovi brzine testirani su tako što se na udaljenostima od 5m, 10m i 20m od startne crte postavljena je linija cilja, a na svakoj udaljenosti postavljena je jedan par sistema fotoćelija (slika 1) sa preciznošću mjerenja 0,001 s (Sinclair, Edmundson, Metcalfe, Bottoms, Atkins i Bentley, 2021). Upisani su rezultati vremena za koje je pretrčana dionica od 5m, 10m i 20m u stotinkama sekunde za sva tri mjerenja, a kao meritorni rezultat uzima se najbolji rezultat.

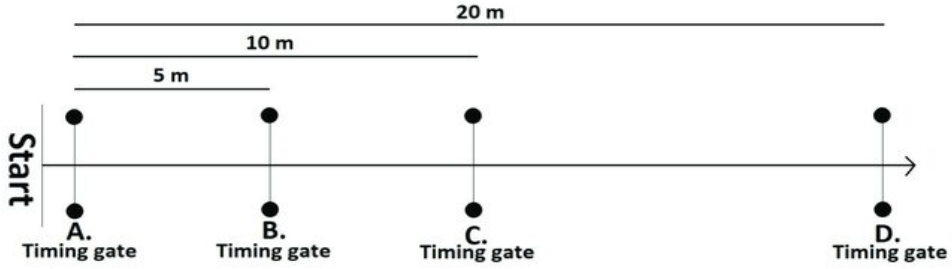

Figure 1. *Diagram of the 5, 10, and 20 m sprint speed test protocol (Sinclair et al., 2021).*

Slika 1. *Dijagram protokola testova brzine sprint 5, 10, i 20 m (Sinclair i sar., 2021).*

Agility tests

For the assessment of agility, three tests were used, which characterize different degrees of change of direction and direction of running with different durations, that is, with different number of changes of running direction.

Agility Test "505"

The subjects had the task of crossing the distance between plastic markers 15 m apart in the shortest possible time. A computerized photocell system for timing is set at 10 meters. The subjects tried to reach the maximum acceleration from the start line to the photocells (10 m), then to stop behind the line of the second marker that was placed at 15 m, turn 180° and run back again with maximum acceleration to the finish line (5 m). The athlete will complete the test three times turning in each direction and may have 2-3 minutes of rest between each test. The best time of the three tests in each direction should be recorded to the nearest 0.01 seconds. The total distance covered in this task is 20 meters (Shaw, 2021; Sinclair et al., 2021).

Testovi agilnosti

Za procjenu agilnosti primjenjena su tri testa koje karakterišu različit stepen promjene pravca i smjera trčanja sa različitim trajanjem, odnosno, sa različitim brojem promjena smjera trčanja.

Test agilnosti „505"

Ispitanici su imali zadatak da za što kraće vrijeme pređu rastojanje između plastičnih markera međusobno udaljenih 15 m. Kompjuterizovani sistem fotoćelija za mjerenje vremena postavljen je na 10 metru. Ispitanici su nastojali da od linije starta do fotoćelija (10 m) postignu maksimalno ubrzanje, a zatim da se zaustave iza linije drugog markera koji je postavljen na 15 m, okrenu se za 180° i ponovo trče nazad maksimalno ubrzavajući do linije cilja (5 m). Sportista će završiti test tri puta okrećući se u svakom smjeru i može imati 2-3 minute odmora između svakog testa. Najbolje vrijeme od tri testa u svakom smjeru treba zabilježiti s točnošću od 0,01 sekunde. Ukupno pređeni put u ovom zadatku iznosi 20 metara (Shaw, 2021; Sinclair i saradnici, 2021).

Figure 2. *Agility test protocol diagram – 505 (Shaw, 2021; Sinclair et al., 2021)*

Slika 2. *Dijagram protokola testa agilnosti – 505 (Shaw, 2021; Sinclair i saradnici, 2021)*

Zigzag agility test

In this test, the subjects had the task of running 20 meters as fast as they could, changing direction by 100º every 5 meters. A computerized photocell system for time measurement is placed at the start and at the finish line - perpendicular to the direction of the subject's movement. The distance covered in this task is about 20 meters (Little and Williams, 2005; Mirkov et al., 2008).

Test agilnosti Cik-Cak trčanje

U ovom testu ispitanici su imali zadatak da trče 20 metara što brže mogu mijenjajući pravac za 100º svakih 5 metara. Kompjuterizovani sistem fotoćelija za mjerenje vremena je postavljen na startu i na cilju – okomito u odnosu na smjer kretanja ispitanika. Pređeni put u ovom zadatku iznosi oko 20 metara (Little i Wiliams, 2005; Mirkov i saradnici, 2008).

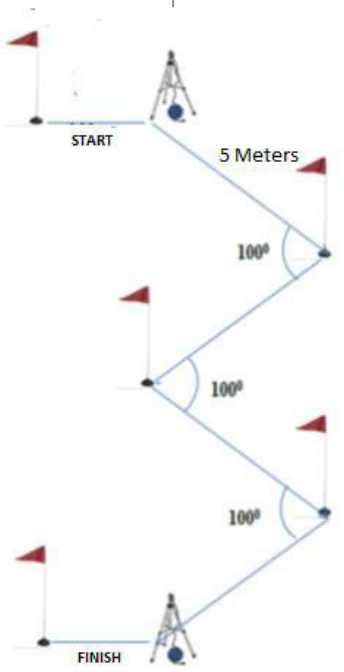

Figure 3. *Diagram of the agility test protocol - Zig-Zag (Little and Williams, 2005)*

Slika 3. *Dijagram protokola testa agilnosti – Cik-Cak (Little i Wiliams, 2005)*

Agility test 10x5 m

The test subjects had the task of covering 50 m in the shortest possible time by running ten times between the lines placed at a distance of 5 meters. Photocells for timing were placed at the start and the finish lines. In this test, subjects change direction nine times by 180° crossing marked lines. To measure time in this test, a photocell system with a measurement accuracy of 0.001 s was used (Reilly, Bangsbo and Franks, 2000).

Test agilnosti 10x5 m

Ispitanice su imale zadatak da za što kraće vrijeme pređu 50 m trčeći deset puta između linija postavljenih na rastojanju 5 metara. Fotoćelije za mjerenje vremena su bile postavljene na liniji starta, odnosno cilja. U ovom testu ispitanici devet puta mjenjaju smjer za 180° prelazeći označene linije. Za mjerenje vremena u ovom testu korišćen je sistem fotoćelija sa preciznošću mjerenja 0,001 s (Reilly, Bangsbo i Franks, 2000).

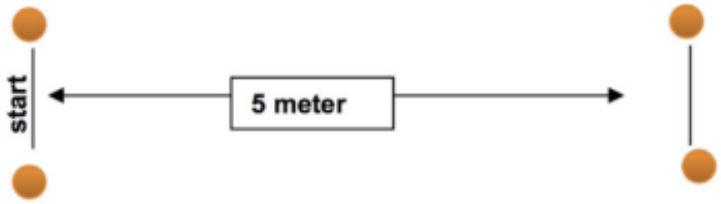

Figure 4. *Agility test protocol diagram - 10x5m (Reilly, Bangsbo and Franks, 2000)*

Slika 4. *Dijagram protokola testa agilnosti – 10x5m (Reilly, Bangsbo i Franks, 2000)*

Data collection and processing methods

The data obtained were processed in the SPSS software package (version 26.0; SPSS, Inc., Chicago, IL, USA). Standard statistical parameters (arithmetic mean, standard deviation, variance, skewness and kurtosis) were calculated for each variable, and the statistical significance of the differences in arithmetic means between the initial and final measurements was determined by the T-test for dependent samples (Čolakhodžić, 2021).

Program contents of the six-week preparatory period

The six-week program was implemented during the preparatory period of the 2021/22 Premier League of BiH competition season. The training process was structured in the way that the game and exercises were combined, and the game method was primarily applied. The time structure of the 90-minute training is divided into five phases: warm-up (15 min), orientation (20 min), learning (25 min), application or test phase (20 min) and cool-down (10 min). In the warm-up phase, the emphasis was on the anatomical and physiological preparation of the players for the efforts that await them. In the orientation phase, the intensity increased slightly compared to the warm-up phase and was implemented through various ball games and exercises for the development of motor skills. In the learning phase, five moments of the game were represented: possession of the ball, possession of the opponent, transition after a won ball, transition after a lost ball and standard situations. In the test phase of the training, the intensity was higher compared to the other phases of the training. The cool down phase had the task of lowering the physiological curve to an optimal level, and low-intensity content was used: stretching and relaxation exercises, various calming games and shooting. During the preparatory period, 6 preparatory matches were played.

Ethics approval

The research involved female adults in accordance with all relevant national regulations and institutional policies, and followed the principles, ethical guidelines

Metode prikupljanja i obrade podataka

Obrada dobivenih podataka izvršena je u programskom paketu SPSS (version 26.0; SPSS, Inc., Chicago, IL, SAD). Za svaku varijablu izračunati su standardni statistički parametri (aritmetička sredina, standardna devijacija, varijanca, skjunis i kurtosis), a T-testom za zavisne uzorke utvrđena statistička značajnost razlika aritmetičkih sredina između inicijalnog i finalnog mjerenja (Čolakhodžić, 2021).

Programski sadržaji šestosedmičnog pripremnog perioda

Program u trajanju od šest sedmica realizovan je u toku pripremnog perioda takmičarske sezone 2021/22 Premijer lige BiH. Trenažni proces je struktuiran tako da se igra i vježbe kombinuju, a prevashodno se primjenjivao metod igre. Vremenska struktura treninga u trajanju od 90 minuta, podijeljena je u pet faza: zagrijavanje (15 min), orijentacija (20 min), učenje (25 min), primjena ili test faza (20 min) i hlađenja (10 min). U fazi zagrijavanja akcenat je bio na anatomsko-fiziološkoj pripremi igračica za napore koji ih očekuju. U fazi orjentacije intenzitet se nešto povećao u odnosu na fazu zagrijavanja i realizovao se kroz razne igre sa loptom i vježbe za razvoj motoričkih sposobnosti. U fazi učenja bila je zastupljeno pet momenata igre: posjed lopte, posjed lopte protivnika, tranzicija po osvojenoj lopti, tranzicija po izgubljenoj lopti i standardne situacije. U test fazi treninga intezitet je bio veći u odnosu na ostale faze treninga. Faza hlađenja je imala zadatak spustiti fiziološku krivu na optimalan nivo, a koristili su se sadržaji niskog inteziteta: vježbe istezanja i relaksacije, razne igrice smirivanja i šutiranje. U toku pripremnog perioda odigrane je 6 pripremnih utakmica.

Etičko odobrenje

Istraživanje je uključivalo odrasle ženske osobe u skladu sa svim relevantnim nacionalnim propisima i institucionalnim politikama, a slijedilo je načela, etičke smjernice i pravila za istraživanje s ljudskim predmetima u skladu sa Deklaracijom iz Helsinkija.

and rules for research with human subjects in accordance with the Declaration of Helsinki.

Results

The results obtained in this research are shown in table 1, where the central and dispersion parameters in the initial and final measurements are shown, in table 2 the correlation results of the initial and final measurements are shown, and in table 3 where the obtained values of the T-test for dependent samples are shown.

Table 1. *Central and dispersion parameters of variables*

***Variables* / Varijable**	**N**	***Initial* / Inicijalno**					***Final* / Finalno**				
		Mean	**Std. Dev.**	**Var.**	**Skew.**	**Kurt.**	**Mean**	**Std. Dev.**	**Var.**	**Skew.**	**Kurt.**
Age (years) Starost (godina)	18	21,27	4,573	20,918	,400	-,538	21,27	4,57365	20,918	,400	-,538
Height (cm) Visina (cm)	18	167,27	5,828	33,977	-,486	-,859	167,36	5,85814	34,318	-,502	-,857
Mass (kg) Masa (kg)	18	61,15	7,368	54,293	,272	,012	59,48	7,84961	61,616	,549	,080
BMI (kg/m²) BMI (kg/m²)	18	21,77	1,785	3,187	,556	-,505	21,21	1,84611	3,408	1,099	,994
AgilityZig-Zag (s) Agilnost Cik-Cak (s)	18	6,48	,463	,215	,982	2,087	6,62	,45852	,210	,840	,135
Agility10x5 (s) Agilnost10x5 (s)	18	16,36	1,108	1,229	1,116	1,329	15,66	,82587	,682	,700	,121
Agility 505 (s) Agilnost 505 (s)	18	2,64	,184	,034	1,371	2,381	2,50	,20888	,044	,161	1,735
Speed 5m (s) Brzina 5m (s)	18	1,30	,080	,007	-,769	-1,435	1,25	,09613	,009	-,145	-1,435
Speed 10m (s) Brzina 10m (s)	18	2,13	,104	,011	-,552	-,721	2,09	,13195	,017	,011	-,721
Speed 20m (s) Brzina 20m (s)	18	3,60	,266	,071	1,594	-,395	3,58	,15707	,025	,390	-,395

Legend: *cm-centimeter; kg-kilogram; m – meter; s - second; BMI – body mass index; N-number of respondents*

Table 2. *Table of connections between initial and final measurements*

***Variables* / Varijable**		**N**	**Correlation**	**Sig.**
Pair 1	*Height I & Height F* / Visina I & Visina F	18	,999	,000
Pair 2	*Mass I & Mass F* / Masa I & Masa F	18	,955	,000
Pair 3	*BMI I & BMI F* / BMI I & BMI F	18	,831	,000
Pair 4	*Zig-Zag I & Zig-Zag F* / Cik-Cak I & CikCak F	18	,754	,000
Pair 5	*Agility 10x5 I & Agility 10x5 F* / Agilnost 10x5 I & Agilnost 10x5 F	18	,546	,019
Pair 6	*Agility 505 I & Agility 505 F* / Agilnost 505 I & Agilnost 505 F	18	,531	,023
Pair 7	*Speed 5m I & Speed 5m F* / Brzina 5m I & Brzina 5m F	18	,364	,137
Pair 8	*Speed 10m I & Speed 10m F* / Brzina10m I & Brzina 10m F	18	,568	,014
Pair 9	*Speed 20m I & Speed 20m F* / Brzina20m I & Brzina 20m F	18	,403	,097

Legend: *I-initial; F-final; m – meter; BMI – body mass indeks; N-number ofsubjects; sig.-statistical significance*

Rezultati

Rezultati dobijeni u ovom istraživanju prikazani su i tabeli 1, gdje su prikazani centralni i disperzioni parametri u inicijalnom i finalnom mjerenju, u tabeli 2 prikazani su rezultati korelacije inicijalnog i finalnog mjerenja i u tabeli 3 gdje su prikazane dobivene vrijednosti T-testa za zavisne uzorke.

Tabela 1. *Centralni i disperzioni parametri varijabli*

Legenda: *cm-centimetar; kg-kilogram; m –metar; s - sekunda; BMI – tjelesni maseni indeks; N-broj ispitanika*

Tabela 2. *Tabela povezanosti između inicijalnog i finalnog mjerenja*

Legenda: *I-inicjalno; F-finalno; m – metar; BMI – tjelesni maseni indeks; N-broj ispitanika; sig.-statistička značajnost*

Per table 1, we can see the average age of the test subjects who underwent the program: age = 21.27 ± 4.57 years, average height = 167.2 cm ± 5.82 cm, while the average body mass of female football players was mass = 60.4 kg ±7.36 kg. By reviewing the arithmetic means of the speed and agility variables, we can see that there are certain differences between the initial and final measurements, the statistical significance of which will be determined by the T test for dependent samples. Table 2 shows the correlation coefficient of variables between the first and second measurements, and the significance of that correlation.

Uvidom u tabelu 1. vidimo su ispitanice koje su podvrgnute programu prosječne starosti: godine=21,27 ±4,57 godina, prosječne visine =167,2 cm ±5,82cm, dok je prosječna tjelesna masa nogometašica iznosila masa = 60,4 kg ±7,36 kg. Pregledom aritmetičkih sredina varijabli brzine i agilnosti, vidmo da su ostvarene određene razlike između inicijalnog i finalnog mjerenja, a čiju statističku značajnost ćemo utvrditi T testom za zavisne uzorke. Tabela 2. nam pokazuje koeficijent korelacije varijabli između prvog i drugog mjerenja, te značajnost te korelacije.

Table 3. *T test for dependent samples*

Tabela 3.*T test za zavisne uzorke*

Variables / Varijable		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Dev.	Std. Err. Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	*Height I – Height F* Visina I – Visina F	-,08333	,19174	,04519	-,17868	,01202	-1,844	17	,083
Pair 2	*Mass I – Mass F* Masa I – Masa F	1,66667	2,33566	,55052	,50517	2,82816	3,027	17	,008
Pair 3	*BMI I – BMI F* BMI I – BMI F	,56111	1,05671	,24907	,03562	1,08660	2,253	17	,038
Pair 4	*Zig-Zag I – Zig-Zag F* Cik-Cak I – Cik-Cak F	-,13833	,32357	,07627	-,29924	,02257	-1,814	17	,087
Pair 5	*Agility 10x5 I – /* Agilnost 10x5 I – *Agility 10x5 F /* Agilnost 10x5 F	,70278	,95419	,22490	,22827	1,17729	3,125	17	,006
Pair 6	*Agility 505 I – /* Agilnost 505 I – *Agility 505 F /* Agilnost 505 F	,13667	,19150	,04514	,04144	,23190	3,028	17	,008
Pair 7	*Speed 5m I – Speed 5m F* Brzina 5m I – Brzina 5m F	,04111	,10064	,02372	-,00894	,09116	1,733	17	,101
Pair 8	*Speed 10m I – Speed 10m F* Brzina 10m I – Brzina 10m F	,04500	,11252	,02652	-,01096	,10096	1,697	17	,108
Pair 9	Speed 20m I – Speed 20m F Brzina 20m I – Brzina 20m F	,02556	,24917	,05873	-,09835	,14946	,435	17	,669

Legend: *m – meter; BMI – body mass index; I-initial; F-final; BMI – body mass index; sig.-statistical significance; df – degrees of freedom; t-value of the T test*

Legenda: *m – metar; BMI – tjelesni maseni indeks; I-inicjalno; F-finalno; BMI – tjelesni maseni indeks; sig.-statistička značajnost; df –stepeni slobode; t-vrijednost T testa*

Table 3 shows the results of the T test for dependent samples, where the value of the t test (t), degrees of freedom (df) and the significance of the difference (sig.) are shown for each applied variable. The t-test for dependent samples was used to determine the differences in arithmetic means between the initial and final measurements of the treated variables in senior football players in Bosnia and Herzegovina, after a six-week preparatory period. Based on the results, we can see that under the influence of programmed work during the preparatory period of six weeks there were statistically significant changes in body mass (t= 3.027; df=17; sig= .008) and body mass index

U tabeli 3. su prikazani rezultati T testa za zavisne uzorke, gdje je za svaku primjenjenu varijablu prikazana vrijednost t testa (t), stepena slobode (df) i značajnost razlike (sig.). T testom za zavisne uzorke utvđene su razlike aritimetičkih sredina između inicijalnog i finalnog mjerenja tretiranih varijabli kod nogometašica seniorki u Bosni i Hercegovini, nakon provedenog šestosedmičnog pripremnog perioda. Na osnovu rezultata vidimo da je pod uticajem programiranog rada u toku pripremnog perioda od šest sedmica došlo do statistički značajnih promjena u tjelesnoj masi (t= 3,027; df=17; sig= ,008) i tjelesnom masenom indexu BMI (t=2,253; df=17; sig.=,038)

BMI (t=2.253; df =17; sig.=.038) at the level of .95% ($p \leq 0.05$) and in the variables that define the agility of football players Test 10x5 m (t=3.125; df=17; sig.= .006) and in the Test " 505" (t=3.028; df=17; sig.= .008) at the level of .95% ($p \leq 0.05$).

Discussion

the t-test for dependent samples was used to determine the differences in arithmetic means between the initial and final measurements of the treated variables in senior football players in Bosnia and Herzegovina, after a six-week preparatory period. The results of the anthropometric characteristics of top football players do not deviate from the average weight and height of other unselected women, and their height ranges from 160-169 cm, while the body weight ranges from 52-65 kilograms. Comparing the results of this research and previous studies of the anthropometric characteristics of football players (Ingebrigstena et al., 201, Krišto, 2013, Sporiš et al., 2007), we see that there are no significant differences in relation to these anthropometric variables in comparison to our football players. We can see that under the influence of the programmed work during the preparatory period of six weeks, there were statistically significant changes in body mass and body mass index BMI at the level of .95% ($p \leq 0.05$) and in the area of agility of football players, which is defined by Test 10x5 tests. m and Test "505" at the level of .95% ($p \leq 0.05$). The smallest differences can be observed in the 20m running speed variable, what is almost on the edge between the speed and endurance zone. We find similar results with other researchers, who obtained statistically significant changes in agility and short sprinting after the preparatory period, while the greatest effects in sprinting above 20 meters were achieved during the competitive season (Mara et al., 2015). This research is one of the few on the population of football players in BiH, where we examine the effects of a six-week preparatory period on the improvement of primary motor skills essential for success in football. The obtained results provided important information to coaches working in women's football regarding a more effective approach in training based primarily on the game method. In football, speed does not depend solely on physical abilities, but includes genetic predispositions and the ability to make quick decisions (brain functions). Therefore, the main goal of speed training is to improve the player's ability to observe, evaluate, evaluate and act quickly in situations encountered during the game where speed is crucial. In order for this to be achievable, speed training should be conducted in condi-

na nivou od .95% ($p \leq 0,05$) i u varijablama koje definišu agilnost nogometašica Test 10x5 m (t=3,125; df=17; sig.= ,006) i kod Testa „505" (t=3,028; df=17; sig.= ,008) na nivou od ,95% ($p \leq 0,05$).

Diskusija

T testom za zavisne uzorke utvđene su razlike aritimetičkih sredina između inicijalnog i finalnog mjerenja tretiranih varijabli kod nogometašica seniorki u Bosni i Hercegovini, nakon provedenog šestosedmičnog pripremnog perioda. Rezultati antropometrijskih karakteristika vrhunskih nogometašica, ne odstupaju od prosječne mase i visine ostalih neselektiranih žena, a njihova visina se kreće u rasponu od 160-169 cm, dok se masa tijela kreće u rasponu od 52-65 kilograma. Poredeći rezultate ovog istraživanja i dosadašnjih istraživanja antropometrijskih karakteristika nogometašica (Ingebrigstena i saradnici, 201, Krišto, 2013, Sporiš i saradnici, 2007) vidimo da nema značajnije razlike u odnosu na ove antropometrijske varijable kod naših nogometašica. Vidimo da je pod uticajem programiranog rada u toku pripremnog perioda od šest sedmica došlo do statistički značajnih promjena u tjelesnoj masi i tjelesnom masenom indexu BMI na nivou od .95% ($p \leq 0,05$) i u prostoru agilnosti nogometašica koji je definisan testovima Test 10x5 m i Testa „505" na nivou od ,95% ($p \leq 0,05$). Najmanje razlike uočavamo kod varijable brzine trčanje 20m,a koja na neki način ulazi u zonu brzinske izdržljivosti. Slične rezultate nalazimo i kod drugih istraživača, koji su dobili statistički značajne promjene u agilnosti i kratkom sprintu nakon pripremnog perioda, dok su najveći efekti u sprintu iznad 20 metara postignuti u toku takmičarske sezone (Mara i saradnici, 2015). Ovo istraživanje predstavlja jedno od rijetkih na populaciji nogometašica u BiH, gdje ispitujemo efekte šestosedmičnog pripremnog perioda na poboljšanje primarnih motoričkih sposobosti bitnih za uspjeh u nogometu. Dobiveni rezultati su dali važne informacije trenerima koji rade u ženskom nogometu u vezi sa efikasnijim pristupom u treningu zasnovanom prvenstveno na metodi igre. U nogometu brzina ne ovisi isključivo o fizičkim sposobnostima, već uključuje genetske predispozicije i sposobnost brzog odlučivanja (moždane funkcije). Stoga, glavni cilj treninga brzine je unapređivanje igračeve sposobnosti uočavanja, vrednovanja, procjenjivanja te brzog djelovanja u situacijama na koje nailazi za vrijeme utakmice gdje je brzina presudna. Da bi to bilo ostvarivo trening brzine treba provoditi u uvjetima koji odgovaraju fudbalski specifičnim situacijama, a ovaj pripremni period je bio tako i programiran. Zbog velike važnosti agilnosti prije samog ulaska u pripremni period trenin-

tions that correspond to football-specific situations, and this preparatory period was programmed accordingly. Due to the great importance of agility before entering the preparatory training period, various agility tests are used to check the training of athletes. There are many different tests, and those that are closest in character to the sport we practice and that have been used in previous research have been selected. We mentioned earlier that agility comes in a package with speed and explosiveness, and it is this package that is most responsible for success in the football game. Based on all of the above, we see that well-developed abilities to quickly and efficiently change the direction of movement, as well as the ability to quickly and efficiently manipulate the ball in newly created situational conditions, are of primary importance for success in football.

Conclusion

This study adds to the current literature on the anthropological status and training technology of female football players by examining the effectiveness of a six-week preparatory training period on improving speed and agility. The obtained results show that the six-week preparatory period based on a combination of games and exercises produced a significant improvement in the agility of female football players, but not in the area of sprinting performance. These observations have a clear practical importance to football and fitness coaches. It is known that agility and speed are primary for success and overall performance in football, and based on these results we can conclude that the six-week preparatory period produced partial statistically significant changes in the area of speed and agility. The obtained results clearly tell us that future training technology should be directed more towards training in realistic and situational conditions of matches and games, and improving the speed of a tested sample of football players.

ga, raznim testovima agilnosti provjerava se utreniranost sportaša. Postoji mnogo različitih testova, a odabrani su oni koji su po karakteru najbliži sportu kojim se bavimo i koji su korišteni u dosadašnjim istraživanjima. Ranije smo napomenuli kako agilnost dolazi u paketu s brzinom i eksplozivnosti, a upravo taj paket je najzaslužniji za uspješnost u nogometnoj igri. Na temelju svega navedenog vidimo da su od primarne važnosti za uspjeh u nogometu dobro razvijene sposobnosti brze i efikasne promjene pravca kretanja kao i sposobnost brzog i efikasnog manipuliranja loptom u novonastalim situacijskim uvjetima.

Zaključak

Ova studija dopunjava trenutnu literaturu o antropološkom statusu i trenažnoj tehnologiji nogometašica, ispitujući efikasnost šestosedmičnog pripremnog trenažnog perioda na poboljšanje brzine i agilnosti. Dobiveni rezultati pokazuju da je šestosedmični pripremni period baziran na kombinaciji igre i vježbi, proizveo značajno poboljšanje sposobnosti agilnosti kod nogometašica, ali ne i u prostoru sprinterskih performansi. Ova zapažanja su od jasne praktične važnosti za nogometne i kondicione trenere. Poznato je da su agilnost i brzina primarne sposobnosti za uspjeh i ukupan učinak u nogometu, te na osnovu ovih rezultata može se konstatovati da je šestosedmični pripremni period proizveo djelomične statistički značajne promjene u prostoru brzine i agilnosti. Dobijeni rezultati jasno ukazuju da je trenažnu tehnologiju nogometašica potrebno usmjeriti u pravcu vježbanja u realističnim i situacionim uslovima stvarne utakmice i igre, te na izbor adekvatnih trenažnih operatora za poboljšanje brzine kod datog uzorka nogometašica.

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Effectiveness of Shadow Training Using Badminton Steps Application in Increasing Footwork Agility on Badminton Athlete

Fadli Ihsan, Ahmad Nasrulloh, Rina Yuniana
Department of Sports Science, Faculty of Sport Science, Universitas Negeri Yogyakarta, Indonesia

Correspondence:
Ahmad Nasrulloh, Department of Sports Science, Faculty of Sport Science, Universitas Negeri Yogyakarta, Indonesia
ahmadnasrulloh@uny.ac.id

Abstract: *The purpose of this study was to see how the effect of shadow training using the badminton step application on footwork agility. This research is experimental design. Research data collection was carried out by obtaining pre-test and post-test data with a sample of 10 athletes during the experimental study which was held at the UNJA Jambi Sports building. PB member. UNJA sampled in this study were over ten years old. Tohar's proposed 30-second leg exercise was used as an instrument in this investigation with a validity of 0.706 and reliability of 0.808. Data were analyzed quantitatively using normality and homogeneity tests and t-tests for hypothesis testing. Based on the results of the t-test, the researcher believes that giving shadow exercises using the badminton step application can make a good contribution because using the badminton step application can give orders to athletes during shadow training stably. The results showed that shadow training with badminton tank steps had an effect on footwork agility. Furthermore, the findings of the paired sample t-test on the pre-test and post-test data resulted in a value at -9000 with a significant (2-tailed) 0.000 < 0.05, supporting this conclusion. So based on the data obtained T-count is -9000 and has a significance value of 0.000 <0.05. It can be concluded that shadow training with badminton has an effect on an athlete's footwork agility. Therefore, it can be concluded that shadow training affects the application of the badminton steps on footwork. There is a significant influence in increasing footwork agility using shadow exercises with the application of badminton steps. Based on the results of the t-test, the researcher believes that giving shadow exercises using the badminton step application can make a good contribution because using the badminton step application can give orders to athletes during shadow training stably.*

Keywords: *training, shadow, badminton, steps application, agility.*

Introduction

The development of badminton is very rapid at this time and many new players have qualified to play qualities, therefore in Indonesia, they must develop existing programs so that they become better so that they can make badminton achievements in Indonesia superior. Seeing the development of badminton in Indonesia and supported by a qualified training center is overseen by the Indonesian Badminton Association in almost all cities and districts. Badminton schools or clubs are a place for early athletes to develop, and their existence is very important in producing young players who are expected to play badminton in the future. To achieve optimal achievements, badminton athletes must be nurtured gradually, both in schools, clubs, and training halls in their respective regions. The most significant factors in achieving adequate training results are training targets and training plans that are packaged in stages according to the skills of the athlete. Badminton is a game sport that can be played indoors or outdoors on a court with lines that vary in length and width. (Leong & Krasilshchikov, 2016), A badminton game is a rally game. The higher the level of play of an athlete, the longer the rally ball is played. Badminton is a difficult sport that requires good physical fitness while also having the second largest fan base in the world after football (Arganata, 2016). (Yudaparmita & Adnyana, 2021), argues that badminton is a sport in which players use a variety of beating tactics ranging from slow to fast, as well as deceptive moves. (Rusdiana et al., 2021), suggesting that badminton is two or four players competing in the racket sport of badminton on a rectangular court with a high net in the middle. Badminton is a game in which the player aims to drop the shuttlecock onto the opponent's court while defending the shuttlecock from falling on his court, (Hinda Zhannisa & Sugiyanto, 2015). (S. Nugroho et al., 2021), badminton requires good qualities of strength, endurance, flexibility, speed, agility, and coordination of movements. In the badminton game, agility is an essential aspect of achieving agility, which can be done with various kinds of exercises such as zig-zag

exercises, shuttle runs, squat jumps, squat thrusts, dogging runs, and shadows. However, in this study, the researchers discussed shadow exercises in doing shadow exercises there are various types of shadow exercises, shadow point movement exercises, shuttlecock taking practices, and shadow feather exercises (Muthiarani, 2017). In this study, researchers used shadow exercises using an application, namely the badminton steps application, guided by the application of shadow training to improve agility, there was no shadow training utilizing the application, this made the researchers confident in conducting this research. (Tyan, 2021), shadow is a movement without a ball whose activity is like playing a real game. This shadow exercise can improve agility. (T. Nugroho et al., 2018), activities performed quickly and precisely are what define agility(Marganda Limbong, 2021), agility is a movement that can make the legs move without losing balance.

To gain agility in training, one must know the purpose of the training, the overall goal of the training is to assist coaches, coaches, and sports teachers in using and developing conceptual abilities and skills to help players realize their full potential and achieve peak performance (Bompa & Buzzichelli, 2015). (Wea & Samri, 2022), suggest the purpose of training is to help athletes maximize their abilities and potential. The purpose of training is to improve the physical condition of an athlete to the maximum, (Nasrulloh et al., 2021, 2022; Wahyudi, 2018) According to (Bompa & Buzzichelli, 2015; Ichsan Sabillah et al., 2022), training is a way to perfect the ability of exercises that include theoretical and practical information, methods, and guidelines, to achieve goals on time. This is to the view that (Khomari, 2015), regular, directed, increased, and repetitive training loads are used to prepare children methodically, physically and cognitively to achieve optimal success.

In carrying out exercises, trainers must have training principles, namely according to (Bompa & Buzzichelli, 2015), including: (1) individual, (2) adaptation, (3) overload, (4) progressive load, (5) specifications, (6) varied, (7) warming up and cooling, (8) periodization, (9) reversibility (reverse), (10) moderate load (not excessive), (11) exercise must be systematic, and (12) long-term exercise. Furthermore, in a more specific and accurate training program, sports technology assistance is needed for coaches and athletes, (Muthiarani & Yuniana, 2021). (Sobko et al., 2020), Modern badminton is a demanding athletic sport requiring players to react rapidly, move fast across the court, and make snap judgments. Athletes must possess the agility to be able to achieve this.

In badminton, agility is the aspect that supports achievement that has the most influence according to (Muthiarani & Yuniana, 2021). Agility is defined as the ability to change posture quickly and with good coordination. (Fauzi et al., 2020; Gumantan & Mahfud, 2020), agility is the ability to change direction quickly, which is an essential element possessed by athletes. Agility is a physical ability that a badminton athlete must have to compete, (Karyono & Paluris, 2022). In badminton, agility refers to the ability to change direction precisely and quickly and move the body from side to side, (Gunawan & Elfry, 2021). Agility training is an exercise that is used by athletes in various sports, (Kusminto et al., 2021). Agility is defined as the ability to change direction quickly and be able to also keep the body in balance, (Maryono et al., 2017). (Özgür & Hotaman, 2020), The ability to use various racquet techniques, in addition to physical and physiological factors, is a requirement for the highest performance in badminton, but from that the agility of a strong contribution in supporting achievements.

Agility is the ability to quickly change the direction of movement of the body or body parts. Agility is the ability to change direction and position without losing balance quickly. Because agility is a very influential aspect of badminton, obtaining agility that can support the achievements of athletes requires the proper training methods. (Rahmat Putra Perdana dkk, 2018), agility is defined as the ability to change postures quickly and with solid coordination, indicating that a person's agility is quite good. To have good agility, you can train with shadow exercises, namely shadow exercises that are done without using a ball, Shadow is a shadow movement exercise that steps forward, sideways, and backward without using a shuttlecock According to (Budi & Malang, 2020), badminton shadow practice is done only by hitting the shadow instead of the shuttlecock. (Marpaung & Manihuruk, 2017), Shadow steps are footwork exercises that modify body position to make it easier for players to hit the shuttlecock in its position while on the courtShadow training is a badminton exercise that imagines the movements of the game, (Suhartik et al., 2022). (Wismanadi et al., 2020), shadow training is an exercise in hitting and chasing the shuttlecock as in the actual game but without a shuttlecock. (Rahman & Warni, 2017), Shadow training is a movement exercise on the badminton court without a shuttlecock by performing movements like in a game. Even though the shadow is created just by hitting the shadow, the movements are identical to badminton games, including the movement of running after the shuttlecock to the right, left, forward, or backward, stepping quickly, jumping to perform a jump smash, and

simultaneously hitting the shadow shuttlecock. In this study, researchers used shadow exercises using an application, namely the badminton steps application, to give a signal that the type of exercise was included in the type of shadow point movement exercise, (Muthiarani, 2017), shadow point movement is giving vocal commands and hand signals to direct. The movement of players around the badminton court is known as point shadow movement.

The application used is the badminton steps application, badminton steps is an application developed by Oranda Apps used to improve agility in playing badminton, this application provides badminton footwork training using random shadow footwork exercises to improve agility. Using this application to provide the agility of the athlete's foot requires accuracy and foresight from the coach in compiling a program to be given to athletes.

In doing shadow exercises, it can be done by stepping movements into the corner of the field. Footwork Can be practiced in various methods, including holding the shuttlecock in a particular position and moving/stepping in on certain direction (shadow movement). Shadow badminton is a mental activity where you imagine yourself playing badminton. In badminton there are six target areas of footwork, namely (1) movement to the left of the face, (2) movement of the face to the right, (3) movement to the left side, (4) movement to the right side, (5) movement to the right and to the left. Back, and (6) movement to the left and back, (Poole, 2013).

Looking at previous studies that are relevant to the researcher's research, the first study (Rahman & Warni, 2017) entitled "influence of shadow 8 exercise on agility in badminton players. Mustika Banjarbaru Ages 12 – 15 Years" and the second study (Marpaung & Manihuruk, 2017) entitled "the effect of shadow training on increasing agility in badminton game" and the third study (Saputra, 2020) entitled "the effect of shadow exercise on increasing agility badminton athletes. Fifty City", from the three previous studies that the researcher compared with the research to be conducted, there are several things that distinguish the first different research subjects, and that makes the researchers believe and really want to do this research because from the three previous studies in giving treatment or giving exercise there is no there are those who use the application of these differences, researchers are very confident in conducting this research. The purpose of this study, firstly, the researcher wants to provide a new type of exercise to athletes to improve footwork agility and the researcher will obtain data on how much influence the badminton steps application has in improving footwork agility.

The problems today in the field are the lack of footwork agility or athlete's footwork, unprogrammed forms of exercise, not varying the provision of footwork exercises, and lack of physical training and footwork exercises. Footwork is essential in badminton, according to (Kardani & Rustiawan, 2020), In the badminton game, footwork is a fast and precise movement, and footwork is essential. (Taufik, 2015), footwork is defined as foot movement that regulates body position to make it easier to produce action hits based on that position. Footwork in badminton is the core foundation of the overall badminton movement, (Huang & Zhang, 2021). footwork is the most basic badminton skill that athletes must possess, requires the ability to accelerate or slow down and change direction on the court, and is associated with accurate shooting and improved game performance, (Chiu et al., 2020).

The analysis results require training adjustments for athletes and providing variations in training so that training is not monotonous for athletes. From the author's observations and interviews with the trainer, PB. UNJA, which is centred on training in the Jambi PORKES building, lacks leg agility or footwork due to less than optimal training and often not achieving the program targets carried out in training. The unprogrammed form of exercise and the lack of focus in providing training causes a decrease in the athlete's physical condition, impacting reduced leg agility and significantly impacting the decline in athlete achievement. Physical exercise is an essential exercise to improve skill, lack of physical exercise, footwork training and not varying the provision of exercise is one of the causes of decreased achievement. This study aims to see the effect of shadow training using the badminton steps application on footwork agility.

Materials and methods

According to Sutrisno Hadi (Mardian, 2020), the experimental technique is an activity that involves pre-test, practice, and post-test. Each experiment must compare at least two or more groups as the main activity in a scientific investigation. Experimental research, is research conducted to see how a treatment (treatment) or independent variable (variable x) affects the dependent variable (variable y). This study project tries to see how the independent variable of therapy involves the dependent variable or the symptoms of a particular group compared to other groups using other treatments. This study uses a pre-test (TI) to determine a player's initial ability. This study was carried out after the pre-test was completed (X). Researchers conducted a final test after treatment (T2). The outcome of the

treatment was determined using pre-and post-testing. Pre-test and post-test were used in this study.

The place of this research is located in the PB hall. UNJA Jambi. This research was conducted for approximately four weeks, starting after obtaining a research permit. Implementation in 1 week, there are four meetings. The population used in this study were PB athletes. UNJA consists of 15 athletes. From this population, a sample of 10 athletes was obtained from the conditional sampling technique, namely those aged over 10-18.

Collecting data in this study using a measurement test, the test instrument used for collecting initial data (pre-test) and final data (post-test) using a foot exercise test, Tohar designed a series of leg exercises used to collect data in this investigation with validity. 0.706 and 0.808 reliability. The data collected in this study were data (pre-test) from the number of athletes who performed a series of footwork tests for 30 seconds and data (post-test) from the number of athletes who performed a series of footwork tests for 30 seconds after the sample was treated with the method shadow training using the badminton steps application badminton steps.

Data analysis technique using t-test. The data analyzed were the data on the 30-second leg exercise test and before and after the test. The analysis in this study uses parametric statistics by using the help application, namely the IBM SPSS statistic 25 application. Normality and homogeneity tests are essential tests in this study. The purpose of the normality prerequisite test is to ensure that the data is standard or not so that the data analyzed is by the tests to be carried out using SPSS 25 with the normality test using the Kolmogorov-Smirnov with a significant level of 5%. If the statistical significance is more significant than 0.05, the data is normally distributed; however, if the statistical significance is less than 0.05, the data are not normally distributed.

The homogeneity test is the second test required and checks whether the pre-test and post-test data are similar. With the help of the SPSS 25 program, the homogeneity test in this study used the Levene test with a significant level of 5%. If the significant level is greater than 0.05, the data is homogeneous or has the same variance. Still, if the significance level is less than 0.05, the data is not homogeneous or has a different variance.

This research aims to see the effect of shadow training using badminton steps application on footwork agility. To determine whether exercise has an effect, it must be analyzed using paired sample t-test or independent t-test with a significant level of 5%, namely by comparing the data from the pre-test to the data from the post-test results. Data analysis used SPSS 25 and paired sample t-test or independent t-test. If the significant count is less than 0.05, Ho is rejected, and Ha is allowed, so it can be concluded that exercise affects footwork agility. On the other hand, if the signature count is more than 0.05, then Ho is accepted, and Ha is rejected, and it can be stated that the exercise does not affect footwork agility in badminton athletes. The results of the paired sample t-test on the data from the pre-test and post-test results are shown below.

Result

The results of the study can be seen in Table 1, the results of increasing shadow training using the badminton steps application.

Table 1. *The results of the pre-test, post-test, improvement, and average (mean)*

No	Pre-test	Post-tes	enhancement
1	11	12	1
2	8	9	1
3	12	14	2
4	10	12	2
5	9	11	2
6	12	13	1
7	16	18	2
8	15	17	2
9	12	13	1
10	10	11	1
Mean	11,5	13	1,5

Based on the statistical analysis data in Table 1, it can be seen that the average pre-test is 11.5, the average post-test result is 13, and an increase in the mean from pre-test to post-test was 1.5.

Table 2. *Normality Test Results*

	Data	Kolmogorov-Smirnov[a]		
		Statistic	Df	Sig.
Learning outcomes	pre test	.221	10	.182
	post test	.200	10	.200*

Based on the data above, the test data from the pre-test results of the six-elbow agility in badminton athletes were normalized by the Kolmogorov-Smirnov method, which was carried out with the help of SPSS 25. The significance was 0.182, and the statistical significance of the post-test data was 0.200. The statistical significance of all these data is greater than 0.05, which is the tolerance level for the Kolmogorov-Smirnov normality test, implying that the data in this study are normally distributed.

Homogeneity Test

The homogeneity test is a preparatory test in this study that determines whether the pre-test and post-test data are similar. With the help of the SPSS 25 program, the homogeneity test in this study used the Levene test with a significant level of 5%. If the considerable level is greater than 0.05, the data is homogeneous or has the same variance. Still, if the significance level is less than 0.05, the information is not homogeneous or has a different conflict.

Table 3. *Homogeneity test results*

No	Data	Sig Count	Sig	Information
1.	Pre-Test	0.893	0,05%	Homogen
2.	Post Test	0.896	0,05%	Homogen

Based on the data above, regarding the normality test using SPSS 25, the results of the pre-test sig-count of 0.893 and post-test sig-count 0.896 from the two data obtained were greater than 0.05, so the data in this study were homogeneous.

Hypothesis testing

This research aims to see the effect of shadow training using badminton steps application on footwork agility. To determine whether exercise has an effect, it must be analyzed using paired sample t-test or independent t-test with a significant level of 5%, namely by comparing the data from the pre-test to the data from the post-test results. Data analysis used SPSS 25 and paired sample t-test or independent t-test. If the significant count is less than 0.05, then Ho is rejected, and Ha is allowed, so it can be concluded that the exercise affects footwork agility if the signature count is more than 0.05, then Ho is accepted, and Ha is rejected, and it can be stated that the exercise does not affect footwork agility. The results of the paired sample t-test on the data from the pre-test and post-test results are shown below.

Table 4. *Uji t paired samples test*

	Paired Samples Test			
	t	Sig.	Sig 5%	Information
Pre-test Post test	-9.000	0.000	0,05	Sig.

The conclusion of the hypothesis test above shows that the value of sig (2 tailed) is 0.000, which indicates that sig is less than 0.05. This means that Ho is rejected and Ha is accepted, which means that there is an effect of exercise on footwork agility.

Discussion

Exercise is an activity that is carried out continuously and programmed to get better results than before doing the exercise. (Aprilia et al., 2018), Exercise is a systematic process of practicing or working that is done for some time in a structured manner. (Tamim, 2017), in carrying out training, athletes must master various aspects that can help them achieve their goals, such as physical, technical, tactical, and mental conditions. To be able to achieve optimal performance, training must focus on elements of strong physical, technical, tactical, or mental development, (Fansuri & Situmeang, 2021). In the exercise, there are also training goals and objectives, namely to improve the abilities and perfect the potential possessed by the athletes who are fostered. The purpose of training is to implement concepts and programs for athletes to achieve peak performance, (Bompa & Buzzichelli, 2015). The main purpose of training is to shape and help athletes achieve the best performance/ability, (Firdaus Soffan Hadi, 2016). Various variables in badminton support the success of playing, including tactics, technique, and physicality. In the physical aspect, according to Sapta Kunta (Sumintarsih, 2012), badminton players are needed to develop physical components, one of which is talent. Agility or Agility is the ability to quickly and decisively shift the direction and position of one's body while moving without losing balance. Agility relates to balance and helps cover the field by changing direction rapidly, (Ahmed et al., 2022).

In the world of badminton, agility is very important for athletes to have because to be able to catch the shuttlecock provided by the opponent with fast movements, agility is needed. (Hotwani, 2021), agility is a movement with high intensity leading to an explosive movement pattern. Agility to change body position quickly and correctly without losing balance when moving sequentially in a short time, followed by strengthening intrinsic muscles, (Hermilasari et al., 2020). Get agility can be trained with the shadow training method: shadow training is an exercise that is done without using the ball, which is done the same as playing. (Yudaparmita & Adnyana, 2021), shadow training is instructing athletes or giving instructions to athletes to make movements to the corners of the field, like playing for real without using the ball. (Winarno, 2019), shadow badminton is a movement without a shuttlecock carried out from one place to another. From the explanation above, the researcher tried to compare the research conducted by the researcher with a similar study, the first research was conducted by (Gunawan & Elfry, 2021) entitled "effort to improve agility through shadow exercise at the athletes of the blutanline union with Kartini Malang, the results showed that the exercise shadow improves agility, speed, and balance, in the study Gunawan and Elfry used shadow training, but it was not explained what type of shadow exercise was applied ". The second research is a study conducted by (Marpaung & Manihuruk, 2017) entitled "the effect of shadow training on increasing agility in badminton games, in carrying out shadow training in Marpaung and Manihuruk's research it is also not explained what type of shadow exercise is used",compared with research conducted by researchers, the shadow exercise given is a type of shadow point movement exercise using an application called badminton steps, this application gives orders in the form of directions to be followed by athletes.

Based on the research, the average pre-test result was 11.50, and the average post-test result was 13.00 and the average increase after treatment was 1.5. In the normality test, the results from Kolmogorov-Smirnova are taken, namely, the sig value with the provision that if the sig value > 0.05, then the data is normally distributed and vice versa if the sig value < 0.05, then the information is not normally distributed, in this study the researchers obtained the results The pre-test sig value is 0.182 and the post-test sig value is 0.100, the results of the two data> 0.05, it can be concluded that the data is normally distributed.

The results of the pre-test sig-count of 0.893 and the post-test sig-count of 0.896 from the two data obtained using SPSS 25 were greater than 0.05, indicating that the data in this study were homogeneous. After knowing the data from this study is homogeneous, the new researcher can choose a follow-up test that will be used to get the results of whether shadow using the badminton steps has an effect or not. The result of the t-value is -9000 with a significant (2-tailed) count of 0.000 when the data from the paired sample t-test are confronted with data from the pre-test and post-test findings. Based on the paired-sample t-test, Ho is rejected, and Ha is accepted, indicating that the shadow practice of badminton steps application has an effect.

Conclusion

Based on the discussion and conclusions from the results of research data on the impact of shadow training using the badminton steps application on footwork, researchers explore the most important aspects that support athlete

achievement, one of which is footwork agility. Improve footwork agility which gives significant results by using the badminton steps application; this application also makes it easier for coaches to provide shadow training programs that will provide footwork agility which is the essential aspect in supporting achievement in badminton then this research can have implications for: Motivation and knowledge of coaches will use the application of badminton steps to apply shadow training in training programs to improve the agility of badminton athletes' footwork, their motivation, and knowledge of athletes tih to look for other methods to improve the footwork agility of badminton athletes, as a suggestion for PB coaches. UNJA and agility training guidelines have been designed to be developed in various forms to improve footwork agility. There is a significant influence in increasing footwork agility using shadow exercises with the application of badminton steps. Based on the results of the t-test, the researcher believes that giving shadow exercises using the badminton step application can make a good contribution because using the badminton step application can give orders to athletes during shadow training stably.

Disclosure statement
No author has any financial interest or received any financial benefit from this research.

Conflict of interest
The authors state no conflict of interest.

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Impact of Lumbopelvic Hip Complex Exercises on Upper Extremity Range of Motion, Strength and Functonal Performance Among Collegiate Overhead Athlete

Muhammad Muneer PP, Nagaraj Sibbala
Padmashree Institute of Physiotherapy, Affiliated to Rajiv Gandhi University of Health Sciences
Bangalore, Algeria

Correspondence:
Muhammed Muneer, Padmashree Institute of Physiotherapy, Affiliated to Rajiv Gandhi University of Health Sciences, Bangalore, Algeria
nagarajsibbala@gamil.com

Abstract: *An overhead athlete is a sportsperson who engages in activities that necessitate the use of the upper body in a forward and upward action, such as pitching a baseball, throwing a softball, spiking a volleyball, serving a tennis ball, swinging a golf club, passing a football, or launching a javelin. The arm needs to move to different locations and speed up along very specific trajectories for each of these tasks. To determine the impact of lumbopelvic hip complex exercises on upper extremity range of motion, strength and functional performance among collegiate overhead athletes. Based on the selection criteria, 46 people were recruited, however, only 40 of them did the lumbopelvic hip complex exercise. Six people were drop outs as they didn't meet the loads of the exercise. The subjects who took part did two sets of ten repetitions five days a week for twelve weeks. The order of the exercises was chosen by each person. All of the people on the intervention team were given a moderate level of resistance, which they used for the whole study. College overhead athletes showed statistically significant improvement in functional performance when CKCUEST was employed to describe performance (19.32±1.55-21.37±1.71) (t=18.458). The results of a paired t-test reveal a statistically significant (i.e., p<0.001) difference when the means are compared. Twelve weeks of lumbopelvic hip complex training has a significant influence on the range of motion, strength, and functional performance of the overhead throwing players in collegiate athletes.*

Keywords: *Lumbopelvic hip complex, Range of motion, strength, functional, performance, collegiate overhead athletes.*

Introduction

An overhead athlete is a sportsperson who engages in activities that necessitate the use of the upper body in a forward and upward action, such as pitching a baseball, throwing a softball, spiking a volleyball, serving a tennis ball, swinging a golf club, passing a football, or launching a javelin. The arm needs to move to different locations and speed up along very specific trajectories for each of these tasks. It's not only the arm that has to move in unison; the body's entire kinetic chain, from the toes to the trunk to the pelvis to the hand, has to work in harmony as well. Athletes that perform intricate yet explosive movements risk serious harm when doing them in the air.

A skilled and sophisticated maneuver, the overhead throw places significant strain on the shoulder joint. Extreme stress is placed on this complex by the overhead thrower. When a person throws a ball, they produce huge pressures that put extreme strain on the shoulder joint. The throwing shoulder needs to be flexible enough to allow for excessive external rotation, but sturdy enough to prevent symptomatic humeral head subluxations (Wilk, Meister & Andrews, 2002).

The motion of throwing the ball above is a high-speed, high-stress sporting exercise. The glenohumeral joint is the most mobile of any articulation in the body, which, along with the repetitive nature of the activity, can lead to looseness and instability (Wilk, Yenchak, Arrigo, & Andrews, 2011). The capsuloligamentous structures of the shoulder and the combined neuromuscular control of the entire upper extremity work in constant interaction and coordinated equilibrium to provide glenohumeral stability. Overhead throwers need challenging, dynamic, and particular rehabilitation therapies because of the repetitive stresses and loads exerted on the glenohumeral complex and the excessive motion required for throwing (Wilk, Meister & Andrews, 2002).

For motions such as the tennis serve, overhead throw, and volleyball spike, the high rotational forces experienced by the shoulder during the acceleration and deceleration phases of the movements place the soft tissue structures at risk for microtrauma and an ensuing injury, the repetitive overhead motions and subsequent periscapular and RTC

fatigue place the shoulder in similarly vulnerable positions to that of the more ballistic athletic movement. Injuries like subacromial impingement and rotator cuff tendinitis are common in overhead athletes (Laudner & Sipes, 2009).

The musculoskeletal backbone consists of the spine, hips, pelvis, upper legs, and midsection. Muscles in the abdomen, low back, and pelvis play an important role in generating and transferring energy from large to small body parts, and in keeping the spine and pelvis stable, in a variety of sports (Putnam, 1993). Integrating proximal and distal segments in producing and directing forces to maximize athletic function benefits greatly from the core's (lumbopelvic hip complex) stability.

When the body is in motion, the huge, bulky muscles in the central core form a hard cylinder and a large moment of inertia to counteract the disturbance, while yet providing a solid foundation for distal movement. The core function is most commonly provided via the kinetic chain, the coordinated, sequenced activation of body segments that sets the distal segment in the optimum position at the optimum velocity with the optimum timing to produce the desired athletic task (Laudner, Wong & Meister, 2019). In addition, as the core is important to practically all kinetic chains of sports activities, regulation of core strength, balance and motion will maximize all kinetic chains of upper and lower extremity function.

Performing an overhead throw is akin to a kinetic chain exercise, which calls for individual muscles to work in unison like linked links in a chain. To complete a throw, one needs to time the activation of one's muscles appropriately and in a coordinated method over multiple segments, working from the proximal to the distal joints. The kinetic chain can readily be split down into three key components from proximal to distal the lower extremities, the lumbopelvic-hip complex, and the upper extremity.

The main component of the kinetic chain that controls both the proximal and distal ends is the lumbopelvic-hip complex. The lumbopelvic-hip complex is made up of the abdominal, proximal lower limb, hip, pelvic, trunk, and spinal muscle groups. The lumbopelvic-hip complex's primary function in throwing is to keep the body steady, allowing for maximum transmission of force from the lower to the upper body. About half of the energy in a throw comes from the legs, and if those forces are diminished by 20%, the shoulder takes on an additional 34% of the load. Any interruption in one part of the kinetic chain will affect the complete system in a dynamic movement Gilmer, et. al., 2019)

The kinetic chain connects body segments and distributes energy from one body segment to the next during motion such as throwing. In overhead throwers, the legs and core transfer more than half of the kinetic energy to the upper extremity. The typical sequence of actions during a general throwing motion includes the stride, pelvis rotation, upper torso rotation, elbow extension, shoulder internal rotation, and wrist flexion.

Shoulder injuries are common among overhead throwers because to weaknesses in the kinetic chain, which includes the core, spine, hip, glenohumeral range of motion, and scapular kinetics.

Safely transferring energy from the legs to the projectile release requires precise sequencing of muscle activation and synchronization. All parts of the body must coordinate their efforts for the kinetic chain to be effective.

Loading strains emerge at unfamiliar locations of musculoskeletal tissues when certain features of segmental coordination are disrupted. Reduced range of motion in the hips and shoulders, immobility in the spine, and weakening in the muscles all contribute to increased mechanical stress of tissues further along the kinetic chain. The danger of getting hurt is raised as a result of this. When the hips, core, legs, and spine can't move efficiently, it puts extra stress on the rest of the body (Zaremski, Wasser & Vincent, 2017).

Improving neuromuscular control is just as important as strengthening the lumbopelvic-hip complex to stop uncontrolled and compensatory movements (Chaudhari, et. al., 2014).

OBJECTIVES OF THE STUDY

- To determine the impact of lumbopelvic hip complex exercises on upper extremity range of motion, strength and functional performance among collegiate overhead athletes.

HYPOTHESIS

Null Hypothesis [H_0]

There is no significant impact of lumbopelvic hip complex exercise hip complex on upper extremity ROM, strength and functional performance among collegiate overhead athletes.

Alternate hypothesis [H_1]

There is a significant impact of lumbopelvic hip complex exercise on upper extremity ROM, strength and performance among collegiate overhead athletes.

METHODOLOGY

Source of Data

- Padmashree group of institutions

Inclusion Criteria:

1. Collegiate over-head athletes
2. Age Group: 18 - 25 years
3. Both male and female subjects
4. Shoulder pain questionnaire used as a diagnostic criterion for inclusion.

Exclusion Criteria:

1. Slap lesions
2. Recent sports injuries to shoulder
3. Shoulder dislocation

Method of collection of data

- Population: Collegiate overhead athletes.
- Sampling method: Convenience sampling.
- Sample size: 40 subjects
- Study design: Single Group Pre-Post-test Experimental design
- Type of study: pre to post Experimental study
- Duration: 6 months

Materials Required:

- Pen
- Paper
- Goniometer
- Hand held dynamometer

Methodology

Based on the selection criteria, 46 people were recruited, however, only 40 of them did the lumbopelvic hip complex exercise. Six people were drop outs as they didn't meet the loads of the exercise

Before the intervention, the subjects gave their consent after being told what would happen. Before the intervention, all of the subjects' age, gender, height, weight, and body mass index (BMI) were documented. Before starting the lumbopelvic hip complex exercises, all of the people were given tests to measure their upper extremity range of motion (ROM), strength, and functional performance.

The subjects who took part did two sets of ten repetitions five days a week for twelve weeks. The order of the exercises was chosen by each person. All of the people on the intervention team were given a moderate level of resistance, which they used for the whole study. After the intervention, ROM, strength, and functional performance were all checked again.

The range of motion of the shoulder abductors, external rotators, and internal rotators was measured with a universal goniometer. The strength of the shoulder abductors, external rotators, and internal rotators was measured with a hand-held dynamometer. The functional performance of the upper extremity was measured with a closed kinetic chain upper extremity stability test (Chaudhari, McKenzie, Borchers & Best, 2011).

Exercises

Pelvic Bridge

The participants were told to lie on their backs with their knees extended and their feet flat on the ground. The participants were taught to lift their pelvis and back off the ground while drawing their belly button in toward their spine. They had been told to keep their hands in the "up" posture for two seconds.

Figure 1. *Pelvic bridge*

Standing Hip Abduction

Participants were taught to execute standing hip abduction while wearing a resistance band around their ankles. The verbal cue to keep the ankle dorsiflexed and the knee extended was given to the participants.

Figure 2. *Standing Hip abduction*

Standing Hip Extension

Participants were given a resistance band to wrap around their ankles, then told to stand with their knees extended and extend their hips.

Figure 3. *Standing hip extension*

Deep Squat

Participants were asked to perform a deep squat with their arms extended in front of them while wearing a resistance band above the knee. To prevent knee valgus during the squat, the resistance band was employed to stimulate hip abduction muscle activation (Chaudhari, et. al., 2011).

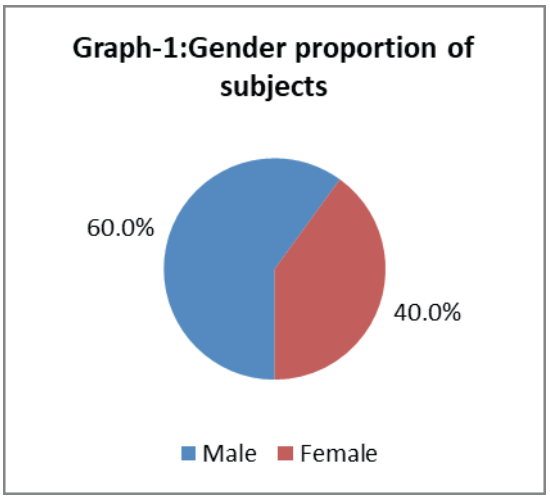
Figure 4. *Deep squat*

Results:

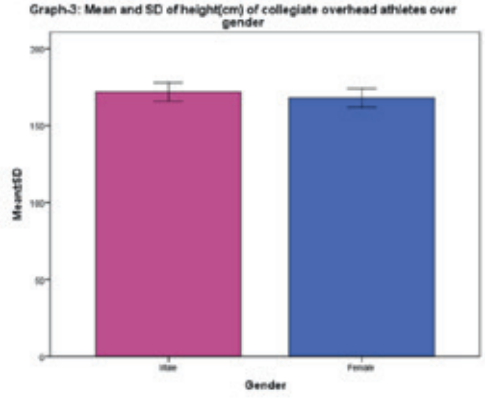
Table 1. *Distribution of collegiate overhead athletes according to gender, age, height, weight and BMI*

S.No.	Background variables	Male (24,60.0%)		Female (16, 40.0%)		Unpaired t-value, p-value
		Range	Mean ± SD	Range	Mean ± SD	
1	Age	19-24	24.79±1.47	18-23	20.50±1.63	t=2.601, p<0.05
2	Height(cm)	158-185	171.63±.5.97	130-176	168.00±6.08	t=1.835, p>0.05
3	Weight(kg)	60-83	70.46±7.45	52-65	57.38±4.39	t=6.311, p<0.05
4	BMI	20.3-29.4	24.09±2.57	17.8-25.8	20.21±1.91	t=5.149, p<0.05

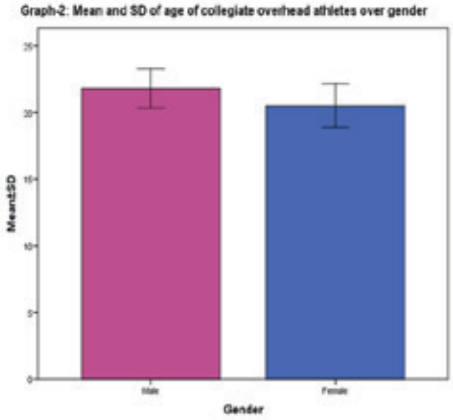
Note: *Significant (p<0.05): Not significant (p>0.05)*



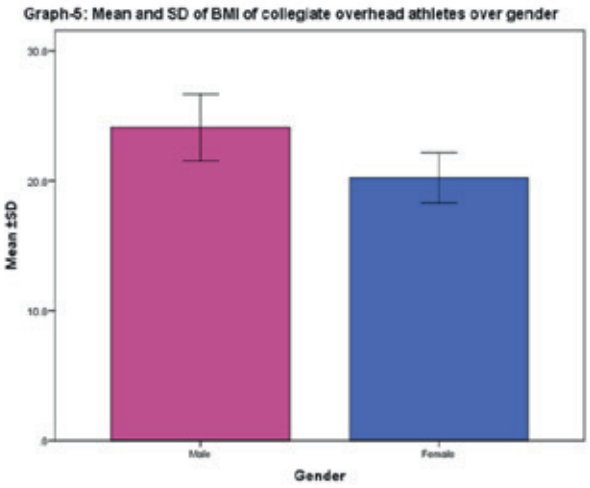
Graph 1. *Show gender proportion of the subjects were the males 60.0% and females 40.0%*



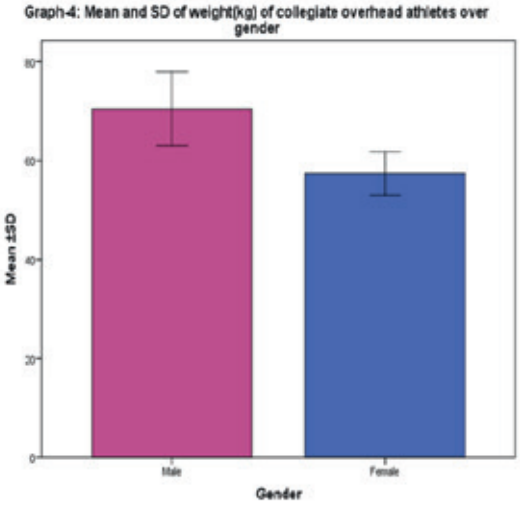
Graph 2. *Mean and SD of collegiate overhead athletes over gender*



Graph 3. *Mean and SD of height (cm) of collegiate overhead athletes over gender*



Graph 4. *Mean and SD of collegiate overhead athletes over gender*

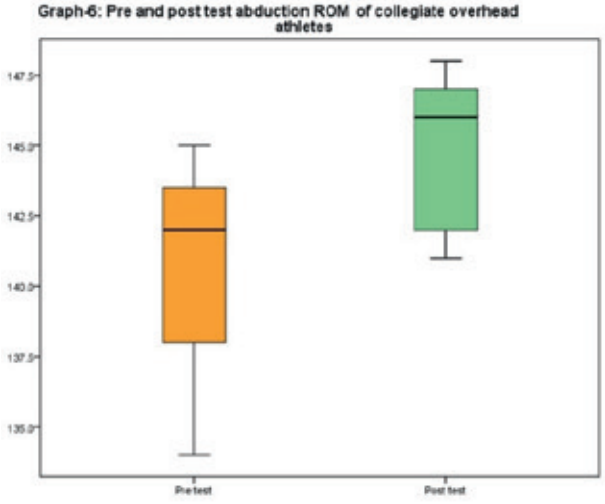


Graph 5. *Mean and BMI of collegiate overhead athletes over gender*

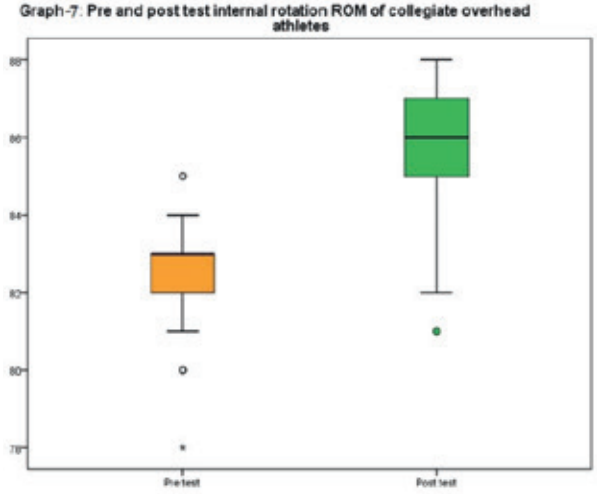
Table 2. *Range, mean and SD of outcome measures of ROM of collegiate overhead athletes.*

S.No.	Shoulder ROM (Rt)	Pre test		Post test		Paired t-tes	p-value
		Range	Mean ±SD	Range	Mean ±SD		
1	Abduction	134-145	141.15±2.84	141-148	145.02±2.36	t=13.065*	p<0.001
3	Internal rotation	76-85	82.45±1.37	81-88	85.93±1.84	t=13.286*	p<0.001
5	External rotation	76-86	81.80±2.18	78-88	84.05±2.39	t=6.324*	p<0.001

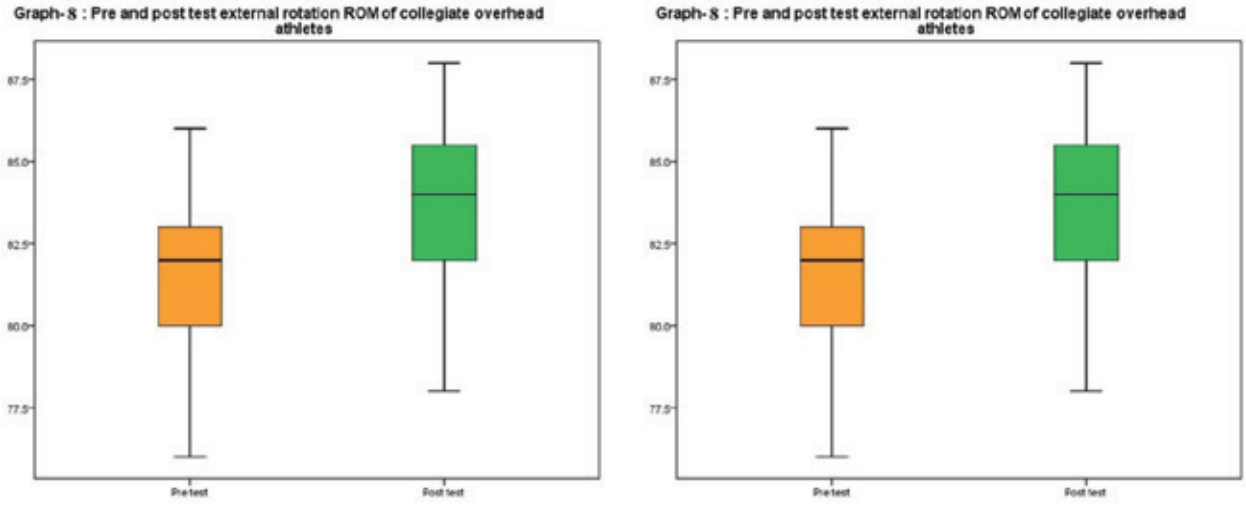
Note: ** denotes –Significant. (p<0.05).*



Graph 6. *Pre and post test abduction ROM of collegiate overhead athletes*



Graph 7. *Pre and post test internal rotation ROM of collegiate overhead athletes*

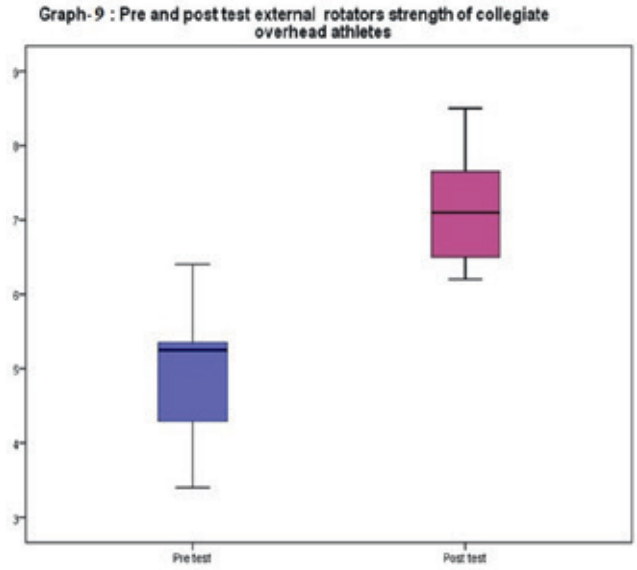


Graph 8. *Pre and Post test external rotation ROM of collegiate overhead athletes*

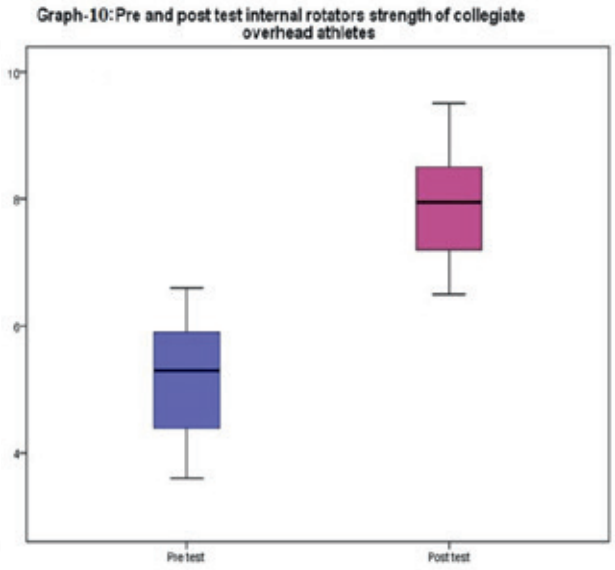
Table 3. *Range, mean and SD of outcome measures of strength and functional performance of collegiate overhead athletes.*

S. No.	Strength	Pre test		Post test		Paired t-test	p-value
		Range	Mean ±SD	Range	Mean ±SD		
1	Abductors Right side	6.90-10.00	8.46±0.93	9.5-12.5	11.24±0.81	t=16.552*	p<0.001
2	Internal rotators right side	3.6-6.6	5.19±0.98	6.5-9.5	7.94±0.89	t=13.833*	p<0.001
3	External rotators right side	3.4-6.4	4.95±0.75	6.2-8.5	7.24±0.64	t=13.190*	p<0.001
4	Functional Performance	17-22	19.32±1.55	18-25	21.37±1.71	t=18.458*	P<0.001

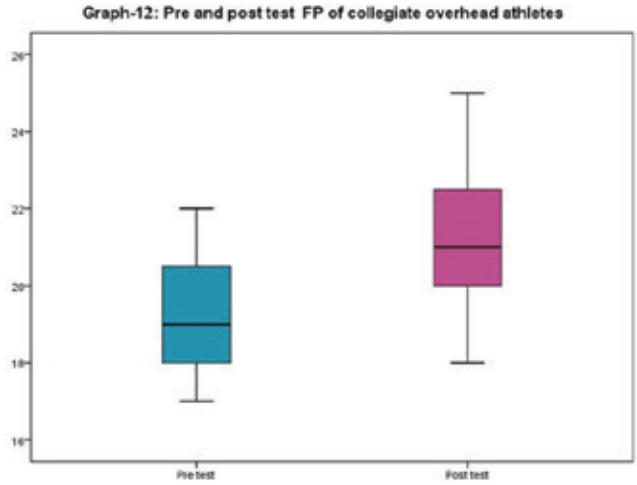
Note: ** denotes –Significant., (p<0.05).*



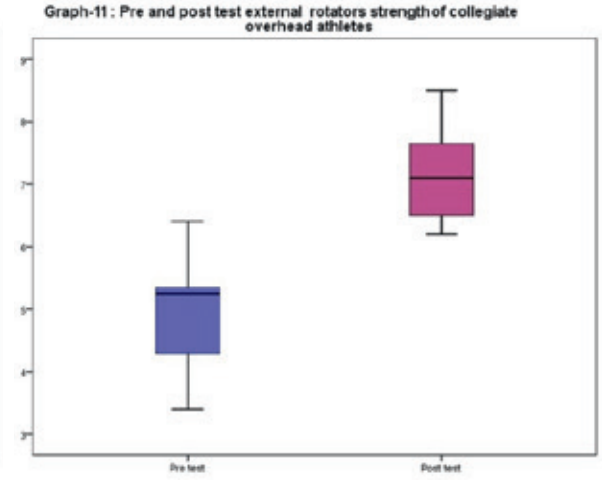
Graph 9. *Pre and post test external rotators strength of collegiate overhead athletes*



Graph 10. *Pre and post test internal rotators strength of collegiate overhead athletes*



Graph 11. *Pre and post test external rotators strength of collegiate overhead athletes*



Graph 12. *Pre and post test FP of collegiate overhead athletes*

Discussion

The purpose of this research was to examine the effect of lumbopelvic hip complex training on the range of motion, strength, and functional performance of the overhead limbs in collegiate athletes. Research has shown a substantial effect on the outcome variables.

In 2011, researchers Chaudhari, McKenzie, Borchers & Best, concluded that the lumbopelvic hip complex is responsible for the transmission of force and motion across the kinetic chain. Energy flow from the lower extremities through the torso to the throwing hand has been shown in previous research to theoretically necessitate excellent lumbopelvic control. Athletes who throw from above might potentially create more force and transfer it more effectively to the throwing hand by contracting the hip, pelvic, and thoracic muscles with good lumbopelvic control (Lee & Kim, 2015). The lumbopelvic hip complex serves as the pivot point between the upper and lower extremities. All motions of the extremities involve feed-forward activity in the lumbopelvic hip complex, suggesting that these muscles contract in advance of limb movement. The lumbopelvic hip complex helps the body move efficiently to complete a job by acting as a link in a kinetic chain (Kibler, Press & Sciascia, 2006).

In 2021, high school baseball players Downs, Wasserberger & Oliver,studied the effects of a pre-throwing program designed to strengthen the lumbopelvic-hip complex on their shoulder range of motion and isometric strength.

The intervention group now includes four low-impact, high-competition (LPHC) activities in their pre-workout regimen. Passive bilateral shoulder range of motion and isometric strength were measured before and after the season for both the control and intervention teams. When compared to the control group, the intervention group saw substantial increases in both shoulder range of motion and isometric strength. Moreover, the intervention group was able to keep their shoulder range of motion steady by working on their lumbopelvic hip complex strength and control. This is consistent with the latest research, which found that exercises targeting the lumbopelvic hip complex increased flexibility in collegiate overhead athletes (Chaudhari, et. al., 2011).

Shoulder range of motion in upper limb abduction (141.152.284-145.022.36), (t=13.065), IR (82.451.37-85.931.84), (t=13.286), and ER (81.802.18-84.052.39), (t=6.324), were all significantly different before and after the intervention. The mean pre- and post-test scores were compared using a paired t-test, and there was a statistically significant difference (p0.001).

Consistent with previous research, this study found that an intervention program centered on the lumbopelvic hip complex led to increased muscular activation and strength in the upper extremities.

Hodges & Richardson, 1997 and Oliver, et. al., 2015, results from this study show that collegiate athletes can improve their performance and reduce their risk of injury by increasing their lumbopelvic control, as measured by changes in their abduction (8.460.93-11.240.81), internal rotation (190.98-7.940.89), and external rotation (4.950.45-7.240.64) mean and standard deviation (SD) pre- and post-test (Cope, Wechter, Stucky, Thomas & Wilhelm, 2019). Alterations in biomechanics and insufficient force production and transfer could lead to poor athletic performance and injury if the lumbopelvic hip complex was weak while the extremities were strong. When the lumbopelvic hip complex is robust, an athlete is better able to execute complicated, quick movements in unison, which boosts performance (Bullock, et. al., 2018).

College athletes' upper-extremity performance was examined in a 2022 study by Parmanand Jha1 et al. Both groups continued their regular training regimens throughout the study, but the experimental group also completed a five-week core training routine (three days/week). The core stabilization program is designed to strengthen the abdominal, low back and pelvic floor muscles over the course of five weeks. The study found that collegiate athletes' upper limb performance indicators including UQ-YBT and FTPI might be enhanced by participating in a progressive core stability training program over the course of five weeks (Jha, et. al., 2022).

College overhead athletes showed statistically significant improvement in functional performance when CK-CUEST was employed to describe performance (19.321.55-21.371.71) (t=18.458). The results of a paired t-test reveal a statistically significant (i.e. $p<0.001$) difference when the means are compared.

It has been proposed that strengthening the lumbopelvic region can increase power, and hence performance, during the pitching action. However, this region may also be crucial in reducing the stress applied to the shoulder and elbow during the throwing motion. For the reason that adjusting one's lumbopelvic control can have a profound effect on one's proprioception strength and flexibility in the upper extremities (Gilmer, Gascon & Oliver, 2018).

Therefore, the results of the study showed that the range of motion, strength, and functional performance of collegiate overhead athletes all benefited more from exercises targeting the lumbopelvic hip complex. There was a statistically significant difference between pre- and post-test measurements of outcomes including ROM, strength, and functional performance.

Limitations:
Few subjects have engaged in compensatory/trick movements during the strength tests. Results may have been impacted if the documented values would have differed.

Recommendations:
We urge further research comparing the effects of lumbopelvic hip complex exercise and core stability exercise on upper extremity performance, as well as testing these interventions on a more representative sample of the population.

Conflict of Interest: *None*

Funding: *Self- Funding*

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Prevalence of High Blood Pressure and Association With Obesity in Macedonian Children Aged 6 Years Old

Jeton Tifeku[1,2], Žarko Kostovski[2], Gontarev Sryozha[2], Bekim Ramabaja[3], Zorica Stankovska[4]
[1]Physio Clinic "JETONI" Ferizaj
[2]Ss. Cyril and Methodius University Skopje, Faculty of Physical Education, Sport and Health, Republic of North Macedonia
[3]Universum College, Department of Physiotherapy, Lipjan
[4]Ss. Cyril and Methodius University Skopje, St. Kliment Ohridski Faculty of Pedagogy, Republic of North Macedonia

Correspondence:
Bekim Ramabaja, Department of Physiotherapy. Universum College. Lipjan
bekim.ramabaja@universum-ks.org

Abstract: *The prevalence of high blood pressure in children is increasing worldwide, largely but not entirely, determined by the concurrent epidemic of childhood obesity. The objectives of this study were to determine the prevalence of prehypertension and hypertension in Macedonian children of 6 years of age and to determine the relationship between the different components of blood pressure (BP) with different adiposity indicators. Cross-sectional study including a sample of 1200 children aged up to 6 years, drawn randomly from several schools from three regions in the Republic of North Macedonia. To achieve the goals of the research, weight, height, the body mass index (BMI), tri-ponderal mass index (TMI), percentage of fat tissue (%FM), systolic and diastolic BP, mean arterial pressure and pulse pressure were measured. The prevalence estimates for prehypertension and hypertension were 6.8% and 13.2%, respectively. In both sexes, adiposity indicators were positively and significantly related to systolic and diastolic BP ($p<0.001$), so students from higher categories of adiposity had significantly higher BP levels ($p<0.001$). Our results show a high prevalence of high blood pressure in Macedonian children. Moreover, high levels of adiposity are associated with high blood pressure in early childhood, confirming that this may be associated with cardiovascular risk later in life. Taking into account also lack of exercise and pathologies that may develop also in physiotherapeutic aspect due to this issue.*

Keywords: *Blood pressure, Obesity, Weight status, Children, Physical activity, BMI, Kinesiology.*

Introduction

Over the last decade, epidemiological studies have reported an increase in blood pressure (BP) levels in children (Xi et al., 2016), as well as the prevalence of prehypertension and hypertension (Sorof et al, 2006; McNiece et al., 2007).; Ostrowska-Nawarycz, & Nawarycz, 2007; Raj et al., 2007; Kelishadi et al., 2006) largely, but not entirely, driven by a concurrent increase in childhood obesity. This fact is accompanied by a growing recognition of the importance of blood pressure measurements in children. However, the importance of monitoring blood pressure (BP) levels in the pediatric age goes beyond its association with obesity because it has been consistently reported that, independent of body mass index (BMI), BP levels track from childhood to adulthood (Bao et al., 1995; Chen & Wang, 2008), and that BP levels in childhood predict young adult cardiovascular risk (Rademacher et al., 2009). Despite the widely reported increase in the prevalence of high BP in the pediatric population worldwide, only a few studies have investigated blood pressure in Macedonian children, reporting the prevalence to be around 21% (Stankovska et al., 2021).

The prevalence of overweight/obesity among Macedonian children is around 37% (Gontarev et al., 2018; Gontarev & Ruzdija., 2014; Myrtaj et al., 2018). A recent study conducted in 6-year-old children from the Skopje region (Macedonia) reported an overweight/obesity prevalence of 34% (Emini et al., 2022). Increased BP levels should be associated with the high prevalence of obesity, but studies analyzing the association between adiposity indicators and BP are rare in Macedonian children (Stankovska et al., 2021), and none have been conducted in children ≤ 6 years.

Traditionally, BP measurements include only systolic blood pressure (SBP) and diastolic blood pressure (DBP) values, but other indices such as mean arterial blood pressure (MAP) or pulse pressure (PP) have also been shown to be independent predictors of cardiovascular events in both normotensive and hypertensive adults (Franklin et al., 2009; Safar et al. 2001).

In contrast, recent studies have suggested that tri-ponderal mass index (TMI) could be a better prognosticator of health in children than BMI (Khoshhali et al. 2020; De Lorenzo et al., 2019; Peterson et al., 2017). Despite its

usefulness in body conformation research, the connection between TMI and blood pressure in children has not been conclusively elucidated.

Since the current prevalence estimates of overweight/obesity among Macedonian children is one of the highest in Europe (Ortega et al., 2023), the prevalence estimates of high blood pressure among Macedonian children may represent an indirect indicator of the impact of the obesity epidemic on the BP level. Thus, the objectives of this study were to determine in Macedonian children aged 6 years: 1) the prevalence of prehypertension and hypertension and 2) the association between indicators of adiposity (BMI, %FM and TMI) with traditional ones (SBP, DBP) and alternative (MAP, PP) blood pressure components.

METHODS

Sample of respondents

The research was carried out on a sample of 1200 children randomly selected from several schools from three regions (Skopje, South-Eastern and Pologsk) in the Republic of North Macedonia. The sample is divided into two subsamples according to gender, namely 557 respondents are boys and 643 respondents are girls. The average age of respondents of both sexes was 6.3±0.3 years.

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

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

Anthropometric measures and body composition

The measurement of anthropometric measures was carried out according to the recommendations of the IBP-International Biological Program. The height of the subjects (without shoes) was measured to the nearest 0.1 cm with a portable stadiometer. BMI was calculated as weight divided by height squared. TMI was calculated as weight divided by height cubed. The percentage of adipose tissue % FM was determined by the bioelectrical impedance (BIA) method. The measurement is realized by Body Composition Monitor, model "OMRON - BF51. Before starting the measurement in the Body Composition Monitor, the parameters of gender, age and body height of the respondent were entered. In order to ensure better accuracy of the results obtained from the assessment of body composition, before each measurement were fulfilled, prerequisites recommended by ACSM.

Blood pressure

The blood pressure measurement (systolic and diastolic) is performed by experts from the medicine, doctor-specialist's pediatrician fields. Blood pressure measurements were performed using the oscillometric method through a calibrated Omron (Kyoto, Japan) electronic and digital device model HEM 742, with cuffs of appropriate size to fit the arms of adolescents. This device has been validated for use with adolescents (Christofaro et al. 2009). Participants were informed about the procedures and were instructed to remain at quiet rest for at least five minutes in a quiet environment and without noise, with emptied bladder, not having performed exercise 90 min before the tests or smoked or ingested food, coffee, alcoholic drinks or mate at least 30 min before data collection. The atmosphere was quiet and with no noise. Blood pressure was measured three times at intervals of 60 seconds, and the result was the median value of the three measurements. NBP was defined as BP < 90th percentile; prehypertension was defined as BP between the ≥90th percentile and the <95th percentile; and hypertension was defined as BP ≥ 95th percentile. The mean arterial pressure (MAP) was calculated using the traditional formula. The pulse pressure (PP) was calculated as SBP minus DBP. We adopted the methodological recommendations of the Update on the Task Force Report on High Blood Pressure in Children and Adolescents.

Statistical analysis

The normal distribution of the continuous variables was checked graphically (normal probability plot) and statistically (Kolmogorov - Smirnov test) procedures. All variables had a normal distribution, which is why we used parametric statistics in the analyses. Anthropometric and blood pressure (BP) measures were presented as arithmetic mean and standard deviation (SD). Gender differences on quantitative variables were tested using the Student T-test.

Partial correlation coefficients were applied in order to determine the relationship between each component of BP (SBP, DBP, MAP and PP) and indicators of adiposity (BMI, %FM, TMI), controlling for age, according to sex.

We categorized %FM low (first quartile), medium (second and third quartiles) and high (fourth quartile). Children were classified as underweight, normal weight, overweight and obese according to the BMI cut-offs proposed by Cole and Lobstein (2012).

ANCOVA models were used to determine mean differences in each BP component (SBP, DBP, MAP and PP) between BMI and %FM categories, controlling for age in the total sample and also separately by sex. Pairwise post hoc hypotheses were tested using the Bonferroni correction for multiple comparisons. All, analyzes were performed using the Statistical Package for Social Sciences software (SPSS, v. 22.0 for WINDOWS; SPSS Inc., Chicago, IL, USA), and values of $p < 0.05$ were considered statistically significant.

Results

The research was carried out on a sample of 1200 respondents, of which 557 (46.4%) were boys and 643 (56.6%) were girls. The average age of the respondents was 6.3±0.3 years. No significant differences were observed between the mean age of the girls and boys.

Table 1. *Characteristics of the study sample.*

	Total (n=1200)		Boys (n=557)		Girls (n=643)		F	Sig.
	Mean	SD	Mean	SD	Mean	SD		
Age (years)	6.30	0.26	6.30	0.27	6.30	0.26	0.17	0.681
Weight (Kg)	121.49	5.69	121.89	5.94	121.15	5.45	5.11	0.024
Height (cm)	25.66	5.59	26.01	5.70	25.35	5.48	4.12	0.043
BMI (kg/m2)	17.26	2.77	17.38	2.73	17.14	2.80	2.21	0.137
TMI (kg/m3)	14.09	2.46	13.89	2.31	14.26	2.57	6.69	0.010
% FM	22.51	7.65	23.87	7.07	21.35	7.93	30.76	0.000
SBP (mm Hg)	101.01	11.18	101.72	10.55	100.40	11.67	4.15	0.042
DBP (mm Hg)	63.81	10.93	63.95	10.88	63.69	10.98	0.17	0.681
MAP (mm Hg)	36.99	10.28	36.02	9.25	37.83	11.03	9.29	0.002
PP (mm Hg)	75.97	10.48	77.03	7.96	75.06	12.18	10.68	0.001

Abbreviations: *BMI = body mass index; FM = fat mass; TMI = Tri-Ponderal Mass Index; SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure (DBP + {0.333 x (SBP—DBP)}); PP = pulse pressure (SBP-DBP). In bold when p value ≤ 0.05*

Table 1 shows the characteristics of the sample. From the review of the table showing the values of arithmetic means. standard deviations and the level of statistical significance. it can be seen that no statistically significant differences were determined between boys and girls in the variables weight. height. BMI (body mass index) and DBP (diastolic blood pressure). Mean values of height. weight. percentage of body fat. SBP (systolic blood pressure) and PP (pulse pressure) were higher in boys compared to girls. Girls showed higher mean values of Tri-Ponderal Mass Index and MAP (mean arterial pressure). The prevalence of prehypertension was 6.8% in boys and 6.7% in girls. while the prevalence of hypertension was 10.9% in boys and 15.3% in girls. No statistically significant differences were found between the estimates of prehypertension prevalence by sex groups. but girls had a significantly higher prevalence of hypertension than boys ($p<0.05$).

Table 2. *Partial correlations coefficients (r) of systolic blood pressure. diastolic blood pressure. mean arterial pressure and pulse pressure with BMI. %fat mass and TMI controlling for age.*

		BMI	%FM	TMI
SBP	Total	0.206	0.192	0.080
	Boys	0.153	0.101	0.106
	Girls	0.244	0.247	0.068
DBP	Total	0.143	0.119	0.055
	Boys	0.107	0.038	0.054
	Girls	0.173	0.182	0.056
MAP	Total	0.073	0.071	0.108
	Boys	0.083	0.065	0.115
	Girls	0.063	0.056	0.120
PP	Total	0.071	0.049	0.028
	Boys	0.123	0.094	0.025
	Girls	0.043	0.046	0.015

Abbreviations: *BMI = body mass index; FM = fat mass; TMI = Tri-Ponderal Mass Index; SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure (DBP + {0.333 x (SBP—DBP)}); PP = pulse pressure (SBP-DBP). In bold when p value ≤ 0.05*

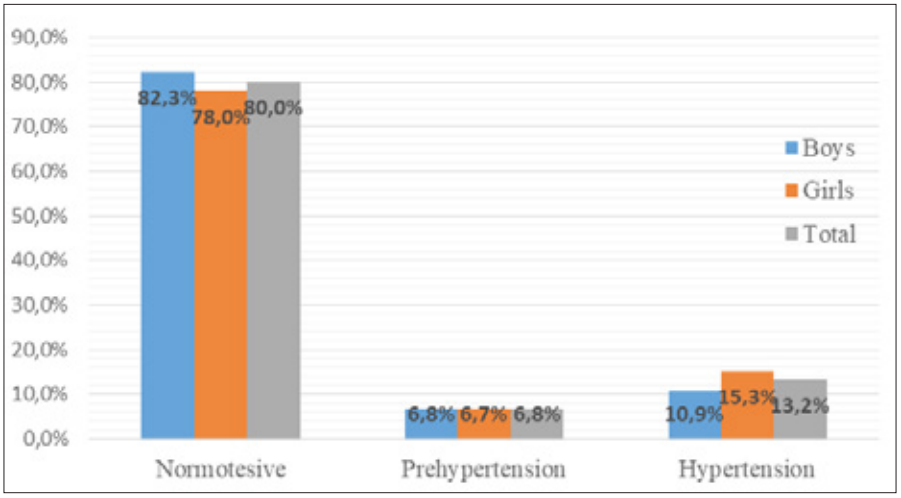

Figure 1. *Prevalence of normotensive. prehypertension and hypertension includes stages 1 and 2 in children. by sex and in the total sample.*

The partial correlation coefficients between blood pressure and adiposity indicators. controlling for age. are shown in Table 2. The Body mass index (BMI) is in a low statistically significant positive correlation with SBP and DBP in the entire sample of subjects and individually in subjects from male and female. Also. body mass index has a low and statistically significant correlation with pulse pressure (PP) in male respondents. Percentage of adipose tissue (%FM) has a low statistically significant positive correlation with SBP in the overall sample of subjects and individually in male and female subjects. Percentage of adipose tissue (%FM) had a low statistically significant positive correlation with DBP in the overall sample of subjects and in female subjects. Tri-Ponderal Mass Index (TMI) was in a low and statistically significant correlation with SBP in the overall sample and male respondents. Also. Tri-Ponderal Mass Index (TMI) is in a low and statistically significant correlation with mean arterial pressure (MAP) in the entire sample of respondents and individually in male and female respondents.

Mean differences in all BP components (SBP. DBP. MAP. PP) by categories of BMI and %FM. controlling for age and sex. are shown in Table 3. In the total sample. children categorized as obese according to body mass index and with high percentage of body fat showed higher mean values of systolic and diastolic blood pressure. Similar results were found when data were analyzed separately by gender ($p<0.001$) (data not shown).

Table 3. *Mean differences in blood pressure parameters according to adiposity categories in total sample controlling for age.*

BODY MASS INDEX										
	UW		**NW**		**OV**		**OB**		**p**	**Post-hoc**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**		
SBP	100.83	11.88	99.16	10.12	101.68	10.82	105.55	11.14	0.000	1<4; 2<3; 2<4
DBP	62.95	11.14	62.57	9.92	64.65	10.59	67.27	13.47	0.000	1<4; 2<4
PP	35.43	13.08	36.47	10.42	38.33	9.57	38.10	8.93	0.032	1<3; 2<3
MAP	75.87	10.50	75.70	9.73	75.70	9.14	77.96	11.51	0.023	2<4
% FAT MASS										
	Low		**Medium**		**High**				**p**	**Post-hoc**
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**				
SBP	99.87	10.80	99.87	10.01	104.56	11.01			0.000	1<3; 2<3
DBP	62.48	10.44	63.28	10.00	66.05	12.63			0.000	1<3; 2<3
PP	36.58	11.19	36.98	9.88	38.42	9.22			0.070	ns
MAP	75.25	10.25	76.18	9.36	77.25	11.12			0.062	ns

Abbreviations: *SBP = systolic blood pressure; DBP = diastolic blood pressure; MAP = mean arterial pressure (DBP + {0.333 x (SBP—DBP)}); PP = pulse pressure (SBP-DBP). Categories of BMI are Underweight (UW). Normal Weight (NW). Overweight (OV) and Obesity (OB) according to gender-and-age-specific cut-offs defined by Cole and Lobstein. Categories of fat mass are Low. Medium. and High. representing the 1st. 2nd and 3rd and 4th quartiles.*

Discussion

Studies that assess the prevalence of high blood pressure in children ≤ 6 years old are rare worldwide. and none have been conducted in Macedonia. This study shows that the prevalence of high blood pressure (prehypertension and hypertension) in children aged 6 years from three regions in Macedonia was 17.7% and 22.0% in boys and girls. respectively. Furthermore. the prevalence of prehypertension and hypertension in the total sample was 6.8% and 13.2%. respectively. Also. a positive relationship between adiposity categories and BP levels was established.

Considerable variability in the prevalence of hypertension (≥95th percentile) has been reported in different population studies in the same age groups of children worldwide; some of them were similar to our results: 23% in China (Chen & Li. 2011) and 19.9% in Brazilian children (Crispim et al. 2014). Lower percentages are reported in Sydney. 13.7% (Gopinath et al.. 2011). Seychelles. 12% (Chiolero et al.. 2007) and 6.4% in Minnesota and California (Lo et al.. 2013).

Potential reasons that could explain this variability in blood pressure levels across countries include differences in the procedures used to measure BP in these studies and differences in obesity trends and samples that included children of different ethnicities.

In Macedonia. so far no special studies have been conducted on the prevalence of hypertension in children under the age of 7. using the classification of BP established by the 4th report have been conducted so far. In the research carried out by Stankovska et al. (2021) year of a sample of children from 6 to 10 years. prehypertension was determined in 8.4% and hypertension in 21.3% of Macedonian children. Other studies were conducted in older children (Pireva et al. 2018; Gontarev et al.. 2017).

The relationship between adipose tissue and various components of BP in children has been shown in several studies. Eisenmann et al. found that BMI. WC. skinfold sum and %FM (measured via dual energy X-ray absorptiometry) were moderately and positively correlated with SBP. DBP and MAP (Eisenmann et al.. 2005). as also determined in other studies in which BMI (Aguirre et al.. 2012; Martín. García-Aranda & Almendro. 2005) and triceps skin fold thicknesses (Freedman et al.. 2009) were associated with SBP and DBP.

Our results are partially consistent with other studies. which indicated that. overall. the intensity of association of various indicators of adiposity was similar with SBP and physiological components of BP (MAP. PP) (Drozdz et al.. 2009; Plachta-Danielzik et al.. 2008). supporting that children with greater obesity are more likely to be at risk of hypertension.

Our findings also suggest that children in the higher BMI and %FM categories have higher levels of SBP and DBP in both boys and girls. as found in other studies in the same age group and different ethnicity (Falkner et al.. 2006; Salvadori et al.. 2008; Flores-Huerta et al.. 2009; Almas & Jafar. 2011; LA de Hoog et al.. 2012). However. the results of longitudinal studies are inconsistent because while some authors have concluded that the increase in obesity rates partly explains the rise in high blood pressure (Peters et al.. 2012; Din-Dzietham et al.. 2007). Other authors have determined that the prevalence of elevated blood pressure decreases while the prevalence of obesity increases (Chiolero et al.. 2009; Freedman et al.. 2012). supporting the notion that children with high levels of BMI at such an early age are less likely to become hypertensive or have high blood pressure during adolescence (Din-Dzietham et al.. 2007). Therefore. other factors. such as physical fitness or dietary changes (Aburto et al.. 2013) may be influencing this longitudinal relationship.

A number of studies investigating the relationship between tri-ponderal mass index (TMI) and blood pressure indicate that children classified as underweight are less likely to be hypertensive. Overweight/obese individuals tend to be more hypertensive than those with a normal weight classification. Shim (Shim. 2019; Onagbiye & Toriola. 2022). who evaluated the allocation of tri-ponderal mass index under age and sex. and the association of excessive fatness groups in according to sex- and age-specific tri-ponderal mass index with MetS and its components. found that children in the overweight and obese groups had a higher propensity for increased BP compared with individuals having normal weight. In this study tri-ponderal mass index (TMI) was shown to be a weaker predictor of blood pressure than the body mass index and percentage of fat tissue. Perhaps the tri-ponderal mass index has a greater predictive power in older children.

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

However. epidemiological data suggest that BP is an important and common health problem in children. Therefore. it is essential to develop and implement effective public health strategies to prevent and control prehypertension and hypertension. Early identification. control and treatment of risk factors and healthy lifestyles (especially in children and adolescents) can reduce the risk of cardiovascular disease and other chronic non-communicable diseases and can reduce the public health burden in the future. It is also important to focus attention on subjects with established prehypertension or hypertension - at high risk or very high risk of cardio metabolic comorbidities. However. given the recommendations and guidelines used for the evaluation and treatment of HBP in children and adolescents. it may often go undiagnosed. For example. in a large cohort study of a pediatric population. a high frequency of undiagnosed prehypertension and hypertension was found (Hansen et al.. 2007). There is evidence that both prehypertension and hypertension in adolescents and children are significant determinants of cardiovascular target organ damage (Urbina. et. al.. 2011). and these adverse changes are strongly associated with an increased risk of cardiovascular problems in adulthood. A meta-analysis of analyzed studies showed that prehypertension and hypertension were associated with a higher risk of stroke. myocardial infarction. and total cardiovascular outcomes (Guo et al.. 2013).

This study has some limitations that should be mentioned. First. because this was a cross-sectional study. it does not allow us to draw causal conclusions. Second. potential overestimation of the prevalence of high BP due to the determination of BP in a single occasion. compared to other studies that reported two more screenings of BP in those individuals classified as pre-hypertensive and hypertensive (Crispim et al.. 2014; Chandramohan et al.. 2012). According to the Fourth Report. the recommended measurement of BP should be performed by auscultatory method (Fourth Report. 2004). but in this study. BP measurements were obtained using an automatic oscillometric monitor validated for children. Unfortunately. we could not do that in the current study. since the measurements were performed in school conditions in one day. so we chose an automatic oscillometric monitor to avoid inter-observer variability. since it is usually difficult to distinguish between 4th and 5th Korotkoff sound in young children. even for trained nurses. Biochemical parameters. socioeconomic factors. family history and dietary factors were not taken into account in the research. Finally. measurements in school settings may also affect BP values. due to the difficulties that sometimes exist in maintaining a quiet and peaceful environment.

Conclusion

Our data show a high prevalence of prehypertension and hypertension in Macedonian children from 6 years old. These findings are important from a clinical and public health point of view. as they support the idea that early detection of pre-hypertensive and hypertensive status in young children can help prevent cardiovascular disease in adulthood in the Macedonian population. Healthy lifestyle changes and correction of unfavorable lifestyle habits (through increasing physical activity. kinesiology exercises. maintaining an appropriate body weight and healthy eating habits. reducing sodium intake. increasing dietary potassium intake) are essential to prevent HBP.

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Technological Readiness and Psychological Well-Being Serve as Predictors of Students' Academic Performance?

Abdul Rachman Syam Tuasikal[1], Mochamad Ridwan[1], Fransisca Januarumi Marhaendra[1], Kolektus Oky Ristanto[1], Afifan Yulfadinata[1], Khairul Hafezad Abdullah[2], Edi Setiawan[3]

[1]*Universitas Negeri Surabaya, Indonesia*
[2]*Science Laboratory Unit, Department of Academic Affairs, Universiti Teknologi MARA, Perlis, Malaysia*
[3]*Universitas Suryakancana, Indonesia*

Correspondence:
Edi Setiawan, Universitas Suryakancana, Indonesia
edistewanmpd@gmail.com

Abstract: *This study intends to investigate the relationship between technology readiness and psychological well-being with academic performance. The investigation utilised a quantitative approach and correlational statistical procedure. In this study, the participants were students majoring in physical education at the Universitas Negeri Surabaya in Indonesia (n=85). The current study adopted questionnaires to evaluate technology readiness and psychological well-being, whereas test scores served as indicators of student academic accomplishment. IBM SPSS was employed to evaluate this study's normality and descriptive statistics. In the meantime, the Pearson correlation was utilised to test the relationship between variables. A multiple regression analysis was run to examine the strongest predicator of technology readiness, psychological well-being with academic performance. The results indicated a significant positive relationship between of technology readiness and psychological well-being with academic performance (p-values≤0.05). Thus, it may be inferred that technology readiness and psychological well-being components could be predictors of academic performance in physical education for students. This study's findings contribute to our knowledge and supply lecturers with information and scientific insight into the significance of technology readiness and psychological well-being for university students.*

Keywords: *Technology Readiness, Psychology Well-Being, Academic Performance, Physical education.*

Introduction

The COVID-19 pandemic has significantly changed the physical education system in all countries (Fang, Teng & Wang, 2021, López-Valenciano, Suárez-Iglesias, Sanchez-Lastra & Ayán, 2021), including Indonesia (Mujriah et al., 2022). Before the COVID-19 pandemic, most of the learning system practised at the universities was face-to-face, and then it shifted in bloom to an online learning system (Jumareng et al., 2021; Fierro et al., 2022). During the pandemic, it was corroborated that online learning fostered more inventive or innovative learning circumstances than face-to-face education (Butt, Mahmood & Saleem, 2022). A likely reason is that multiple benefits of online physical education instruction, including knowledge acquisition, are more accessible and expedient for students (Prasetyanto, Rizki & Sunitiyoso, 2022). Nevertheless, previous studies have produced contradictory outcomes; online physical education classes had undesirable effects, such as shoddy internet connections and costly data caps (Jumareng et al., 2022). In addition, online learning has disrupted psychological well-being (Rahman, Hamka & Lin, 2020; Teresa, Guss & Boyd, 2021; Ahmad, Ismail & Husain, 2022), which tangentially cause a gradual decline in their academic performance (Hashemi, 2021; Yuda et al., 2022).

Academic performance is an important aspect that all students must achieve in universities (Abdullah, Shamsi, Jenatabadi, Ng & Mentri. 2022). It is a parameter for students to show they have succeeded or failed in their academics (Moore, 2019). According to Zanevskyy and Zanevska (2021), students with exemplary academic performance would perform well in sports. Previous studies reported that high academic performance would help students to find work more accessible; otherwise, they would find it difficult to get a job (Tentama & Abdillah, 2019), and even become unemployed for a relatively long time (Yuda et al., 2022). Academic performance is the main asset for students to be successful from year to year and in the future (Fokkens-Bruinsma, Vermue, Deinum & van Rooij 2021). Several factors are claimed or predicated to be predictors of academic performance, namely, technological readiness and students' psychological well-being.

The first factor that had been estimated to be a predictor of student academic performance was technology

readiness (Wang, Xia, Guo, Xu & Zhao, 2022). Some researchers have interpreted technology readiness as a person's readiness, awareness, attitude, involvement or willingness to use technology at home, work or campus (Blut & Wang, 2020; Andarwulan, Al Fajri & Damayanti, 2021). According to Warden, Yi-Shun, Stanworth & Chen (2022), technological readiness has a positive dimension: optimism is defined as a positive view of technology, and innovativeness is defined as the ability to use new technology in order to become innovative. While the negative dimension, discomfort, is defined as unwilling or reluctant to use technology, insecurity is defined as distrust of technology (Mukerjee, Deshmukh & Prasad, 2019). A study reported that research on technology readiness in education showed an increase because it was claimed could achieve goals in learning (Geng, Law & Niu, 2019). Technology readiness is an important and beneficial factor for students to be aware and more involved in learning technology in physical education, for example, laptops, computers (Yosser, Idrus & Ali, 2020) or internet platforms (e.g., zoom meeting, google meet, google classroom) (Jumareng et al., 2021). Previous studies explained that technology readiness has several benefits; for example, it encourages students to be more literate, comfortable using technology and helping them to go through the learning process, but if students did not have readiness then it would hinder involvement and difficulties in using technology (Chang, Yu, Chao & Lin, 2020). Data from a recent study claimed that there was a lack in the readiness of using technology. In fact, in India, many students do not have digital technology skills, which impacts decreasing academic performance (Wang, Xia, Guo, Xu & Zhao, 2022).

Psychological well-being was the second factor estimated to predict students' academic performance. Psychological well-being was conceptualised as the ability to develop potential independently and determine life goals in a more positive direction (Muqodas et al., 2020; Rahman, Hamka & Lin, 2020; Li, 2021). According to Ku-Johari, Bali-Mahomed, Mahmud, Amat & Saadon (2022), psychological well-being is welfare that is free from negative feelings and turns into positive ones. Psychology well-being has several dimensions, including self-acceptance, positive relationships with others, desire to develop, ability to make their own choices, environmental mastery, life goals and personal growth (Tran et al., 2022; Wahyuningsih, Novitasari & Kusumaningrum, 2022). Previous research has documented the benefits of Psychology well-being, for example, related to the level of stress (Tan, Huang, Geng, Cheung & Zhang. 2021), depression and happiness of a person (Ilhan & Otman, 2020).

Previous studies have individually examined academic performance, technology readiness, and psychological well-being. However, it still needs to be determined whether technological readiness and psychological well-being are related to academic success. In order to close the gap, we attempted to propose a new method for examining the relationship between technological preparedness, psychological well-being, and academic success within the physical education framework. This research contributes to the understanding of current stakeholders (e.g., lecturers, faculty, government) regarding the significance of technology preparedness and psychological well-being in achieving academic performance for students in this era. This study intends to determine the association between technological preparedness and psychological well-being, and the yearly academic performance of students.

Materials and Methods

This study adopted a quantitative approach by using the correlational method. The objective of this study was to reveal the relationship between variables (Jumareng & Setiawan, 2021; Yuda et al., 2022).

The participants in this study were students majoring in physical education at the Universitas Negeri Surabaya (n=85) in Indonesia. The recruitment method was conducted as follows: (i) researchers emailed invitations to the first- and fourth-year students, (ii) researchers recorded the number of students who responded to the email and were willing to participate in this study, (iii) researchers identified that 85 out of 156 students majoring in physical education were willing to be participants in this study, (iv) students were asked to write the statement about their willingness to be involved in this study, (vi) students who participated were given a gift of $20 as an appreciation of their involvement.

Participants in this study consisted of 45 males (age: 21.05±2.3 years, weight: 51.68±6.4 kg, height: 1.60±0.5 cm) and 40 females (age: 21.47±0.9 years, weight: 50.60±7.8 kg, height: 1.60 ± 0.4 cm). Inclusion criteria for participation include psychologically and physically sound persons. Before the research began, all participants were informed of the regulations governing the conduct of this study. The participants are then needed to make and sign a statement expressing their desire to participate in this study. Participants in this study were compensated with 15 USD as a token of appreciation.

Instruments

Technology readiness. In this study, the instrument used to measure technology readiness was adapted from previous research (Ferreira, da Rocha & da Silva, 2013). This instrument has several dimensions, including optimism (5 question items), innovativeness (5 question items), discomfort (4 question items) and insecurity (4 question items). The participants filled out the instrument by using a Likert scale from a value of 1 (strongly disagree) to a value of 5 (strongly agree) (Chang, Yu, Chao & Lin, 2020).

Psychology well-being. This instrument was adapted from previous research (Teresa, Guss & Boyd, 2021). Psychological well-being has several dimensions, namely: self-acceptance, positive relationships with others, desire to develop, ability to make their own choices, mastery of the environment, life goals and personal growth. There were eight questions for each dimension, for example, "I live a purposeful and meaningful life". The participants filled in the question items using a Likert scale from 1 (strongly disagree) to 5 (strongly agree). A higher total score indicates high psychological well-being. This instrument has Cronbach's alpha reliability of 0.89.

Academic performance. The instrument for measuring student academic performance was test scores. The average score of test results was considered an indicator of progress in students' academic performance (Gustems-Carnicer, Calderon, Calderon-Garrido & Martin-Pinol, 2020; Fokkens-Bruinsma, Vermue, Deinum & van Rooij, 2021; Yuda et al., 2022).

Research procedure

This research was conducted from 6th to 8th October 2022 at the Universitas Negeri Surabaya (Indonesia) and received approval from the head of the physical education study program with permit number: 08/UNESA-11/2022. Researchers conducted this study according to the World Medical Association (Helsinki Declaration), namely the rules of research with human subjects. All test activities were carried out from 08.00-10.00 in the morning. On 6th October 2022, the participants carried out a technology readiness test. On 7th October 2022, all participants took a psychological well-being test. Then in the final activity on 8th October 2022, participants took an academic performance test.

Statistical analysis

Data obtained from the questionnaire were processed through IBM SPSS version 25.0 (Armonk, NY: IBM Corp), with the following steps: (i) searching for descriptive statistics (mean+standard deviation), (ii) testing data normality (Kolmogorov-Smirnov), (iii) Pearson's Correlation was used to assess the relationships between technology readiness, psychological well-being with academic performance. A multiple regression analysis was run to examine the strongest predicator of technology readiness, psychological well-being with academic performance (Jumareng & Setiawan, 2021). The level of significance was 0.05 (Mouloud & Nawal, 2020; Zanevskyy & Zanevska, 2021).

Results

The normality test results showed a normal distribution ($p \geq 0.05$). Table 1 shows the descriptive statistical results of the technology readiness variables (mean=75.33, SD=6.474), psychology well-being (mean=77.39, SD=6.653) and academic performance (mean=78.12, SD=5.668). The results of the Pearson correlation test on senior students showed that there is a significant relationship between technology readiness and psychological well-being ($r=0.857^{**}$, p-values≤ 0.05), technology readiness and academic performance ($r=0.762^{**}$, p-values≤ 0.05), psychological well-being and academic performance ($r=0.852^{**}$, p-values≤ 0.05) (Table 2). While Table 3 shows, the results of regression analysis obtained technology readiness ($\beta=0.387$, p-values≤ 0.05), psychological well-being ($\beta=0.385$, p-values≤ 0.05), which has a high correlation with academic performance ($\beta = 19.158$, p-values≤ 0.05).

Table 1. *Descriptive statistics on technology readiness and psychology well-being towards academic performance*

Variable	n	Mean±Standard Deviation
1. Technology readiness	85	75.33±6.474
2. Psychology well-being	85	77.39±6.653
3. Academic performance	85	78.12±5.668

Table 2. *Correlation of technology readiness and psychology well-being with academic performance (n=85)*

Variable		1	2	3
Technology readiness	Pearson Correlation p-values	1.000	–	–
Psychology well-being	Pearson Correlation p-values	0.857** 0.000	1.000	–
Academic performance	Pearson Correlation p-values	0.762** 0.000	0.852** 0.000	1.000

Table 3. *The regression analysis of technology readiness and psychology well-being with academic performance student (n=85)*

Coefficientsa						
Model		Unstandardised Coefficients		Standardised Coefficients	t	p-values
		B	Std. Error	Beta		
1	(Constant)	19.158	4.194		4.568	0.000
	Technology readiness	0.387	0.082	0.442	4.716	0.000
	Psychology well-being	0.385	0.080	0.452	4.819	0.000

a. Dependent Variable: Academic performance

Discussion

This study aims to reveal the relationship between technology readiness and psychological well-being student academic performance.

The first finding in this study showed that the aspect of technology readiness was a significant predictor of student academic performance every year. This is because technology readiness was a vital predictor to support students in effectively carrying out the learning process. According to Warden, Yi-Shun, Stanworth & Chen (2022), technological readiness boosted students' involvement and tended to be more active in the learning process. With positive technology readiness, students are willing and aware to adapt by recognising and learning technology-based learning (Blut & Wang, 2020). A study reported that the current learning system that utilises technology must be supported by students' readiness to ensure the learning process can be conducted optimally (Geng, Law & Niu, 2019). In addition, readiness to use technology could facilitate students to interact and discuss with friends or lecturers and easily accomplish lecture assignments that lecturers offered through online platforms (Bubou & Job, 2020; Jumareng et al., 2021). The results of this study were in line with previous studies, which showed that the current COVID-19 pandemic could reduce academic performance (Kuhfeld et al., 2020) due to students were less prepared to carry out online-based technology learning; for example, students were not technology literate or not understand using a computer (Hanif et al., 2021), laptop, smartphone or online platform (Wang, Xia, Guo, Xu & Zhao, 2022). On the other hand, students who had the readiness to use technology could get more benefits, such as increased motivation and movement performance (Juliantine, Setiawan, Jumareng, Gani & Asnaldi, 2022; Jumareng, Setiawan, & Németh, 2022) and academic performance (Calabuig-Moreno, González-Serrano, Fombona & García-Tascon, 2020; Jastrow, Greve, Thumel, Diekhoff & Sußenbach, 2022).

The second finding in this study showed that the psychology well-being was also a positive predictor of student academic performance. It is noted that psychological well-being is a factor that can trigger students to show up their ability, such as the desire to develop positive relationships with others (Deng & Yang, 2021), the ability to decide their own choices (Priambodo, Prakoso & Setyorini, 2022), environmental mastery and life goals (Jeoung, 2020). A study has proven that the level of positive psychological well-being in students will potentially make them more successful in academics (Piñeiro-Cossio, Fernández-Martínez, Nuviala & Pérez-Ordás, 2021). In addition, by having positive psychological well-being, students can control and reduce depression, anxiety and stress (Roy & Gupta, 2022) as well as academic pressure (Ahmad, Ismail & Husain, 2022).

Conclusion

Based on the results and discussions described, we emphasise that technology readiness and psychology well-being are important predictors for students in supporting their academic performance every year. The principal limitation of this analysis was not involving participants from other universities in Indonesia. Thus, future research needs to involve more participants from several universities. In addition, future research can add other variables estimated to have a relationship with academic performance. This research contributes to recent studies by providing information and insight to stakeholders (e.g., lecturers and the government) concerning the importance of technology readiness and psychological well-being for the academic performance of students studying in the physical education department.

Conflict of interest statement: *All authors disclose and certify that they have no conflicts of interest.*

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The impact of a training program for cascade relaxation on the performance of the individual back-air cycle junior gymnasts (10-11 years old)

Gorine Ahmed[1], Madani Mohammed[2], Harbach Ibrahim[1]
[1]*University of Mostaghanem Central, Algeria*
[2]*University of Algiers, Algeria*

Correspondence:
Gorine Ahmed, University of Mostaghanem Central, Algeria
ahmedgorine2018@gmail.com

Abstract: *This study presents one of the modern techniques in the field of cognitive psychology and completes the training process for artistic gymnastics coaches, in order to develop the performance level of artistic gymnastics juniors. The study included two homogeneous and equal groups, one experimental and the other controlled. The two researchers applied the training program for cascade relaxation accompanying the skill training to the experimental sample consisting of (8) young gymnasts to know the impact of this type of training in developing the skill level of the individual back somersault, while the control group underwent skills training only, and the duration of the program was limited to (08) weeks at (03) training units per week, the duration of each unit is (15) minutes. Findings showed that there is a positive direct correlation between the development of the relaxation ability level and the skill level of the back somersault straight for young gymnasts.*

Keywords: *Cascade relaxation, skill performance, back somersault straight, artistic gymnastics.*

Introduction and problematic of the study

The nature of high athletic levels requires the athlete to use his physical, skill, planning, psychological and mental abilities in an integrated manner in order to try to achieve the best possible performance. The methods of physical, skill and plan preparation and its principles have converged to a great extent during recent years, and therefore the need for more attention to the mental aspect has emerged.

Gymnastics for men is one of the competitive sports activities that are important in the competitive field at the global and Olympic level, in which players compete for six devices, where the nature of performance on each device varies according to the nature of the geometrical structure of this device.

Ground movements are the mainstay of all gymnastics movements, and the performance on the floor mat device is linked to certain motor paths that depend on the link between the mind and the motor performance, this requires the player to focus in order to perform skill in a dynamic manner, so the physical and skill preparation is not sufficient for excellence and achievement.

In order for a player to achieve optimal performance, he or she must be accompanied by training in fitness elements, motor skills and mental skills such as relaxation so that they can be used to develop the mental abilities of the athlete in order to help him to think properly and make appropriate decisions.

Mental pressures are the most influential on performance. Negative thinking and confusing ideas such as fear of failure and fear of injury that enter the mind,this results in increased physiological and physical arousal and reduced ability to make the right decisions, which are factors that negatively affect performance.

Relaxation is an important psychological or mental skill in the possibility of developing performance and preparing the player before training or competition, so it should be taken care of along with physical, skill and plan aspects. It is important to reduce anxiety levels and contribute to delayed onset of muscle or mental fatigue and speed of recovery from physical and mental exertion. The ability to adjust the level of emotional stimulation also has positive effects on physical and skill aspects, especially in gymnastics, which requires a high degree of compatibility, accuracy and concentration.

Based on the above, the two researchers in this study tried to highlight the positive impact that a training program for cascade relaxation can play on the development of the performance of the skill of the back somersault straight for young artistic gymnastics (11-12) years old.

General wonder of the study

Does the proposed cascade Relaxation training program have a positive impact on the development of back somersault straight performance among art gymnasts' juniors?

Methodology of research

Research Methodology: The researcher used the experimental method because of its suitability to the nature of the research and its objectives.

Experimental design: The researcher relied on the experimental design with two experimental and control groups with pre and post measurement for each.

Research community: The research community is represented in (50) young art gymnasts (10-11) years old and registered in the State Gymnastics Association in the wilaya of Saida/Algeria for the sports season 2021/2022.

The core study sample: (20) artistic gymnasts (10-11) years old were deliberately chosen from the Nassr Gymnastics Club from the wilaya of Saida/Algeria, where they were randomly divided into two homogeneous and equal groups and (10) young people for each group.

Determination of search variables:

Independent Variable: Proposed cascade Relaxation training Program.

Dependent variable: The level of performance of the ground movements under study.

Extraneous variables: The researcher tried to isolate or control them so that the change in the dependent variable can be attributed to the effect of the experimental variable (independent) by conducting homogeneity between the two research samples in the following variables: (Morphological measurements/skill tests/relaxation ability test) In addition, the two groups are exposed to the same experimental conditions (they train at the same time and the same gym and undergo standardized physical and skill training in terms of size, intensity and density).

Statistical description of the research sample in the study variables:

Table 1. *Shows the homogeneity of the core study sample (n = 20) in body measurements and training age*

T	Morphological variables and training age	unit of measurement	Average	Median	Standard deviation	Coefficient of Skewness
1	Age	years	5.50	5.50	0.51	0.00
2	Weight	Kilograms	54.50	54.50	0.51	0.00
3	Height	Centimeters	35.50	35.50	0.51	0.00
4	Arm length	Centimeters	132.55	133.00	0.51	-0.21
5	Chest size	Centimeters	36.45	36.00	0.51	0.21
6	Training age	Years	11.60	12.00	0.50	-0.44

It is clear from Table 1. that the torsion coefficients are limited between (+3) and (-3) in the variables (age – length – weight – arm length – chest size – training age), which indicates homogeneity among the members of the core study sample.

Table 2. *Shows the homogeneity of the core study sample (n = 20) in the skill performance level*

T	Skills variables	unit of measurement	Average	Standard deviation	Median	Coefficient of Skewness
1	back somersault straight	Scale	3.50	0.52	3.50	0.00

It is clear from Table 2. that the torsion coefficients are limited between (+3) and (-3), which indicates homogeneity among the individuals of the core study sample in the level of skill performance.

Table 3. *Shows the homogeneity of the core study sample (n = 20) in the ability to relax (card of muscle tension levels)*

T	Muscle groups	Average	Standard deviation	Median	Coefficient of Skewness
1	Head	4.95	0.82	5	0.09
2	Arms	4.95	0.82	5	0.09
3	Torso	4.75	1.25	5	- 0.54
4	Legs	3.95	0.82	4	0.09
5	General stress	18.60	0.94	18	0.94

It is clear from Table 3. that the torsion coefficients are limited between (+3) and (-3), which indicates homogeneity among the members of the core study sample in the levels of muscle tension.

Research tools and means of data collection:

1. Nideffer Muscle Tension Levels Card (1985):

Its Arabic version was prepared by Muhammad al-ArabiShamoun and Majda Ismail

This card aims to identify muscle tension levels in four muscle groups (facial, neck, and jaw muscles – shoulder, chest, and arms muscles – abdominal and back muscles – thigh and leg muscles) as a way to identify the optimal level of excitement.

It consists of three levels of muscle tension (total relaxation – moderate tension – high tension).

2. Skill level evaluation form: A form was prepared to assess the performance level of the posterior straight air cycle skill, then it was presented to 4 experts in international gymnastics arbitration and its final version is shown in Table 1.

Skill sections	Scale	Error type	Discount type
Preparatory Section	3	Small	0.1
Main section	5	Medium	0.3
Closing section	2	Big	0.5
Overall grade	10		

Proposed Cascade Relaxation Training Program:

Duration of the program

The application period of the program was set at (08) weeks and at (3) units per week, the duration of each training unit is 15 minutes, thus the total number of training units is (24) units, and the hourly volume is (6) hours, i.e. (360) minutes

Objectives of the proposed training program:

- Work to reduce levels of anxiety and muscle tension.
- Good control of the muscular system.
- Help control some physiological responses.
- Ability to adjust the level of emotional excitation.
- Help reach high levels of calm and psychological comfort.
- Isolate non-performance stimuli and reach the highest levels of attention.
- Develop performance of the individual back somersault.

Interpretation and discussion of findings:

1. Interpretation and discussion of the results of the first hypothesis:

Hypothesis text: There are statistically significant differences at the significance level ($\alpha \leq 0.05$) between the pre and post measurements of the experimental group in the level of relaxation ability and the level of performance of the back somersault straight

1.1. Interpret and discuss findings related to muscle relaxation:

Table 4. *Test "T" to indicate the differences between the pre and post measurement of the experimental group in the levels of muscle tension (ability to relax) (n=10)*

T	Muscle groups	unit of measurement	Pre measurement		Post measurement		T value	Ratio of Change
			A	Σ	A	σ		
1	Head	Scale	14.50	0.70	9.10	0.73	32.18*	59%
2	Arms	Scale	09.90	0.31	7.10	0.56	33.09*	39%
3	Torso	Scale	14.00	0.51	10.80	0.78	32.87*	29%
4	Legs	Scale	14.20	1.39	11.10	0.73	18.20*	27%
5	General stress	Scale	52.60	2.65	38.10	1.85	35.23*	38%

It is clear from Table 4. that there are statistically significant differences at the level of significance ($\alpha \leq 0.05$) between the pre and post measurements of the experimental group and in favor of post measurement in all dimensions of muscle relaxation, which are muscle tension (head, arms, torso, legs).

The researcher attributes these differences to the impact of relaxation exercises that addressed areas where tension is concentrated, such as (neck – face – shoulders – arms – abdomen – back – legs), which had a significant impact in reducing tension and achieving relaxation for all areas of the body.

This is what Shimon (2001) noted: "Relaxation exercises help reduce the impact of stress response and help optimize stress, increase concentration, eliminate anxiety, and develop and activate the forces of mental perception, as well as increasing the ability to work for long periods in addition to the many physical and psychological benefits that can be achieved with the development of the ability to relax. ".

This is consistent with the view of Sulaiman and Thamer Mahmoud (2010) thatcascaderelaxation exercises have several psychological benefits such as (emptying repressed emotions, maintaining emotional stability, eliminating negative thoughts, and reducing levels of anxiety and muscular and mental tension). And other physiological benefits such as (reducing the effect of the sympathetic nervous system responsible for increasing the state of emotion and anxiety, releasing adrenaline hormone, and helping to produce beta endorphin (beta endorphin), which relieves pain and is a source of reassurance and pleasure.

1.2. Discussing the results related to the level of performance of the posterior straight air circulation:

Table 5. *Test "T" to indicate the differences between the pre and post measurement of the experimental group in the level of performing back somersault straight (n=10)*

T	Skills variables	unit of measurement	Pre measurement		Post measurement		Ratio of Change	T value	Statistical significance
			A	Σ	A	σ			
3	back somersault straight	Scale	3.60	0.51	5.70	0.52	58%	12.42-	0.01

The results of Table 5 indicate that there are statistical function differences at the level of significance ($\alpha \leq 0.05$) between the pre and post measurements of the experimental group and in favor of post measurements in the level of performance of the back somersault straight

The researcher attributes these differences to the proposed program based on the relaxation trainings accompanying the skill trainings, this is what Abeer and others (2019) pointed out that training psychological skills such as relaxation helps to reduce stress and anxiety and to acquire the skill of controlling the muscular system to reach the degree of optimal relaxation that helps to increase performance during the training process. Mental skills development exercises also have a positive impact on reducing psychological stress and maintaining the optimal level of emotional stimulation that leads to flow in skill performance and helps reduce errors, this leads to self-

control of negative ideas affecting performance and turning them into positive ideas that lead to the best sports achievements.

1.3. Interpretation and discussion of the results of the second hypothesis:

Hypothesis text: There are statistically significant differences at the significance level ($\alpha \leq 0.05$) in the downstream measurements between the experimental and control groups in the level of relaxation ability and the level of performance of back somersault straightand in favor of the experimental group.

1.3.1. Discussing results related to cascade relaxation:

Table 6. *shows the "T" test to indicate the differences in post measurements between the experimental group and the control group in muscle tension levels (ability to relax) (n=10)*

T	Muscle groups	unit of measurement	control group		Experimental group		T value	Statistical significance
			A	Σ	A	σ		
1	Head	Scale	17.40	1.64	9.10	0.73	17.96	0.01
2	Arms	Scale	11.60	1.07	7.10	0.56	16.90	0.01
3	Torso	Scale	16.80	0.91	10.80	0.78	20.97	0.01
4	Legs	Scale	16.80	1.13	11.10	0.73	16.97	0.01
5	General stress	Scale	62.60	3.27	38.10	1.85	26.59	0.01

It is clear from Table 6. that there are statistically significant differences at the significance level ($\alpha \leq 0.05$) in the post measurements between the experimental and control groups and in favor of the experimental group in the muscle tension levels of the muscle groups (head, arms, torso, legs).

The researcher attributes the reason for these differences to the exercises of cascade relaxation, which have had a great impact in reducing tension and achieving relaxation for all areas of the body and a sense of clarity of mind in the experimental group.

This is what Rateb (1995) pointed out that the skill of relaxation makes the individual ready for the pressures that come to him as a result of internal or external factors that enable him to mobilize his physical, mental and emotional energies and allow him to reduce anxiety, tension and excessive excitement to the appropriate level.

This is consistent with the study of Ayman Najmuddin Abbas et al. (2018) that relaxation exercises contribute to the hormonal regulation of both hormones (triiodothyronine T3, thyroxine T4, ACTH, cortisol, serotonin, and TSH) Increasing it to meet the requirements of completion immediately before the start of the competition, as well as contributing to the regulation of blood sugar and reducing it before the competition, as well as reducing the time for completion, especially in events that require high speed.

1.3.2. Discuss the results related to the level of performance of the straight rear air circulation skill:

Table 7. *Shows the "T" test to indicate the differences in measurements between the experimental group and the control group in the level of skill performance of the ground movements under study (n=10)*

T	Skills variables	Unit of measurement	control group		Experimental group		T value	Statistical significance
			A	Σ	A	σ		
3	back somersault straight	Scale	4.90	0.42	5.70	0.52	-8.34	0.01

From Table 7. it is clear that there are statistically significant differences at the significance level ($\alpha \leq 0.05$) in the measurements between the experimental and control groups and in favor of the experimental group in the performance level of the back somersault straight.

The researchers attribute these differences to the effectiveness of the skillful relaxation exercises, which helped the players reduce the level of physical and cognitive anxiety, adjust the level of emotional arousal, and strengthen self-confidence. This has helped to quickly learn and gain the skill of back somersault straight.

Hassan Allawi (2002) pointed out that the ability to relax muscles plays an important role in the speed of performance, as it is known that muscle tension, especially for antimuscles, is one of the factors that hinder the speed of motor performance and the slowness and lack of mastery of the player for the correct way of performing the movement and to the high degree of excitement and emotional tension.

This is consistent with the study of Suleiman Akla, Thamer Mahmoud (2010) that relaxation exercises are highly effective in reducing the anxiety levels of players, controlling their emotions before, during, or after training and competition, and contributing to delaying the emergence of muscle or mental fatigue and the speed of recovery from physical and mental effort. The ability to adjust the level of emotional stimulation also has a positive impact on motor skills, especially those that require some kind of compatibility, accuracy and concentration, as well as contributing to reducing tired physical repetitions and saving time and effort.

Conclusion

Considering the objectives of the research and the assumptions and conclusion of what resulted from the statistical treatment, it was possible to reach the following conclusions:

The proposed training program for cascade relaxation has actively and positively contributed to:

- Reduce muscle tension levels in the experimental group.
- Good control of the muscular system.
- Isolate non-performance stimuli and reach the highest concentration of attention.
- Developing the performance level of the individual back somersault

Based on the results of the research, the following suggestions can be made:

- The need to combine relaxation training with skills training in order to achieve the best results physically and skillfully.
- Raising the awareness of those in charge of the training process and preparing athletes on the importance of mental skills (relaxation) and their effective role in the rapid acquisition and mastery of motor skills.

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The Relationship Balance of Hand Grip Strength and Body Balance to Archry Ability

Heru Prasetyo[1], Siswantoyo[1], Yudik Prasetyo[1], Susanto[2]
[1]Sports Science Study Program, Faculty of Sports, Yogyakarta State University, Yogyakarta, Indonesia
[2]State Islamic University Sayyid Ali Rahmatullah Tulungagung, Tulungagung, Indonesia

Correspondence:
Heru Prasetyo, Sports Science Study Program, Faculty of Sports, Yogyakarta State University,Yogyakarta, Indonesia
heruprasetyo.2020@student.uny.ac.id

Abstract: *Archery is a static sport that requires good physical strength. This physical strength can affect the achievement of an archery athlete. Physical strength includes hand grip strength and body balance. One way to measure grip strength is to use a handgrip dynamometer. Meanwhile, to measure the balance of the body can use the stock body balance test. Then the sample did a test shooting of 36 arrows with a shooting range of 15 meters. This study was to determine the relationship between hand grip strength and body balance with the ability to shoot archery at a distance of 15 meters. This research is a descriptive-analytic study with a cross-sectional design. The research was conducted at the Archery Training Center, Sleman Regency, Yogyakarta Special Region, Indonesia. The population sample is 60 people aged 12-13 years consisting of 34 boys and 26 girls. The data obtained was then tested for Pearson product-moment correlation and multiple regression correlation tests using the Statistical Product and Service Solutions (SPSS) application version 26. The SPSS analysis test showed that there was a significant relationship between grip strength and archery skills at a distance of 15 meters with a significance value of p = 0.000 (p <0.05) with a correlation coefficient of 0.446. Body balance is also related to archery skills at a distance of 15 meters with a significance value of p=0.043 (p<0.05) with a correlation coefficient of 0.262. Meanwhile, in the multiple correlation test, the results obtained were p = 0.001 (p <0.05) with a correlation coefficient of 0.480. Based on the results and discussion above, it can be concluded that there is a relationship between hand grip strength, body balance, and archery skills at a distance of 15 meters in junior archery athletes in Sleman Indonesia.*
Keywords: *Strength, grip, balance, Archery.*

Introduction

Archery is currently being developed in various provinces in Indonesia (Huang et al., 2022). This sport is no longer foreign to the community, the many archery sports clubs, extracurricular activities and Student Education and Training Centers in Indonesia are a form of archery sports people's efforts to popularize as well as find and nurture talented prospective athletes who are expected to be able to reach a high level. internationally through planned training programs (Brightwell et al., 2022). The development of archery is increasingly being felt, what is clear is that before archery found its form as an archery sport as it is known today, archery had gone through a long period of growth (Gibson et al., 2022). Based on different roles, archery was originally used by humans as a tool to defend themselves from dangerous attacks by wild animals, as a tool for finding food, as a tool for hunting, then used for weapons of war and then as a sporting tool both as a recreational sport. or achievements

Archery as we know is a sport that must be trained continuously. This is in accordance with the goals of physical education, with physical exercise in addition to getting fitness it can also improve character (Susanto et al., 2022). As a sport that is quite popular in Indonesia, archery has a quite varied scope, starting from archery as a sport of achievement and recreation. The ability level of athletes from beginner or junior to master level is also a division in archery. The division of archery classes based on ability level will certainly affect the pattern of training performed. In general, the division of classes based on this ability can be seen from the age of the athletes or how long they have been pursuing archery. Decheline (2020) argues that each division or class in archery has a different target distance and size. To improve the ability and strength of an athlete, physical training is needed, especially how an athlete can grip a bow properly. He explained that the exercise could be done with bow training. Bow training is done by asking the athlete to draw the bow in the right and proper position without arrows, and stay in the anchor position for at least 15 seconds. Then return the string to its original position, and do the same movement over and over again. Give rest breaks between each movement so that the body is not too tense so that the benefits of bow training exercises can be achieved.

Archery is a static sport that requires good physical fitness, especially in the upper body muscles, as well as strength and endurance (Kuswahyudi et al., 2021). Isotonic contractions occur when performing archery techniques while pulling the bowstring (Verawati et al., 2020). The fingers of the bowstring arm must touch the chin, the fingers must be tucked under the chin (brace), and the bow arm, as well as the pulling arm, must be fully locked to achieve an isometric contraction. Thus in archery, the muscles in charge of pulling the bowstring must receive special attention because they work extra hard in pulling and holding the weight of the bowstring which is quite heavy and repetitive in a series of archery movements (Jembatan, 2003). As a result, these muscles must have the strength and endurance to pull the bowstring while maintaining the consistency of the axis of motion (Putra et al., 2022). Shoulders, finger pull muscles, forearm muscles, hand muscles, back muscles, and trunk muscles are the main muscles that must be developed in archery. (Simsek et al., 2018). Apart from that, additional exercises such as circuit physical training are quite effective in improving the athlete's physique (Susanto et al., 2021).

Aspects of body balance play a role in the success of archery activities (Han et al., 2015). The ability to maintain body balance in various positions, the ability to maintain the center of gravity on a pedestal, especially in an upright position and maintain balance in a moving position, as well as the ability to maintain balance when shooting is very much needed by an archer, especially when aiming at targets and releasing a bow (Sarro et al., 2021)). The process of releasing arrows also requires a static balance that must be maintained during the shooting process. Good balance and, according to biomechanics, less effort from the muscles involved in the movement can allow the archer to perform good technique and less effort from the muscles involved in the movement (Chiu, 2018). Anatomy and mechanics of motion are all important in proper archery technique, with the axis of motion being the most important. The axis of motion I and the axis of motion II are the precise and correct axis of motion in archery (Taha et al., 2016). The attitude of the bow holding arm must be in a straight line, and the axis of motion is the attitude of the shoulders. The position of the arrow is the axis of motion II, and the pulling arm must be in a straight line (Taha, Muazu Musa, et al., 2017). Archery is also a precision sport that requires accuracy and consistency (Sarro et al., 2021). For each arrow fired, the archer must be able to perform the correct action. Based on the description above, the motion of archery involves anatomical aspects, especially in the structure of the bow handler's arm which must be straight, and the bowstring pulling fingers which must be strong to withstand the bowstring pull. The bow pulling fingers must receive more attention because when holding the bowstring, the fingers must be strong and not tense. This will be very influential when the archer is released (Sirufo et al., 2020).

Based on the results of observations on junior archery athletes in Sleman Regency, Special Region of Yogyakarta, the results of archery accuracy by club members varied greatly. Common mistakes that are often made by archers related to archery techniques, namely: a) the pulling elbow is too high above the arrow line, b) the front and back shoulders are too high, c) the hands or fingers are too much in the bow, d) the chest is puffed out, e) bowstring touches the center of the chin, f) body weight is placed on the heel, g) no set up position, h) pulls do not reach the holding position, i) bowstring touches the center of the chin during anchoring, j) pulls continuously with does not reach the holding position, k) shoots too quickly and loses connection with the back muscles.

In addition to the above, another problem is the athlete's lack of balance when shooting, so that the bow wobbles due to working extra hard in pulling and holding the weight of the bowstring which is quite heavy and repeated in a series of archery movements when shooting and resulting in an inaccurate target. The latest data from the archery accuracy test by shooting 36 times the average score obtained is 210. This result is still far from the overall score of 360. In the sport of archery, the results of performance and achievement can be seen in the achievement of the score, namely the number of arrows hit on the target face or target target (Sax van der Weyden et al., 2022). So it can be concluded that accuracy in archery is closely related to the strength of the fingers which function as a bowstring puller and body balance. So there is a problem of how significant the relationship between grip strength and body balance with the ability to shoot 15 meters arrows in junior archery athletes in Sleman Regency, Special Region of Yogyakarta.

Metode

This research is a descriptive study with a cross sectional design. The purpose of this study was to determine the relationship between grip strength, body balance, and archery skills at a distance of 15 meters in junior archery athletes in Sleman Regency, Special Region of Yogyakarta. This research was conducted at the Sleman Regency ar-

chery field in January 2022. The population used in this study were Sleman Regency archery athletes, the sample size of this study was 60 Sleman Regency junior archery athletes using the purposive sampling method and the following criteria: 1) active as archery athletes in Sleman Regency, 2) Physically and mentally healthy, 3) 12-13 years old, 4) Willing to take the test, 5) Have shot at 15 meters.

The independent variables are grip strength and body balance, and the dependent variable is the skill level of archery at a distance of 15 meters. Body balance was measured using the stork balance stand test (Castillo-Rodríguez et al., 2020). Grip strength was measured using a hand grip strength tool (Innes, 1999). Shooting 36 arrows at a target face with a diameter of 80 cm is used to determine the level of archery skill. A score of 1-10 will be awarded for each shooting opportunity. Using the application (SPSS) version 26, the data is then tested with the Pearson product-moment test and multiple correlation tests. The following is a hand grip strength test described in table 1.

Table 1. *Level of grip strength*

Category	Level of grip strength	
	Male	Female
Not enough	< 19.4	>49
Enough	19.4 – 31.2	44-48
Good	>32.2	35-43

After testing the grip strength, proceed with testing the balance speed described in table 2.

Table 2. *Balance test rate*

Speed	Score (secod)
Not enough	<10
Enough	10-24
Average	25-39
Good	40-50
Very good	>50

Results

The results showed that there was a significant relationship between grip strength and body balance with the ability to shoot 15 meters arrows in junior archery athletes in Sleman Regency, Special Region of Yogyakarta. Of the 60 respondents, there were 34 (57%) male respondents and 26 (43%) female respondents according to table 3 below.

Table 3. *Gender Characteristics*

Gender	Frequency	Percentage (%)
Male	34	57
Female	26	43
Total	60	100%

Respondents with a total of 60 people, divided into 34 male respondents and 26 female respondents. In the male respondents, there were 30 respondents with a weak grip strength level and 4 respondents with a normal grip strength level. For female respondents, there were 16 respondents with a weak grip strength level, 8 respondents with a normal grip strength level, 2 respondents with a strong grip strength level. The following describes the characteristics of the level of grip strength in table 4.

Table 4. *Grip Strength Level Characteristics*

Category	Male		Female	
	Frequency	%	Frequency	%
Not enough	30	88	16	61
Enough	4	12	8	31
Good	0	0	2	8
Total	34	100%	26	100%

Respondents with a total of 60 people were divided into 34 male respondents and 26 female respondents. For male respondents, there were 30 respondents with less grip strength and 4 respondents with sufficient grip strength. For female respondents, there were 16 respondents with less grip strength, 8 respondents with sufficient grip strength, 2 respondents with strong grip strength, described in table 5.

Table 5. *Characteristics of respondents at the balance test level*

Category	Male		Female	
	Frequency	%	Frequency	%
Very less	11	88	3	11%
Not enough	15	12	8	32%
Pretty good	5	0	4	15%
Good	0	0	4	15%
Very good	3	0	7	27%
Total	34	100%	20	100%

Respondents were divided into 34 male respondents and 26 female respondents. For male respondents, there were 5 respondents who received a score of 171-210, 9 respondents who received a score of 211-240, 6 respondents who received a score of 241-270, 3 respondents who received a score of 271-300, 8 respondents who received a score of 301-330 and 4 respondents who received a score 331-360. For female respondents, there were 2 respondents with a score of 171-210, 5 respondents with a score of 211-240, 6 respondents with a score of 241-270, 1 respondent with a score of 271-300, 7 respondents with a score of 301-330 and 5 respondents with a score of 331- 360. The following are the characteristics of the respondent's score in table 6.

Table 6. *Score Characteristics of Respondents Shoot 15 Meters*

Interval Score	Male		Female	
	Frequency	%	Frequency	%
171-210	5	15	2	8
211-240	9	26	5	19
241-270	6	17	6	23
271-300	3	8	1	4
301-330	8	23	7	27
331-360	4	11	5	19
Total	34	100%	20	100%

The SPSS analysis test showed that there was a significant relationship between hand grip strength and archery skills at a distance of 15 meters with a significance value of p = 0.000 (p <0.05) with a correlation coefficient of 0.446. Based on the correlation value, there is a moderate correlation between grip strength and archery skills at a distance of 15 meters. Body balance is also related to archery skills at a distance of 15 meters with a significance value of p=0.043 (p<0.05) with a correlation coefficient of 0.262. Based on the correlation value, there is a moderate correlation between body balance and archery skills at a distance of 15 meters. Meanwhile, in the multiple correlation test, the results obtained were p = 0.001 (p <0.05) with a correlation coefficient of 0.480. Based on the correlation value,

Table 7. *Test analysis of hand grip strength, body balance, and 15 meter archery*

Variable	R Value	P Value	Conclusion
Hold & Shoot	0.446	0.000	Important
Body Balance & Shooting	0.262	0.043	Important
Handgrip, Body Balance & Shooting	0.480	0.002	Important

Discussion

To provide a good archery technique requires coordination, arm muscle endurance, grip strength, flexibility, pull length, arm length, and balance. Good sport and good physical condition in the long run are needed to support the dominant factors in archery. The physical condition referred to here is that archers not only have great muscle strength but also have good muscle endurance, so that the athlete's performance is not only good at the start of the match but also remains consistent throughout the match. (Kuswahyudi et al., 2021). Several factors such as physical, technical, and mental affect an athlete's performance when competing in archery competitions. Visual coordination (accuracy), sense of movement (feeling/kinesthetic senses), and arm strength are important factors that need attention (Kuswahyudi, 2018). Accuracy is closely related to the muscle strength of the fingers which function as a bowstring puller (Tian et al., 2022).

Archery is a relatively static sport that requires upper body strength and endurance, especially in the forearms and shoulder girdle (Taha, Haque, et al., 2017). Shooting movements will be more efficient if the bow arm is straight when shooting, meaning that the energy expended when holding it will be well coordinated (Dan et al., 2016) (Taman, 2013). Archery comparatively demands very specific strength and endurance for successful shooting and repeated performance, both during training and competition. Compared to other strength or endurance events, it does not require very much effort in terms of body balance (Açıkada et al., 2019). In this study, balance is significantly related to archery skills. This is because balanced archery is needed. When doing archery, an athlete must be able to hold his body while aiming at the arrow (Ahmad et al., 2014). So, body balance in archery is of course the main reference for basic archery techniques (Dan et al., 2016).

Good balance, athletes will have the skills to maintain an attitude to maintain the desired body posture (Vendrame et al., 2021). Balance, namely the ability to maintain body balance when placed in various positions, the ability to maintain the center of gravity in the fulcrum, especially when in an upright position and maintain balance when in a moving position, balance when shooting is needed by an archer, especially when aiming at targets and releasing the bow. in the release process (release of arrows) the balance must be maintained while in a state of shooting (Huang et al., 2022). To get a good technique, archers must train their balance according to biomechanical guidelines so that they don't expend a lot of wasted energy. So that the correct posture greatly influences the holding and aiming techniques, so that the realise technique can also be done correctly. Body posture when doing this technique must also be considered so that the body does not lean to the left or to the other side, so that when aiming (aiming) can focus on the intended target.

In addition to balance, the arms play an important role in determining accuracy because arm muscle strength and hand grip strength are very important in the archer's ability to direct arrows to certain targets. (Sezer, 2017). Significant correlation analysis tests confirm this. An archer's movements will be consistent and stable during practice and competition if they have good arm strength and grip. Success in archery is influenced by several factors including physical condition and mobility (Humaid, 2014).

Archery requires athletes to perform repetitive movements with a high level of precision and accuracy. Savvides (2020) said that the physiological patterns produced in archery are not the same as other sports that are dominant in aerobic or anaerobic abilities. The position taken when shooting is that one hand is used to hold (push) the bow in a definite position, while the other hand pulls the bowstring to the position of the base of the thumb of the hand used to pull the bowstring to touch the chin. Movements performed from set up to release have a very important role in the quality of an archery athlete's shot. Improving physical and technical abilities to achieve maximum archery performance certainly cannot be achieved with just one or two practice sessions. However, there is a need for formation that is carried out consistently and progressively which is carried out regularly.

Proper archery technique requires a balance between the role of the upper body as a thrower, and the lower body as a pedestal. Some aspects that need to be improved on the archer's upper body include the strength of the hand grip when gripping and pushing the handle, with a strong front arm so it doesn't sway easily, and back arm strength to do the right drawing and release. Wu (2022) argues that an archer's feet must be stable. Leg strength which includes the ability to walk at high intensity, the ability to support the body and absorb shocks is needed to be able to perform optimally in archery. It is not uncommon for athletes to feel tired when they have to stand for quite a long time, coupled with the journey when taking arrows and returning to the shooting line which also requires strong leg muscle endurance.

There are several kinds of exercises that can be done to strengthen the leg muscles of an archer. One of them is balance training. Nakonechnyi (2022), said that leg strengthening exercises that can be done to improve archer strength and balance are jumping with a skipping rope, bending the knees until they touch the chest in a standing position, jumping as far as possible, 30 meter sprint, 4x9 shuttle run meters by stopping and touching the line, and standing unaided when seated. Shin (2020) added that core muscle strength greatly influences the performance of various sports such as surfing, shooting, and including archery. Core muscle strength which affects the athlete's balance when standing for a long time, can be improved through the following exercises, namely plank, bracing maneuver, bridge, quadruped bird dog, and modified curl-up. To increase the hand grip strength used by archery athletes in gripping a bow, Wilk (2019) provides examples of several athlete grip strengthening exercises, one of which is by doing bench press exercises using an adjusted weight. There are two types of grip positions in the bench press exercise to get the most out of the exercise. The first is the wide-grip bench press where the position of the hands is wide apart when doing the bench press, and the second is the close-grip bench press where the position of the hands is more closed. These two movements can train several parts of the muscles at once apart from hand grips. Some of them are the chest, back, shoulders and abdomen.

In some cases, it may need to be adjusted according to the age of the athlete's development. If the athlete is still developing, it is better if the coach emphasizes weight training using their own weight or better known as bodyweight workouts. Pull ups are an alternative that can be done by athletes to increase grip strength and increase muscle mass, especially in the arms. Pull ups implement an exercise system using one's body weight by depending on the bar, and lifting the body so that the head is able to go beyond the bar. Sánchez-Moreno (2020) says that pull ups can be used to train several parts of the upper body, which can also be used as a measure of muscle strength against body weight. Pull up exercises are also very common in various sports that focus on upper body strength such as rowing, climbing, and archery is no exception.

The ability to grip the hand or hand grip cannot be mastered with just one or two exercises. There needs to be consistency and perseverance in training if an athlete wants to maximize his potential. According to an explanation from Mangolo (2020), physical exercise both with and without tools that can increase grip strength will be very beneficial in various sports activities. Good training, of course, must have increased results with assistance that is based on scientific theory and training principles that are correct and appropriate. Without regular training, it will be very difficult for athletes to achieve the achievements they expect. The hand grip strength training program covers all the joints in the hand, such as the joints in the fingers, thumbs and wrists. Although an athlete's grip strength can also be influenced by several factors such as age, body size, and gender, that does not mean that this ability cannot be maximized by athletes. Alshdokhi (2020) said that based on the research he conducted, regular grip strengthening exercises carried out for 8 weeks would have a very good impact on an athlete's grip strength. In addition, he also added that there are 35 muscles that develop when doing grip strength training which is composed of various types of hand muscle groups and the forearm.

Leelanoi (2021) mentions several exercise programs that can be carried out by athletes on a regular basis to increase muscle strength in archery, both for the upper body, core, and lower body muscles. You can train your upper body muscles by doing movements such as barbell bench press, barbell row, barbell shrugs, seated dumbbell shoulder press, standing barbell curls, and close-grip barbell bench press. Whereas core or core muscle exercises can be done with crunch movements, while to train the lower body muscles, several exercises that can be done are barbell squats, seated leg curls, and barbell standing calf raises.

Barbell bench press can be done with the body lying on a long bench, and pushing the barbell parallel to the chest. The position of the hands gripping the bar with the width adjusted. Do this movement for 4 sets of 12 repetitions. The next movement is the barbell row, Pisz (2022) says that the barbell row is done by standing in a half-squat position, and the hands are straight below while holding the barbell. Then, lift the barbell by pulling it up to your chest. Perform this movement for 4 sets of 12 repetitions. Meanwhile the movement to increase upper body strength is by doing barbell shrugs. Meechan (2020) explains that barbell shrug is done by standing upright while holding the barbell with your hands straight down, then lifting the barbell by lifting both shoulders simultaneously, then returning to its original position. This movement can be done 4 sets of 12 repetitions.

Apart from the three movements above, another upper body strengthening exercise program for archery athletes is seated dumbbell shoulder press. This exercise can be applied in a way, the athlete sits upright on a bench, while lifting two dumbbells in both hands and positioning them parallel to the shoulders. Then, lift both dumbbells simultaneously until your hands are straight up, then return to their original position. Like the previous exercise, this exercise can also be done for 4 sets of 12 repetitions. Boutros (2022) also adds that this exercise doesn't have to be done with heavy weights, but can be adjusted to the abilities of each athlete, you can use dumbbells or use a bottle filled with sand or water. Standing barbell curls are no less important for building the upper body muscles of an athlete. Perform this movement by standing straight while lifting the barbell with the hand pointing down. Then, lift the barbell by bending both hands closer to the shoulders, then lower both hands but not to the bottom, only half then do the previous movement again. Repeat this movement for 4 sets of 12 reps. The final movement that can train the athlete's upper body muscles is the closed-grip barbell bench press. This movement has been explained previously where the athlete needs to lie down on a bench, while holding the barbell above it with a position that is not too wide between the hands. Then, lower the barbell from the safety until it reaches the chest, then the barbell will position the hands straight ahead, and return to its original position.

The six movements that can be done to build upper body strength can be applied according to the athlete's ability level and condition. The more often you do measurable and structured physical exercise, the more optimal the results you will get. Archery, which tends to take advantage of the stability of the body from the top to the bottom, shows that the strength of each part of the athlete's body greatly influences the quality of his archery. If the movements of the upper body muscle exercises have been explained, then next is how to strengthen the core muscles of the body or we often know them as the core. This core muscle functions to maintain the stability of an athlete's body because it is the center of the body or the support between the upper body and lower body. Having strong core muscles can also support daily activities such as walking, running, or even just standing for long periods of time (Park, 2022).

One of the ways athletes can do to increase core muscle strength is by regularly doing abdominal crunches, which at first glance look like sit-ups, but differ in form. If sit ups place more emphasis on the ability to lift the body so that it can touch the knees, while crunches place more emphasis on the grip of the abdominal muscles during the movement. Crunches are done by lying on the floor or a flat surface while bending your knees. Then lean your hands forward while lifting your body but concentrate your strength on your stomach. Feel the abdominal muscles tighten as the body leans forward, when it is maximal, return to its original position and repeat the movement.

Feet are also the main foundation in archery. Exercising leg strength is just as important as any other part of the body. To be able to increase leg muscle strength, athletes can perform several movements such as barbell squats, seated leg curls, and barbell standing calf raises. Based on the explanation from Case (2020), the multi-joint movements contained in the barbell squat exercise can be used to assess the strength of the leg muscles such as the ability to perform dynamic movements, balance and strength. This movement is done by positioning the barbell on the shoulder, with a squatting body position. Then stand up straight with the barbell position still on your shoulders, after perfect squatting again and do this movement repeatedly.

Meanwhile, seated leg curls can be applied using special tools available at a fitness center or fitness center. The movement is carried out by the athlete sitting on a leg curls bench, and placing his feet on the lower cushion provided. Perform movements such as kicking both legs until they are parallel to the thighs for 4 sets of 12 repetitions with adjusted weight. The last is the barbell standing calf raises movement, which is a movement by positioning the body standing upright while carrying the barbell on the shoulders. Then do the tiptoes for a few reps. If athletes get used to exercise movements that can support their abilities in archery, the results they will get will certainly be maximized.

To achieve ideal results, aspects that support these achievements must be pursued. These two factors are quite prominent, according to our observations in the field and the results of coaching archery athletes at the regional and national levels. Because of the large pushing and pulling forces that must be carried out continuously by the arm muscles, arm muscle endurance is needed in archery (Prasetyo, 2011). The upper arm thrust can also be trained through water media, such as swimming activities (Susanto et al., 2020). The standing position and stability of the athlete's stroke will be greatly influenced by his body balance (Sattlecker et al., 2014). Multiple correlation tests showed that the two parameters were significantly related to the skills and abilities of junior athletes at a distance of 15 meters.

Conclusion

Based on the results of the discussion above, it can be said that there is a relationship between hand strength, body balance, and 15 meter archery skills in junior archery athletes in Sleman Regency, Indonesia. Researchers suggest archery coaches and athletes increase hand strength and improve balance through several exercises. This is necessary to improve the achievements of junior archery athletes. A physical training program to improve body strength and balance for junior archery athletes needs to be carried out regularly, measurably and systematically. In addition, the variations of the exercises used are also adapted to the motor needs of archers by using body weight training (their own body weight) so that their body growth does not experience problems.

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Conflict of Interest
The authors declare that there are no conflicts of interest.

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The relationship of certain values of angular difference and angular velocity to rotational steps in triple jump with numerical implementation

Djedid Abderrahmane, Bitar Hichem, Idris Khodja Mohamed Reda
Institute of Physical Education and Sports, University of Abdelhamid Ibn Badis, Mostaganem, Algeria

Correspondence:
Bitar Hichem, Institute of Physical Education and Sports, University of Abdelhamid Ibn Badis, Mostaganem, Algeria
hichem.bitar@univ-mosta.dz

Abstract: *The kinematic analysis is used to accurately determine the performance level of the players' movements and athletic abilities, which allows the values of the kinematic variables to be extracted and compared with the typical kinematic variables to know the strengths and weaknesses of the players' performance and contribute to change the performance for the better, as our research aimed to investigate the relationship between the values of the time variable The angular velocity of the pivot phases in triple jump and the level of digital performance.*
We used a descriptive research based on the method of motion analysis using kinematography, and the research sample consisted of Four (04) national champions in triple jump, who were deliberately selected. After analyzing and discussing the results, we came to the following conclusions, There is a significant correlation between the angle difference in hop push and performance (R=-0.982) . And a existence of significant correlation between angular velocity and performance only in step (R =0.979) and jump (R=0.981) because angular velocity is the result of angular difference divided by time, so the greater the angular difference with stability or lack of time, the greater the angular velocity.
Keywords: *Angular difference, angular velocity, rotational phases, triple jump, Digital Achievement Level.*

Introduction

The activities of the arena and athletics games are diverse in the performance in athletics, as they have great muscular ability, including the triple jump event, which is one of the jumping games, as it is the focus of attention of spectators, experts, practitioners and specialists in this field, and it depends The success of the athlete in the triple jump depends on the mastery of the technical performance of him, which depends on the proper planning in training. (Hay, 1992)

The trio (Suleiman Saad, Nafeh Al-Dulaimi and Fadel Muhammadon) this basis biomechanics appeared in the modern era as one of the sciences that shows and explains to us the errors and problems faced by the athlete in the performance, whether in the approximate run in terms of the speed of the run or its slowness, as well as the length of the step or its brevity, (Guebli, 2018) shows the problem lats that the sweater faces in the jump phase, such as hop-scotch, step and jump, and show errors in them in terms of the angle of flight for performance, height of flight, flight speed and other body positions. Therefore, biomechanics is the science that provides the proper foundation for the coach and the athlete when it comes to performance issues. It revolves around them and their relationship with the mathematical performance of the various movements.In this regard, both to the fact that achieving objectivity in the study of human movement is very difficult due to the complexity and overlap of factors that affect performance, and the difference in movement patterns and their enumeration(King & Yeadon, 2015) , so the movement analysis allows the individual athlete to control the performance The technician has it well and truly away from the eye of the naked eye, using scientific and technical means for the purpose of analyzing the movement of the athlete for each action , A mathematical mechanism (King & Yeadon, 2015).

Through what has been presented and mentioned previously, we have identified the lack of studies in this area at the at the level of Algeria, , as the researchers identified his field of research in the study of pivot stages (hopscotch, Step and jump) in jumping The trio through the motor performance and its relationship to the digital level for the purpose of identifying what contributes to the development of high athletic performance, as well as the detection of errors and negatives, the technical and motor performance, which helps in the development process for coaches and athletes so that specialists can use it to accompany in this field.

Among the similar studies that deal with our subject:

Study by Samuel James Allen titled "Optimisation of performance in the triple jump using computer simulation". The purpose of this study was to develop a realistic computer simulation model of the triple jump in order to achieve optimal technique. A 13-segment, subject-specific computer simulation model of the triple jump with oscillating masses was developed. Torque generators were placed at each hip and shoulder knee, ankle, and ball joint. Kinematic and kinematic data of the triple jump were collected using a force plate and a Vicon motion analysis system. Features were measured with an iso-accelerometer dynamometer, torque-angle and torque-angle-velocity relationships were calculated, and the improved technique showed corresponding symmetrical shoulder flexion performed by elite athletes. Effects of increased force and neglect of angles Then, the swing constraints were examined. Turns out with increasing strength, performance improves, angular momentum constraints are essential for reproducing realistic renderings.

Study from BING YU titled "Conversion of Horizontal to Vertical Velocity in Triple Jump," The purpose of this study is to determine the effects of selected factors on the conversion of horizontal to vertical velocity in the triple jump. Ten top athletes were studied. for each athlete, 3D kinematic data were collected for at least four complete trials in the same competition. The loss in horizontal velocity and the gain in vertical velocity were calculated during each phase. The loss of horizontal velocity is a linear function of the increase in vertical velocity. The slope of this linear function, A1, is called the conversion coefficient from horizontal to vertical velocity. The loss of horizontal velocity increases with the increase in vertical velocity. The sensitivity of the loss of horizontal velocity to the increase in vertical velocity increased as A1 increased.

Stady of Lise Rioux-Lachaud titled Biomechanical approach to the triple jump. Using an evaluation system combining videographic tools with effort measurement tools, it becomes possible to mechanically analyze the behavior of an athlete during the execution of his movements. In this study, the sports discipline chosen is the triple jump. The support phases being decisive, we highlight for each of them, kinematic and kinetic variables relating to the overall behavior of the body. Studied together, these variables make it possible to understand the performance measured at the center of mass during the aerial phases. We also consider the influence of the different segments on the behavior of the body in the support phase as well as in the aerial phase, which makes it possible to detect any problems encountered by the athlete throughout his jump. Finally, we analyze other types of variables in order to better understand the jumping technique specific to each athlete.

Problematic

Due to the fact that these phases require a high level of physical and technical preparation, and with the aim of learning more about what happens to the athlete in these phases and identify the mechanical variables to pay attention to in order to improve and develop them,(S. Allen et al., 2016) through the use of modern scientific techniques, based on biomechanical-kinetic analysis, because it is important for both the coach and the athlete to save time and effort, and because it is a way to highlight common errors in performance and how to avoid them in order to achieve the ideal performance, i.e.i.e., the application of laws and fundamentals that help determine the best sport form for the motor performance of skills,(Ameti et al., 2022)as well as the mechanical reasons for success and failure in the execution of the movement, based on the fact that the biomechanical variables (angular difference and angular velocity) are a product of physical and skill preparation characterized by a special technique in which speed and power play an important role to achieve a better performance of this event, (Liu et al., 2015) and the competition that the sport is experiencing today to achieve record numbers A new world, but the numerical level of Algerian champions is still low compared to the international and Arab level, so he thought, that a researcher in this study should find the reasons for the low level of performance of Algerian masters through an analysis, to know the values of some variables of angular difference and angular velocity in relation to each of the disciplines (jump, step, jump) (Hay, 1992) and their relationship with performance in order to obtain accurate information about performance, identify weaknesses and strengths and increase the level of performance of Algerian masters in this activity based on a number of points, the most important of which are the level of performance, digital level, angular difference and angular velocity (P. Thotawaththa & Chandana, 2022). Therefore, the following question was raised:

- What is the relationship between the values of the variables angular difference, angular velocity and digital level of performance in triple jump?

The angular difference

It is the difference between the moment of touching down the supporting foot and the moment of leaving the climbing phase for the hop, the step and the jump. The corresponding figure shows this (Li et al., 2005).

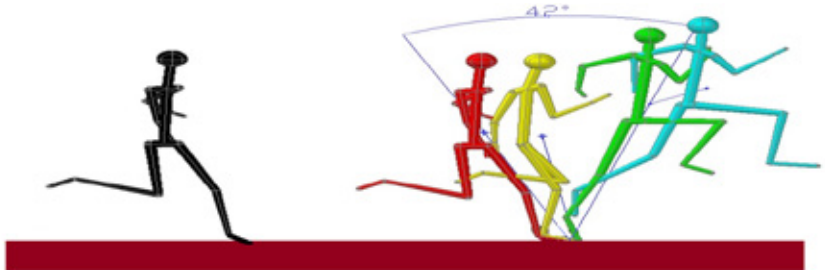

Figure 1. *Explane the phases for the hop, the step and the jump.*

Angular velocity

The angular velocity of the body for the phase (impact - absorption - push-off) of the hop, the step and the jump, by means of the angular difference divided by the time, between the moment when the ascending foot touches the ascending board (the impact phase) from one side and the moment of release (the end of the push-off phase).Velocity angle = angular difference/time (degrees/second).(Hay, 1992)

Triple jump: it is one of the jumping disciplines in athletics.

The pivot phases, the three phases of the triple jump, are as follows(Moura et al., 2022a)

Take-off: In this first phase, you lift off with the jumping leg to reach the greatest horizontal distance possible, and then land on the same jumping leg.(P. C. Thotawaththa & Chandana, 2022)

Step: In this phase, the leg with which the jump was performed is pushed onto the opposite leg and lands on it.

Jump: This is the final swing, the execution of which is similar to the long jump, with the push being executed with maximum forward force.

Digital Achievement Level: It is the result or the distance achieved by the athlete in the triple jump.

Methodes and protocole of research

Research methodology: based on the study, the descriptive approach was used as it is suitable for the type of study.

Research sample: some national champions in triple jump were selected.

Table 1. E*xplane result of sample in triple jump.*

The triple jump.	The research sample.				
	Jumper 1	Jumper 2	Jumper 3	Jumper 4	Jumper 5
Completion distance (m).	16.16	16.15	16.09	16.04	15.89

Research domains:

1 - Human domain: some of the (older) national champions.

2 - Spatial domain: the athletics complex on 05 July in Algiers.

3 - temporal domain:

* Filming phase January 05, 2022

* Video analysis phase from February to March 2022

Research tools:

The following methods were used: Measurement, test, personal interview and technical-scientific observation.

Measurement: The length was measured in centimeters with a tape measure and the mass in kilograms with an electronic scale

Test: The triple jump test was performed in accordance with the legal requirements, giving each player (3) attempts to determine the best of them, and with the help of the work team.

Programs used in research

Analysis is generally a means of breaking down the overall movement into parts and examining these parts in depth to reveal their subtleties (Al-Sumaidaie, 1987,91). After performing the video recording, the researcher converted the video films into CDs. Then, the student used the following programs, each according to its task:

A. Ifilm Idit v1.3: This program can be used to cut parts of the film into small pieces as desired.
B. Format Factory: this is one of the programs used to convert the quality of the movie from DAT to MPEG.
C. .Program Image Ready CS: This program can be used to cut the motion into single consecutive frames.
D. ACD See Manager : With this program, each of the cut images can be displayed, so that the researcher can determine the beginning and the end of the important parts to be analyzed.
E. Auto CAD 2007: it is a global program used in technical applications and corrections. The researcher benefited from this program in the extraction of the mother data for all distances, dimensions and heights, as well as in the extraction of the center of gravity of the body mass by Fisher's method for each image alone.

For extraction, I performed the following steps:

- Identify and select the image to measure its variables :
- Determine the anatomical points on the image and connect the points to obtain the stick figure of the imag.

Dimensional measurement will be measured by specifying the beginning and the end of the displacement, and by the instruction to be selected from the program, we get the measurement of the specified displacement, then the measured displacement is multiplied by the real displacement amount of the drawing scale (the value of the drawing scale (1) meter), we get the real displacement

F. Max Traq: It is one of the programs used in motion analysis to extract angles, distances and offsets and convert them from raw data to real data after converting and multiplying by a real scale.
G. Microsoft Office Excel 2007: it is one of the office programs, and the researcher benefited from this program in mathematically processing the raw data, extracting the center of gravity of the body mass for each image, and drawing the motor trajectories.
H. Microsoft Office Word 2007: it is one of the office programs, and the researcher benefited from this program to obtain the imaginary kinetic series of the jumpers.
I. Paint program: it is one of the programs of the operating system (Windows7) that the researcher used in modifying some of the drawings presented in the study.

The main experience

The main experiment was conducted on January 05, 2022 at ten of the clock in the extension of July 05, 1962 in Algiers, on jumpers and in the presence of the team of assistants.

(06) Trials were filmed for each player, according to international law, for the effectiveness of the triple jump. The best trial was selected according to the performance for the analysis of the movement with a drawing scale of 1 cm in length at each camera location, as shown in Figure No. (17), to convert the dimensions of the image to reality or the distance of the cameras from the field of action as follows:

Camera No. (01): It is 12 m away from the area of the approximate run, at a height of (0.60), to cover the camera beam for the last three steps of the approximate run, as well as the area of ascent, flight and landing of the inflatable.

Camera #(02): The same distance and height to cover the area of the ascent, flight and descent of the step stage as well as the ascent, flight and descent of the jump stage

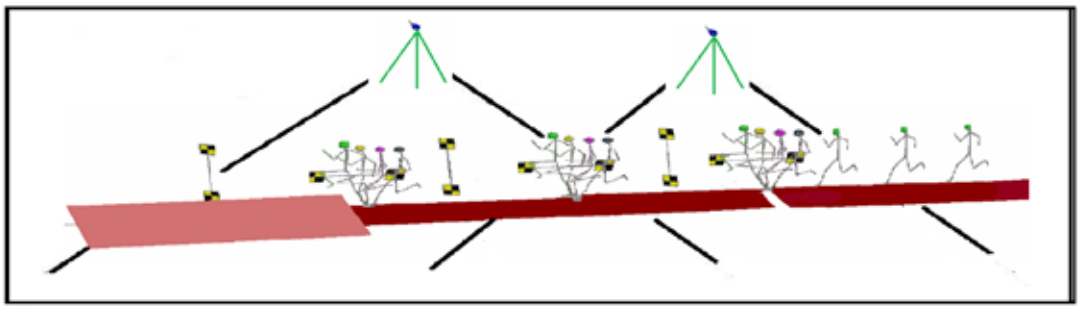

Figure 2. *Explane Stages of the triple jump*

Control of variables

- The homogeneity of the sample in terms of height and weight.
- The best triple jump trial was selected from (06) actual trials of the jumpers.
- Direct monitoring of the completion of the photographs with the help of the working team (specialists in photography).
- Dimensions were determined using a measuring board in the photograph for a distance of 1 m and using guide marks to accurately determine angles and dimensions.

Results

Presentation and discussion of the values of the variables angular difference and angular velocity of the progress stages of the research sample. It shows the arithmetic mean, standard deviations, correlation coefficients with performance and likelihood ratio in the values of the variables of angular difference and angular velocity of the progress stages of the research sample.

Table 2. *Explane the results of correlation coefficient*

Angular velocityfor phases getting up					
Phases	**Variants**	**Mean**	**Standard Deviation**	**Value (r) Calculated**	**Probability**
Hopscotch	Angular difference(degrees).	58.075	5.262	*-0.982	0.030
	Time (Sec).	0.175	0.019	-0.582	0.418
	Angular velocity(degrees/sec).	329.68	26.543	-0.101	0.899
Step	Angular difference(degrees).	51.790	2.272	0.626	0.374
	Time (Sec).	0.180	0.022	0.356	0.644
	Angular velocity(degrees/sec).	289.08	35.063	*0.979	0.025
Jump	Angular difference(degrees).	51	2.582	-0.637	0.363
	Time (Sec).	0.190	0.026	0.185	0.815
	Angular velocity(degrees/sec).	272.98	40.437	*0.981	0.032

(*) Significant at an error rate of ³ 0.05 and in front of a degree of freedom (2) the tabular value of (R) is (0.950).

From the table, it can be seen that there is a significant correlation in the variables (angular velocity) for the steps, the stride and the jump, except for the successful hopping, as the calculated (r) value reaches (0.979) and (0.981), respectively, which is greater than the tabulated (r) value at the significance level (0.05) and amounts to (0.950). As for the variables of angle difference, there was a significant difference with success only in the hop cake phase, because the estimated (r) of (-0.982) was calculated, which is greater than the table value (0.950), then, that there was no significant correlation with the achievement of the step and jump because the values of (ranged t) were calculated between (0.626, 0.637) - which is lower than the table value of (r) at the significance level (0.05), which is (0.950).

Discussion

Through the above table, it is clear that there is a significant correlation between angular difference only in hopping and conversion, and there is a significant correlation between angular velocity and conversion only in walking and jumping(Moura et al., 2022b).

Stability or lack of time increases the angular velocity, moreover, the reason for angular velocity is also related to the front and rear support angles, which form the angular difference according to the following equation: Angular velocity = angular difference / time(Fong et al., 2014), and since time was constant in all phases of the rise of the triple jump, which led to the emergence of such a relationship, since time is inversely proportional to angular velocity, so the longer the time, the lower the angular velocity and vice versa.(Fong et al., 2014)

The researcher attributes this to the absorption of shock on impact with the ground with a loss of horizontal velocity. So flying refers to a "flight angle of the important mechanical factors", (YU, 1999) the trajectory of the weight of the jumper, and this angle is determined by relating the horizontal velocity achieved to the trajectory of the horizontal velocity. And that the loss of horizontal velocity between the approaching run and the increase of the jumped steps is the smallest that can be compared with the rest of the steps, because the jumper wants to maintain the maximum angular distance to continue the technical performance of the sky jump, therefore, the vertical height of the body is as low as possible to maintain the horizontal speed, because the horizontal speed is inversely proportional to the vertical height of the centre of gravity of the body mass, and the angles of the knee, hip, boot and ankle are less bent than in the rest of the steps, and the jumper sets unlike the long jump, in the triple jump the jumper places his leg on the board, often rising with the front foot.(Rioux-Lachaud, 2000)

As in the step, the jumper reduces the angle of flight to maintain horizontal velocity as much as possible, and the appropriate height of the body's centre of gravity to achieve a reasonable horizontal distance.In addition, this step is one of the most difficult steps for the jumper because the ascending leg is the same leg that was lifted in the step pursuit step, which is indicated by allen "The reason for the short distance of the step compared to the other steps is due to the fact that it is performed under difficult and complex conditions, since the ascending foot has performed an ascent and landing after a rather long flight process during the step pursuit process (S. J. Allen, 2010)" In addition, the angles of the knee and ankle of the ascending leg are strongly bent, and the landing of the foot on the ground is done with the heel or the whole foot, which requires more time, so the loss of angular velocity is greater, and in the takeoff, the jumper increases the angle of flight more than in the steps of the pursuit step and the stride to reach a reasonable height, to compensate for the loss of angular velocity in the previous steps, and the time in this step is greater than the rest of the steps, also because of the bending that occurs in the corners of the body, especially the knees and ankles, and the precipitation of the torso forward, resulting in a significant time that leads to a lack of increase in horizontal speed and angular velocity.(S. Allen et al., 2016; Hay, 1992; Hussain et al., 2022; Rioux-Lachaud, 2000; YU, 1999)

Conclusion

The presence of a significant correlation between the angular deviation at the sky command and the realization, and the presence of a significant correlation between the angular velocity and the realization at the step and at the jump. Angular velocity.(Allen et al., 2016; Hussain et al., 2022; Liu et al., 2015(

Although there is a statistically significant correlation in terms of cinematic analysis, it needs to be deepened in kinematic aspects, as the biomechanical analysis of triple jump sports has many connections and plays an important role in the development of this sport.

Our research was concerned with the analysis of the technical phases of the triple jump, so it was necessary to study other physiological, physical and psychological aspects in order to obtain a good numerical performance and to expand the sample so that the results can be generalized

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Influence of the Level of Physical Activity on Symptoms and Duration of Recovery From Covid-19

Utjecaj nivoa tjelesne aktivnosti na simptome i trajanje oporavka od bolesti Covid 19

Lejla Šebić, Alma Suhonić, Erol Kovačević, Nedim Čović, Izet Bajramović

Faculty of Sport and Physical Education, University of Sarajevo, Bosnia and Herzegovina

Correspondence:
Lejla Šebić
Faculty of Sport and Physical Education; University of Sarajevo, Bosnia and Herzegovina
lejla.sebic@fasto.unsa.ba

Fakultet sporta i tjelesnog odgoja, Univerzitet u Sarajevu, Bosna i Hercegovina

Korespondencija:
Lejla Šebić
Fakultet sporta i tjelesnog odgoja, Univerzitet u Sarajevu, Bosna i Hercegovina
lejla.sebic@fasto.unsa.ba

Abstract: *Insufficient physical activity and sedentary lifestyle have exposed most of the population with chronicle diseases, to higher risk of infection of COVID-19, with extremely severe consequences and exhausting and long recovery after the illness. Regular physical activity, as one way of prevention and faster recovery from COVID-19, is an important priority for improvement health and quality of life in people. The aim of this paper is to determine the connection between regular physical activity of the population with the presence of symptoms and duration of recovery from COVID-19. Total number of subjects was 100 people of both genders (male 32 and female 68) of younger age (age: 30-44) without existing chronicle diseases and healed from COVID. Data of regularity of exercising, symptoms, and recovery period were obtained by survey of this study: Active group of subjects (A=53) in continuity at least 3 months, two times a week, 60 minutes and Inactive group (N=47), who never exercised, nor they are physically active. Chi-square test was used (χ^2 test differences between groups), to determine differences of extensive frequencies. Results of the research showed that there are statistically significant differences between two groups ($p<0.001$) on the behalf of group with active subjects, in terms of severity of symptoms of COVID-19 and their recovery lasted shorter than in inactive group of subjects. Study shows that regular physical exercise has significant impact on human body and is important factor of enhancing immune system, which enables faster recovery and easier dealing with symptoms of COVID-19.*

Keywords: *health, physical exercising, Coronavirus, COVID-19. recovery, symptoms.*

Apstrakt: *Nedovoljna tjelesna aktivnost i sedentarni način života su veliki dio populacije sa hroničnim bolestima izložili puno većem riziku obolijevanja od COVID-19 sa izuzetno teškim posljedicama po zdravlje, kao i dugotrajnijim iscrpljujućim oporavkom nakon bolesti. Redovna tjelesna aktivnost kao jedan od načina prevencije i bržeg oporavka od bolesti COVID-19 predstavlja važan prioritet unapređenja zdravlja i kvalitete života ljudi. Cilj rada je bio utvrditi povezanost redovne tjelesne aktivnosti stanovništva sa prisustvom simptoma i vremenom oporavka od COVID-19. Ukupan broj ispitanika za ovo istraživanje je činilo 100 osoba, oba spola (muškarci=32, žene=68) mlađe životne dobi (age: 30-44 godine), bez postojećih hroničnih bolesti, a prebolovale su COVID-19. Podaci o redovnosti vježbanja, simptomima i vremenu koje je bilo potrebno za oporavak, dobivene su na osnovu anketnog upitnika osmišljenog za potrebe ovog istraživanja. Ispitanici su na osnovu nivoa aktivnosti podijeljeni u dvije skupine: Aktivni (A= 53) u kontinuitetu najmanje tri mjeseca dva puta sedmično po 60 minuta i skupina Neaktivni (N=47) koje nisu nikada vježbali niti su tjelesno aktivni. Za utvrđivanje razlika opaženih frekvencija korišten je Chi-square test (χ^2 test razlika između grupa). Rezultati istraživanja su pokazali da između dvije grupe postoje statistički značajne razlike ($p<0.001$) u korist grupe aktivnih ispitanika kada je u pitanju težina simptoma bolesti COVID-19, a njihov opravak nakon bolesti trajao je kraće u odnosu na neaktivnu grupu ispitanika. Istraživanje pokazuje da redovno tjelesno vježbanje ima značajan učinak na organizam čovjeka i čini važan preduslov jačanja odbrambenog imunološkog sistema što omogućava brži oporavak i lakše podnošenje simptoma bolesti COVID-19.*

Ključne reči: *zdravlje, tjelesno vježbanje, Coronavirus, COVID-19, oporavak.*

Introduction

COVID-19 was first described at the end of 2019 in Wzhan, China, according to assessment of multiple cases of acute respiratory infection (Liu and Saif 2020). In fact, the cause of this disease was mutant and new virus from the family of Coronavirus named as severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2), which, in time, spread all over the world (Gorbalenya et al. 2020). Therefore on 11 March 2020 World Health Organization declared state of emergency; virus became global pandemic (Cuthbertson et al., 2020.). the most common symptoms of the disease were high temperature, shortness of breath, rapid loss of taste or smell and septic shock and in more severe cases there were: severe pneumonia , syndrome of acute heavy breathing, sepses and septic shock, that can cause death of a patient (Coronavirus,hr, 2021). Researchers have reported that patients who suffer from diabetes, hypertension, cardiovascular and lung diseases had higher risk of severe diseases caused by virus and could have consequently bigger rate of hospitalization and death ((Huang et al. 2020; Wang et al. 2020). However, many other features of this new Coronavirus and other factors of risk for weight stay unclear. On the other hand, everyday exercising can help in fighting COBID-19 by enhancing immune system and repression of comorbidity such as: obesity, diabetes, hypertension, and heart diseases which increase severe disease of COVID-19 (Siordia 2020). Recent great average study concluded that regular sport activity can decrease severness of disease and the authors discovered that hospitalization of athletes, who participate in sport regularly, was 33% less than in non-athlete groups (Halabchi, et al. 2020). It is evident that regular physical exercising raises level of psychophysical and functional abilities, which are the main indicators of the levels of health. The level of health is one of the basic indicators of level of quality of living, which is more evident in the mid age and further on, therefore it leads to the conclusion that regular physical exercising in adults, is an important condition of their quality of life

Nedavna velika presječna studija zaključila je da redovno bavljenje sportom može smanjiti (Mustajbegović, 2000; Rakovac & Heimer, 2003). In the study of Sallis et al., (2021) on connection of inactivity with severe consequences, after overcoming COVID-19 virus, it is concluded that following the instructions for physical activity is closely related to reduced risk for of severe outcomes after overcoming the virus. Physical activity has many benefits and some of them are presented as an excellent asset in fighting COVID-19 and its consequences on human health. (Wedig, Duelge & Elmer 2020). Results of Tavakol et al (2021) show that physical inactivity is significantly con-

Uvod

COVID-19 je prvi put opisan krajem 2019. u Wuhanu u Kini, prema procjeni višestrukih slučajeva akutne respiratorne infekcije (Liu i Saif 2020). Zapravo, uzročnik ove bolesti je mutant i novi virus iz obitelji koronavirusa nazvan teški akutni respiratorni sindrom koronavirus 2 (SARS-CoV-2), koji se u kratkom vremenu proširio svijetom (Gorbalenya et al. 2020). U skladu s tim, 11. Marta 2020., Svjetska zdravstvena organizacija (WHO) proglasila je izvanredno stanje: virus je postao globalna pandemija (Cuthbertson et al., 2020.).

Najčešći simptomi bolesti su povišena temperatura, suhi kašalj, nedostatak zraka te nagli gubitak mirisa, okusa ili promjene okusa, a u težim slučajevima dolazi i do teške upale pluća, sindroma akutnog otežanog disanja, sepse i septičkog šoka koji mogu uzrokovati smrt pacijenta (Koronavirus.hr, 2021). Istraživači su izvijestili da su pacijenti koji pate od dijabetesa, hipertenzije, kardiovaskularnih i plućnih bolesti imali veći rizik od teških bolesti uzrokovanih virusom i posljedično veću stopu hospitalizacije i smrti (Huang et al. 2020; Wang et al. 2020). Međutim, mnoge druge karakteristike ovog novog koronavirusa i drugi faktori rizika za težinu ostaju nejasni. S druge strane, svakodnevna tjelovježba može pomoći u borbi protiv COVID-19 jačanjem imunološkog sistema i suzbijanjem komorbiditeta kao što su pretilost, dijabetes, hipertenzija i srčana oboljenja koja povećavaju tešku bolest COVID-19 (Siordia 2020). Nedavna velika presječna studija zaključila je da redovno bavljenje sportom može smanjiti ozbiljnost bolesti, a autori su otkrili da su hospitalizacije sportaša koji redovno učestvuju u sportu bile 33% niže od neatletskih skupina (Halabchi, et al. 2020). Jasno je da redovno tjelesno vježbanje podiže nivo psihofizičkih i funkcionalnih sposobnosti koje su osnovni pokazatelji stepena zdravlja. Stepen zdravlja jedan je od osnovnih pokazatelja nivoa kvalitete života, što je posebno uočljivo od srednjih godina života na dalje, pa upućuje na zaključak da je redovno tjelesno vježbanje odraslih važan uslov kvalitete njihova života (Mustajbegović, 2000; Rakovac & Heimer, 2003). U istraživanju Sallis et al., (2021) o povezanosti neaktivnosti sa težim posljedicama nakon prebolovanog virusa COVID-19 zaključeno je da je ispravno pridržavanje smjernica za fizičku aktivnost usko povezano sa smanjenim rizikom za teške ishode nakon prebolovanog virusa. Tjelesna aktivnost ima mnoge prednosti, a neke od njih su prikazane i kao odlično sredstvo u borbi protiv COVID-19 i njegovih posljedica po zdravlje čovjeka (Wedig, Duelge & Elmer 2020). Rezultati istraživanja Tavakol i sar. (2021) pokazuju da je tjelesna neaktivnost značajno povezana s

nected to the severeness of the disease of COVID-19 and that level of physical activity of moderate intensity can protect individual from getting bigger number of symptoms of COVID-19 (Zeigler, 2021). Consequently, based on mention studies it appears that moderate physical activity can be recommended as non-pharmacy, cheap and sustainable way of prevention of severe cases of COVID-19 infection. The assumption of the study was that most of the physically active people had milder symptoms of this disease and faster recovery in relation to physically inactive population.

Methods

Design of the Study and Data collecting

The study is classified as an average study with the aim to establish differences in symptoms and recovery period in individuals, who overcame COVID-19 in relation to the previous level of physical activity. Collecting data was conducted by survey, which was designed for the needs of this study and included 10 questions related to: i) regularity of physical exercising ii) severeness of symptoms of COVID-19 (loss of senses, high temperature, muscle pain, weakness and exhaustion, pneumonia, infusion, oxygen support, hospitalization) and iii) duration of recovery after the disease. Generat part of the survey referred to collecting of basic demographic data, such as: age, work commitments and basic life habits.

Active population was selected by animation from local fitness recreation centers on voluntary base, and most inactive population, within working population. Level of activity was determined by the survey. Overall procedure of answering the questions lasted aprox 10 min.

Subjects

Total number of subjects included in the study was N=100, both sexes (male=32, female=68) of younger age (30-44 age- age group according to standards of WHO), physically healthy, without chronicle diseases and who overcame COVID-19 in the last 6 months. Apartf from overcoming COVID-19, the criterion for active subjects was that they exercise continuously for three months, more that 120 minutes a week. Group of inactive subjects was selected from working population, randomly. Surveys were filled by subjects personally using online tools and all data about participants of the study were protected, respecting ethical aspects of the study, regulated by Helsinki Declaration. Based on the answers on survey question about regular physical activity subjects

težinom bolesti COVID-19, kao i da povećan nivo tjelesne aktivnosti umjerenog intenziteta može zaštititi od dobivanja većeg broja simptoma COVID-19 (Zeigler, 2021). Posljedično, na temelju navedenih istraživanja, čini se da se umjerena tjelesna aktivnost može preporučiti kao nefarmakološki, jeftin i održiv način prevencije teških slučajeva COVID-19. Pretpostavka istraživanja je bila da većina tjelesno aktivnih ljudi ima lakše simptome ove bolesti i brži oporavak u odnosu na tjelesno neaktivnu populaciju.

Metode

Dizajn istraživanja i prikupljanje podataka

Istraživanje je klasifikovano kao presječna studija s ciljem da se utvrde razlike u simptomima i vremenu oporavka kod osoba koje su prebolovale COVID-19 u odnosu na prethodni nivo tjelesne aktivnosti. Prikupljanje podataka je provedeno upotrebom anketnog upitnika koji je osmišljen za potrebe ovog istraživanja, a koji se sastojao od 10 pitanja vezanih za: i) redovnost tjelesnog vježbanja, ii) težinu simptoma bolesti COVID-19 (gubitak osjeta, pojava temperature, bolovi u mišićima, osjećaj slabosti i iscrpljenosti, upala pluća, infuzija, kiseonička potpora, hospitalizacija), te iii) trajanje oporavka nakon bolesti. Anketni uputnici elektronski su dostavljeni ispitanicima putem web linka. Opšti dio upitnika odnosio se na prikupljanje osnovnih demografskih podataka, poput godina starosti, radnih obaveza i osnovnih životnih navika. Aktivna populacija je selektirana animiranjem iz lokalnih fitness rekreativnih centara na dobrovoljnoj bazi, a najveći dio neaktivne populacije u okviru radnog stanovništva. Nivo aktivnosti je utvrđen anketnim upitnikom. Cjelokupna procedura odgovora na pitanja trajala je cca 10 min.

Ispitanici

Ukupan broj ispitanika uvrštenih u istraživanje bio je N=100, oba spola (muškarci=32, žene=68), mlađe životne dobi (30-44 godine starosti – dobna skupina prema mjerilima WHO), tjelesno zdravih bez hroničnih bolesti, a prebolovale su COVID-19 unazad 6 mjeseci. Pored prebolovanog COVID-19, kriterij za aktivne subjekata je bio da u kontinuitetu najmanje tri mjeseca vježbaju više od 120 minuta sedmično. Grupa neaktivnih ispitanika izabrana je iz radno aktivne populacije nasumičnim izborom. Ankete su ispunjavali ispitanici osobno koristeći online alate, a svi podaci o učesnicama istraživanja su zaštićeni, poštujući etičke aspekte istraživanja propisane Helsinškom deklaracijom. Na osnovu odgovora na anketno pitanje o redovnoj tjelesnoj aktivnosti ispitanici su

were divided in two groups (Table 1) : Active (N=53) and Inactive (N=47).

Statistical analysis

Analysis of answers was evaluated by Office Excel program and SPSS 21 (SPSS Inc., Chicago, IL, USA). All results of the answers were transferred to the adequate excel matrix. Chi-square test ((χ^2 test of differences among groups) was used for determination of significance of differences of detected frequencies (f_O). Direction of significance of differences was classified based on standard residential means. Data were shown as number of detected frequencies and percentage of representation. Level of statistical conclusion was set on $p<0.05$

Results

Table 1. *Difference of detected frequencies in relation to regular exercising in fitness center*

podijeljeni u dvije grupe (Tabela 1): Aktivni (N=53) osobe skupina Neaktivni (N=47).

Statistička analiza

Analiza odgovora je procijenjena korištenjem Office programa Excel i SPSS 21 (SPSS Inc., Chicago, IL, USA). Sve rezultati odgovora su prebačeni u adekvatnu excell matricu. Za utvrđivanje značajnosti razlika opaženih frekvencija (f_O) korišten je Chi-square test (χ^2 test razlika između grupa). Smjer značajnosti razlike klasifikovan je na osnovu standardiziranih rezidulanih vrijednosti. Podaci su prikazani kao broj opaženih frekvencija i procentualna zastupljenost. Nivo statističkog zaključivanja postavljen je na $p<0.05$.

Rezultati

Tabela 1. *Razlika opaženih frekvencija u odnosu na redovno vježbanje u fitnes centru*

***How long do you exercise in continuity? /* Koliko dugo vježbate u kontinuitetu?**				
		***Inactive /* Neaktivni**	***Active /* Aktivni**	***Total / Ukupno***
3-5 years / godina	f_O	0 (0%)	9 (100%)	9
	S_{RES}	-2.1	1.9	
2-3 years / godine	f_O	0 (0%)	11 (100%)	11
	S_{RES}	-2.2	2	
1-2 years / godine	f_O	0 (0%)	13 (100%)	13
	S_{RES}	-2.4	2.2	
6 –9 months / mjeseci	f_O	0 (0%)	9 (100%)	9
	S_{RES}	-2.1	1.9	
3-6 months / mjeseci	f_O	0 (0%)	11 (100%)	11
	S_{RES}	-2.1	1.9	
I don't exercise at all / ne treniram uopće	f_O	31 (100%)	0 (0%)	31
	S_{RES}	3.9	-2.1	
I sometimes walk / ponekad šetam	f_O	16 (100%)	0 (0%)	16
	S_{RES}	2.6	-2.4	
Total / Ukupno	f_O	47 (47%)	53 (53%)	100

f_O - detected frequencies; S_{RES} - standardized residuals

f_O - opažene frekvencije; S_{RES} - Standardizirani reziduali

Based on the answers on survey question about regular physical activity subjects were divided in two groups (Table 1): Active (N=53) and Inactive (N=47) group.

Na osnovu odgovora na anketno pitanje o redovnoj tjelesnoj aktivnosti ispitanici su podijeljeni u dvije grupe (Tabela 1): Aktivni (N=53) osobe skupina Neaktivni (N=47).

Table 2. *Differences of detected frequencies of answers to the question about the symptoms and progress of the disease between active and inactive individuals, who overcame COVID-19.*

Tabela 2. *Razlika opaženih frekvencija odgovora na pitanja o simptomima i toku bolesti između aktivnih i neaktivnih osoba koje su prebolovale COVID-19.*

***Questions* / Pitanja**			***Yes* / Da *(%)***	***No* / Ne *(%)***	***Total* / Ukupno**	***χ2***
Did you lose sense of smell and taste? / Da li ste izgubili čulo mirisa i ukusa?	*inactive /* neaktivni	f_O	35 (74%)	12 (26%)	47	χ2= 3.494a; p=0.062
		S_{RES}	0.8	-1.1		
	active / aktivni	f_O	30 (57%)	23 (43%)	53	
		S_{RES}	-0.8	1		
	Total / Ukupno	f_O	65 (65%)	35 (35%)	100	
Pronounced muscle pain during the disease? / Izražena bol u mišićima tokom bolesti?	*inactive /* neaktivni	f_O	42 (89%)	5 (11%)	47	χ2= 213.259a; p<0.001
		S_{RES}	1.4	-2.2		
	active / aktivni	f_O	30 (57%)	23 (43%)	53	
		S_{RES}	-1.3	2.1		
	Total / Ukupno	f_O	72 (72%)	28 (28%)	100	
Did you feel exhaustion and tiredness? / Da li ste osjećali iscrpljenost i umor?	*inactive /* neaktivni	f_O	42 (89%)	5 (11%)	47	χ2= 13.966a; p=0.001
		S_{RES}	1.3	-2.2		
	active / aktivni	f_O	30 (57%)	23 (43%)	53	
		S_{RES}	-1.2	2.1		
	Total / Ukupno	f_O	71 (72%)	28 (28%)	100	
Did you have high temperature? / Da li ste imali povišenu temperaturu?	*inactive /* neaktivni	f_O	44 (94%)	3 (6%)	47	χ2= 23.553a; p<0.001
		S_{RES}	1.9	-3		
	active / aktivni	f_O	26 (49%)	27 (51%)	53	
		S_{RES}	-1.8	2.8		
	Total / Ukupno	f_O	70 (70%)	30 (30%)	100	
Did you have pneumonia? / Da li ste imali upalu pluća?	*inactive /* neaktivni	f_O	22 (47%)	25 (53%)	47	χ2= 19.957a; p<0.001
		S_{RES}	2.8	-1.7		
	active / aktivni	f_O	4 (8%)	49 (92%)	53	
		S_{RES}	-2.6	1.6		
	Total / Ukupno	f_O	26 (26%)	74 (74%)	100	
Were you hospitalized? / Da li ste bili hospitalizovani?	*inactive /* neaktivni	f_O	5 (11%)	42 (89%)	47	χ2= 5.935a; p=0.015
		S_{RES}	1.7	-0.4		
	active / aktivni	f_O	0 (0%)	53 (100%)	53	
		S_{RES}	-1.6	0.4		
	Total / Ukupno	f_O	5 (5%)	95 (95%)	100	
Did you receive IV (infusion)? / Da li ste primili infuziju?	*inactive /* neaktivni	f_O	12 (26%)	35 (74%)	47	χ2= 15.377a; p<0.001
		S_{RES}	2.7	-1		
	active / aktivni	f_O	0 (0%)	53 (100%)	53	
		S_{RES}	-2.5	0.9		
	Total / Ukupno	f_O	12 (12%)	88 (88%)	100	
Were you on oxygen support? / Da li ste bili na kiseoničkoj potpori?	*inactive /* neaktivni	f_O	4 (9%)	43 (91%)	47	χ2= 4.699a; p=0.030
		S_{RES}	1.5	-0.3		
	active / aktivni	f_O	0 (0%)	53 (100%)	53	
		S_{RES}	-1.5	0.3		
	Total / Ukupno	f_O	4 (4%)	96 (96%)	100	

f_O - detected frequencies ; S_{RES} - standardized residuals; χ2 - Chi square test

f_O - opažene frekvencije; S_{RES} - Standardizirani reziduali; χ2 - Chi square test

In Table 2 differences of detected frequencies to the question " Did you lose sense of smell and taste?" between physically active and physically inactive individuals show that there are no significant differences between in symptoms of losing smell and taste (χ^2= 3.494a; p=0.062). Observing differences of detected frequencies to the question "Did you experience pain in the muscles?" it is noticed that there is a significant difference in symptoms of muscle pain between active 57% and inactive 89% individuals (χ^2=213.259a; p<0.001). most of active participants (A=43%) did not feel the pain in muscles in relation to the inactive (N=11%) during the COVID-19 disease (inactive 5; active 23 S_{RES}= -1.3 i 2.1). differences of detected frequencies to the question "Did you feel exhaustion and tiredness?" show that there is a small difference in symptoms of exhaustion and tiredness between active 57% and inactive 89% individuals (χ^2= 13.966a; p=0.001). Bigger number of active subjects 43% did not feel the exhaustion and tiredness during the disease (inactive 5; active 23 S_{RES}= -1.2 i 2.1). Observing differences of detected frequencies to the question "Did you have high temperature?" it is shown that there is significant difference between symptoms of high temperature between active and inactive individuals (χ^2= 23.553a; p<0.001). a significant number of active subjects 51% did not have symptoms of high temperature during the COVID-19 disease, but 6% of inactive subjects did not have temperature (inactive 3; active 27 S_{RES}= -3.0 i 2.8). Differences of detected frequencies to the question "Did you have pneumonia?" show that there is significant difference in symptoms between active and inactive individuals (χ^2= 19.957a;p<0.001). 47% of inactive and 8% of active subjects had pneumonia during the COVID-19 disease (inactive 25; active 49 S_{RES}= -2.6 i 1.6). Differences of detected frequencies to the question "Were you hospitalized?" show that there is statistical difference in symptoms between active 0% and inactive 11% individuals (χ^2= 5.935a; p=0.015). Not a single one subject from active group was hospitalized during the COVID-19 disease (inactive 5; active 0; S_{RES}= -1.7 i .4). Differences of detected frequencies to the question "Did you receive IV (infusion)?" show that there is statistical difference in symptoms between active 0% and inactive 26% individuals (χ^2= 15.377a ; p<0.001). None of the subjects of active group received IV(infusion) during the COVID-19 disease (inactive 12; active 53; S_{RES}= -2.7 i -1.0). Differences of detected frequencies to the question "Were you on oxygen support?" show that there is statistical difference in symptoms between active 0% and inactive 9% individuals (χ^2= 4.699a; p=0.030). None of the subjects of active group was on the oxygen support (inactive 4; active 0; S_{RES}= -1.5 i .3).

U tabeli 2 razlike opaženih frekvencija na pitanje „Da li ste gubili miris i ukus?" između fizički aktivni i neaktivnih osoba pokazuju da ne postoji značajna razlika u pojavi simptoma gubitka mirisa i okusa (χ^2= 3.494a; p=0.062). Podjednak broj ispitanika je imao simptome gubitka mirisa i okusa (neaktivni 35; aktivni 30; S_{RES}= 0.8). Uvidom u razlike opaženih frekvencija na pitanje „Da li ste osjetili bol u mišićima?" vidljivo je da postoji značajna razlika u pojavi simptoma bola u mišićima između aktivnih 57% i neaktivnih osoba 89% (χ^2=213.259a; p<0.001). Veći broj aktivnih ispitanika (A=43%) nije osjetio bolove u mišićima u odnosu na neaktivne (N=11%) u toku bolesti COVID-19 (neaktivni 5; aktivni 23; S_{RES}= -1.3 i 2.1). Razlike opaženih frekvencija na pitanje „Da li ste osjećali iscrpljenost i umor?" pokazuju da postoji mala razlika u pojavi simptoma iscrpljenosti i umora između aktivnih 57% i neaktivnih 89% osoba (χ^2= 13.966a; p=0.001). Veći broj aktivnih ispitanika 43% nije osjetio iscrpljenost i umor tokom bolesti (neaktivni 5; aktivni 23; S_{RES}= -1.2 i 2.1). Uvidom u razlike opaženih frekvencija na pitanje „Da li ste imali povišenu temperaturu?" vidljivo je da postoji značajna razlika u pojavi simptoma povišene temperature između aktivnih i neaktivnih osoba (χ^2= 23.553a; p<0.001). Značajno veći broj aktivnih ispitanika 51% nije je imao simptome povišene temperature tokom bolesti COVID-19, kod neaktivnih 6% nije imalo temperaturu (neaktivni 3; aktivni 27; S_{RES}= -3.0 i 2.8). Razlike opaženih frekvencija na pitanje „Da li ste imali upalu pluća?" pokazuju da postoji značajna razlika u pojavi simptoma upale pluća između aktivnih i neaktivnih osoba (χ^2= 19.957a;p<0.001). Upalu pluća je imalo 47% neaktivnih i 8% aktivnih ispitanika tokom tokom bolesti COVID-19 (neaktivni 25; aktivni 49; S_{RES}= -2.6 i 1.6). Uvidom u razlike opaženih frekvencija na pitanje „Da li ste bili hospitalizovani?" uočeno je da postoji statistička razlika između aktivnih 0% i neaktivnih osoba 11% (χ^2= 5.935a; p=0.015). Niti jedan ispitanik aktivne skupine nije bio hospitalizovan tokom bolesti COVID-19 (neaktivni 5; aktivni 0; S_{RES}= -1.7 i .4). Uvidom u razlike opaženih frekvencija na pitanje „Da li ste primili infuziju?" uočeno je da postoji statistička razlika između aktivnih 0% i neaktivnih 26% osoba (χ^2= 15.377a ; p<0.001). Nijedan ispitanik aktivne skupine nije primio infuziju tokom bolesti COVID- 19 (neaktivni 12; aktivni 53; S_{RES}= -2.7 i -1.0). Razlike opaženih frekvencija na pitanje „Da li ste bili na kiseoničkoj potpori?" uočeno je da postoji statistička razlika između aktivnih 0% i neaktivnih osoba 9% (χ^2= 4.699a; p=0.030). Niti jedan ispitanik aktivne skupine nije bio na kiseoničkoj potpori (neaktivni 4, aktivni 0, S_{RES}= -1.5 i .3).

Table 3. *Difference of detected frequencies to the question "How long did it take you to recover?" between physically active and physically inactive individuals who overcame COVID-19.*

Tabela 3. *Razlika opaženih frekvencija odgovora na pitanje „Koliko vam je trebalo da se oporavite?" između fizički aktivni i neaktivnih osoba koje su prebolovale COVID 19.*

How long did it take you to fully recover from COVID-19? / **Koliko vam je trebalo da se potpuno oporavite nakon bolesti Covid-19?**								
			2-3 months / **mjeseca**	***3-6 months /*** **mjeseci**	***30 days /*** **dana**	***7 - 14 days /*** **dana**	***more than 6 months /*** **više od 6 mjeseci**	***Total /*** **Ukupno**
Criterion of activity / Kriterij aktivnosti	*Inactive /* Neaktivni	f_O	15 (31.9)%	6 (12.8)%	12 (25.5)%	10 (21.3)%	4 (8.5)%	47
		S_{RES}	1.8	1.9	-.2	-2.1	0.7	
	Active / Aktivni	f_O	5 (10.6)%	0 (0)%	15 (31.9)%	31 (66)%	2 (4.3)%	53
		S_{RES}	-1.7	-1.8	.2	2.0	-.7	
Total / Ukupno		f_O	20	6	27	41	6	100
χ^2= 22.477[a]; p<0.001								

f_O- detected frequencies; S_{RES}- standardized residuals; χ^2- Chi square test

f_O - opažene frekvencije; S_{RES} - Standardizirani reziduali; $\chi 2$ - Chi square test

Table 3. differences of detected frequencies to the question "How long did it take you to recover?" between physically active and physically inactive individuals who overcame COVID-19 show that there is statistical difference between active and inactive individuals (χ^2= 22.477a; p<0.001). 66% of active idnividuals recovered within 7-14 days and 31% of inactive individuals recovered within 2-3 months..

Discussion

The aim of this paper is to determine correlation between physical activity of the population with the presence of the symptoms and time necessary for recovery from COVID-19. Results of the study have shown that there are significant differences between active and inactive subjects in terms of symptoms and recovery period after the COVID-19 disease. In active group all symptoms of the disease were less pronounced in relation to inactive group of subjects, except for the symptoms of loss of smell and taste where there was no significant difference between groups. The exact reason for disorder of smell and taste after COVID-19 has still not been understood completely (Bubaš and Capak, 2022). It can be caused by virus nerve damage, local infection and damage of supportive cells and nasal epithelia cells or both. In about 90% or 96% of patients sense of smell will be returned within 30 days from the beginning of the recovery. In a small percentage of individuals who overcame COVID-19 sense of smell and taste comes back in function after twelve months even (Bubaš and Capak 2022). Study shows that there is no significant difference between active

Uvidom u tabelu 3. razlike opaženih frekvencija na pitanje „Koliko vam je trebalo da se oporavite?" između fizički aktivnih i neaktivnih osoba koje su prebolovale COVID 19 uočeno je da postoji statistička razlika između aktivnih i neaktivnih osoba (χ^2= 22.477a; p<0.001). Kod aktivnih osoba 66% se oporavilo u roku od 7 do 14 dana, a kod neaktivnih 31% se oporavilo u periodu 2-3 mjeseca.

Diskusija

Cilj rada je bio utvrditi povezanost redovne tjelesne aktivnosti stanovništva sa prisustvom simptoma i vremenom potrebnim za oporavka od bolesti COVID-19. Rezultati istraživanja pokazali su da između aktivnih i neaktivnih ispitanika postoje značajne razlike u prisustvu simptoma i trajanju oporavka nakon bolesti COVID-19. U aktivnoj skupini svi simptomi bolesti su bili slabije izraženi u odnosu na neaktivnu skupinu ispitanika, osim simptoma gubitak mirisa i okusa gdje nije bilo značajne razlike između grupa. Tačan razlog poremećaja njuha i okusa nakon COVID-19 još nije potpuno shvaćen (Bubaš i Capak, 2022). Može biti izazvan virusnim oštećenjem živaca, lokalnom upalom i oštećenjem potpornih stanica i sin nazalnog epitela, ili oboje. U približno 90 % do 96 % pacijenata osjet mirisa će se barem djelimično vratiti unutar 30 dana od početka oporavka. Kod malog postotka osoba koje su preboljele COVID-19 osjet mirisa i okusa vraća se u funkciju tek nakon dvanaest mjeseci (Bubaš i Capak, 2022). Istraživanje pokazuje da kod lakših simptomima bolesti kao što je gubitak okusa i mirisa nema značajne razlike između aktivnih i neaktivnih ispitanika.

and inactive subjects in terms of lighter symptoms such as loss of smell and taste. The problems with pain in the joints and muscles are common symptoms of COVID-19 and they affect shoulders, neck and knees. In this study symptom of pronounced pain in muscles during the disease had 89% of inactive and 57% of active subjects. During the treatment of the disease, due to general weakness, patients rest and don't move and it can also cause or make them worse, pains, stiffness and muscle weakness. During the treatment of the disease, lying and non-moving lead to termination of loading of skeleton muscles, which cause their gradual atrophy (losing muscle mass). Together with losing muscle mass, termination of loading musculature leads to denervation of muscle fibers and damaging connector between muscle and motor nerve, which causes reduced muscle function, motor control and balance. It is assumed that in physically active subjects trained muscles have less tendency to weaken and faster ability to recover. Weakness of the muscles can later turn into difficulties in activities such as: standing, climbing the stairs, catching and holding objects in hands or lifting arms above the head, so this is one more reason why recovery in inactive group of subjects lasted longer in relation to the active group. Since the body, during the disease, uses all energy to fight the virus, it is expected, in that process, that many valuable resources are consumed, especially, muscles. Active muscle mass as a consequence of regular training, is additional benefit and help in easier overcoming of the disease and it affected the weaker symptoms of exhaustion and tiredness in active group of subjects. Subjects of active group (43%) didn't have symptoms of exhaustion and tiredness at all, while subjects of inactive group (89%) experienced this pronounced symptom during the disease.

Higher level of muscle abilities is important fir metabolism of substance and hormones (Mišigoj-Duraković, 1999). Training increases number of red blood cells and transport of oxygen to the cells, faster blood circulation, faster transport of antibodies, immunoglobulin and white blood cells (defense cells) from the body to the place where their effect is needed. Increased blood circulation also stimulates release of hormones, which warn the cells on presence of pathogen bacteria or viruses. Better metabolism of substance and hormones probably caused less exhaustion during the disease, in active group of subjects, therefore they didn't have the need to take an infusion during the disease, while in inactive group of subjects, 26% of them need to take the infusion. In the last 4 decades many studies on sport and general population have shown that the training of moderate and high intensity and 60 minute duration has positive acute effect to the immune system (Nieman,1990). Such training stimulation leads to increase of anti-pathogen

Problemi sa bolom u zglobovima i mišićima su česti simptomi COVID-19 i zahvaćaju ramena, vrat, leđa i koljena. U ovom istraživanju simptom izražene boli u mišićima tokom bolesti je imalo 89% neaktivnih i 57% aktivnih ispitanika. Tokom liječenja od bolesti zbog opće slabosti oboljeli miruju i ne kreću se, a to također može prouzročiti ili pogoršati bolove, ukočenost i slabost mišića. U toku bolesti, ležanja i nekretanja dolazi do prestanka opterećivanja skeletnih mišića, što izaziva njihove postepenu atrofiju (gubitka mišićne mase). Usporedo s gubitkom mišićne mase, prestanak opterećivanja muskulature dovodi i do denervacije mišićnih vlakana i oštećenja spojnice između mišića i motoričkog živca, a što za posljedicu ima smanjenu mišićnu funkciju, motoričku kontrolu i ravnotežu. Pretpostavka je da kod tjelesno aktivnih ispitanika utrenirani mišići imaju manju tendenciju da slabe i bržu sposobnost oporavka. Slabost mišića može poslije stvoriti poteškoće u aktivnostima kao što su stajanje, penjanje stepenicama, hvatanje i držanje predmeta u rukama ili podizanje ruku iznad glave, tako da je to još jedan od razloga zašto je oporavak kod neaktivne grupe ispitanika trajao duže u odnosu na aktivnu grupu.

Kako tokom bolesti tijelo upotrebljava svu energiju koju ima kako bi se borilo s virusom, u tom je procesu očekivano da se mnogi vrijedni resursi troše, pogotovo mišići. Aktivna mišićna masa kao posljedica redovnog treninga je dodatni benefit i pomoć u lakšem prevazilaženju bolesti, te je utjecala na manje izraženim simptomima iscrpljenosti i umora kod aktivne skupine ispitanika. Ispitanici aktivne grupe 43% u toku bolesti nisu uopće osjećali simptom iscrpljenost i umora, dok kod neaktivnih ispitanika 89% je osjećalo izražen ovaj simptom tokom bolesti.

Viša razina mišićnih sposobnosti važna je za metabolizam tvari i hormona (Mišigoj-Duraković, 1999). Trening povećava broj crvenih krvnih zrnca, a time i transport kisika do ćelija, bržu cirkulaciju krvi, brži transport antitijela, imunoglobulina i bijelih krvnih stanica (obrambenih stanica) tijelom do mjesta gdje je potrebno njihovo dejstvo. Ubrzana cirkulacija krvi također potiče oslobađanje hormona koji upozoravaju stanice na prisutne patogene bakterije ili viruse. Upravo bolji metabolizam tvari i hormona vjerovatno je uzrokovao manju iscrpljenost tokom bolesti kod aktivne skupine ispitanika, a samim tim nisu imali potrebe za primanjem infuzije tokom bolesti, dok je kod neaktivnih ispitanika 26% je moralo primiti infuziju.

Kako trening umjerenog do visokog intenziteta i trajanja do 60 minuta ima pozitivan akutni učinak na imunološki sistem pokazuju i druge brojne studije na sportskoj i općoj populaciji u zadnje 4 dekade (Nieman,1990). Kod takvog trenažnog podražaja dolazi do povećanja anti-patogene aktivnosti tkivnih makrofaga, paralelno s povećanjem cirkula-

activities of tissue macrophage, parallel with the increase of circulation of immunoglobulin, anti-inflammatory cytokines, neutrophil, NK cells, cytotoxic T cells and B cells (Adams 2011). Stated acute changes play the key role in defense activity of immune system and metabolic health of a human. If the training stimulus is repeated continuously, for a longer period of time (few months and years) it comes to permanent strengthen of defense function of immune system which has an influence on weaker symptoms of the disease (Booth, 2014). In active group, probably more subjects, due to continuous months-long exercising, had better immune response of their body, therefore the symptom of high temperature, during the disease, had 49% of active subjects in relation to the 94% of inactive subjects. In the context of pandemic of COVID-19, the effect of exercising on infection of respiratory system of the trainee is especially interesting. Inverse correlation between exercising with moderate intensity and appearance of infection of upper respiratory tract (Nieman, 2000), where acute immune response to the exercising depends on intensity and duration of loading, is determined. Studies show that moderate physical activity is recommended has optimal health effects and strengthening immune system (Chagas et. al., 2020). Results of this study show that 47% of inactive and 8% of active subjects had pneumonia. Since these were recreational athletes, who exercise mostly in moderate intensity and shorter duration of loading, it can be assumed that there was a strong acute response of their immune system. Previous studies showed that immune system responds highly on physical activity of moderate intensity and is related to lower incidence, duration and severeness of infection of respiratory tract (Powel, 1994). Improved immune function, which is induced by moderate intensity of exercising, can decrease flow of inflammatory cells to lungs, reduce loading to pathogens, improve disease outcome and reduce chemokines and anti-inflammatory cytokines in lungs and bronchoalveolar lavage (Kohut et al 2009; Lowder et al; Warren et al 2015). In fighting COVID-19, active subjects have the advantage because training has the impact on healthy respiratory system and cardio-vascular system, because it activates all muscles in the body, heart muscle and thorax muscles, as well, which participate in process of breathing, which supports the data that no subject from active group needed oxygen support, during the disease. 9% of subjects of inactive group needed oxygen support , during the disease. Studies show that there is increased vital capacity of lungs in active individuals in relation to inactive population (Dodig, 1992). Physical exercise has a great impact on respiratory system. It increases thorax, size of lung alveoli, vital capacity and all ventilation parameters. Exercising affects breathing center. Results of

cije imunoglobulina, protuupalnih citokina, neutrofila, NK stanica, citotoksičnih T stanica i B stanica (Adams, 2011). Navedene akutne promjene igraju ključnu ulogu u obrambenoj aktivnosti imunološkog sistema, te metaboličkom zdravlju čovjeka. Ukoliko se trenažni podražaj kontinuirano ponavlja dovoljno dugo (više mjeseci i godina), dolazi do trajnog jačanja obrambene funkcije imunološkog sistema, što ima utjecaj na lakše simptome bolesti (Booth, 2014). Kod aktivne skupine vjerovatno je veći broj ispitanika uslijed kontinuiranog višemjesečnog vježbanja imao bolji imunološki odgovor organizma te je simptom povišene tjelesne temperature tokom bolesti je imalo 49% aktivnih ispitanika u odnosu na 94% neaktivnih ispitanika.

U kontekstu pandemije COVID-19, posebno je interesantan utjecaj tjelovježbe na infekcije respiratornog sistema vježbača. Utvrđena je inverzna povezanost između tjelovježbe umjerenim intenzitetom i pojavnosti infekcije gornjeg respiratornog traka (Nieman, 2000) gdje akutni imunološki odgovor na vježbanje ovisi o intenzitetu i trajanju napora. Istraživanja pokazuju da se za optimalne zdravstvene efekte i jačanje imunološkog sistema preporučuje umjerana tjelesna aktivnost (Chagas et. al., 2020). Rezultati ovog istraživanja pokazuju da je upalu pluća imalo 47% neaktivnih i 8% aktivnih ispitanika. Pošto se radio o rekreativcima koji većinom vježbaju umjerenim intenzitetom i kraćim trajanjem napora može se pretpostaviti da je kod njih upravo bio prisutan jak akutni odgovor imunološkog sistema. Dosadašnja istraživanja pokazuju da imunološki sistem visoko reagira na tjelesnu aktivnost umjerenog intenziteta i povezan je s manjom incidencijom, trajanjem i težinom infekcija disajnog trakta (Powel, 1994). Poboljšana imunološka funkcija koja je inducirana umjerenim intenzitetom vježbanja može smanjiti priljev upalnih stanica u pluća, smanjiti opterećenje patogenima, poboljšati ishod bolesti i smanjiti kemokine i proupalne citokine u plućima ili bronhoalveolarnoj lavažnoj tekućini (Kohut i sur. 2009; Lowder i sur. 2006; Warren i sur. 2015).

U borbi sa COVID-19 prednost imaju aktivni ispitanici jer trening ima utjecaj na zdrav respiratorni i kardio-vaskularni sistem tako što aktivra sve mišiće na tijelu pa tako i onaj najvažniji srčani mišić i mišiće grudnog koša koji učestvuju u samom procesu disanja, čemu u prilog govori podatak da je na kiseoničkoj potpori nije bio ni jedan ispitanik iz aktivne grupe. Kiseoničku potporu je trebalo 9% ispitanika iz neaktivne skupine. Istraživanja pokazuju da je kod aktivnih osoba generalno povećan vitalni kapacitet pluća u odnosu na neaktivnu populaciju (Dodig, 1992). Tjelesno vježbanje ima velik utjecaj na respiratorni sistem. Povećava se prsni koš, površina plućnih alveola, vitalni kapacitet i svi ventilacijski parametri. Vježbanje utječe i na

exercising is prolonged breathing and improvement of vital capacity of lungs and improvement of ratio of residential volume and overall capacity of lungs. Lung diffusion is better in trained individuals than in untrained. Saving the oxygen is a sign of good shape. Trained individual learns how to reduce number of movements and to use necessary muscles, purposefully. In physiological sense aerobic capacity is the most direct indicator of maximal ability of heart-blood and respiratory system. The most important feature of level of active health is high functional ability of transport respiratory system. Physical exercising has an impact on respiratory and circulatory, functional abilities and develops heart-vein and respiratory system (Mišigoj-Duraković, 1999).

Regular physical exercise is related to improved cardio-respiratory conditioning, which can be seen with bigger oxygen consumption (VO2 max) in Ergometric test. Vo2max has shown to be an important indicator for stratification of risk of surgical complications, interventions and hospital admission due to COVID-19(Ahmed 2020). In active group of subjects no one was hospitalized during the disease, while inactive subjects !1% of them had to be hospitalized. It is believed that people with bigger cardio-respiratory capacity linked with physical exercising have lower risk of complications and death rate of COVID -19 and with aerobic capacity, bigger performance of strength is also linked to the smaller risk of death outcome (García-Hermoso 2018). It took 7 to 14 days for 66% of subjects of active group to recover. 31.9% of subjects of inactive group needed 2-3 months to recover. Study shows that regular physical activity has positive acute effect on immune system and metabolic health of an indivdual, it enables faster recovery and better toleration of symptoms of COVID-19. In study (Tavakol et al, 2021) similar results were obtained, which showed that physical inactivity is significantly connected to the severeness of the disease of COVID-19. As an illustration, patients with lower levels of physical activity or lower MET.min/week were hit with more severe form of disease (mid means 343.6 in relation to 779.3 MET.min/week) (p=0,03). Correlation between duration of signs and symptoms and physical activity suggests that patients with lower physical activity suffer longer in comparison to the groups with moderate to high levels of physical activity. Study leads to conclusion that increase of levels of physical activity can partially reduce severeness of disease of COVID-19 and accelerate recovery period. Other studies (Zeigler, 2021) also indicate that similar results, where increased level of physical activity of moderate intensity can protect individual from getting bigger number of symptoms of COVID-19. This is confirmed by the study where physical inactivity is directly or indirectly linked to the bad immune re-

centar za disanje. Rezultat vježbanja je produženo disanje te poboljšanje vitalnog kapaciteta pluća i poboljšanje odnosa rezidentalnog volumena i ukupnog kapaciteta pluća. Plućna difuzija bolja je kod uvježbanih osoba nego kod neuvježbanih. Štednja u iskorištavanju kisika je znak dobre kondicije. Uvježbana osoba nauči smanjiti broj pokreta i svrsishodnije upotrijebiti potrebne mišiće. U fiziološkom pogledu aerobni kapacitet je najdirektniji pokazatelj maksimalne sposobnosti srčano-krvnog i respiratornog sistema. Najznačajnija odlika nivoa aktivnog zdravlja su visoke funkcijske sposobnosti transportnog sistema za kisik. Tjelesno vježbanje utječe na dišne i cirkulacijske funkcijske sposobnosti te razvija srčano – žilni i dišni sustav (Mišigoj-Duraković, 1999).

Redovna tjelovježba povezana je s poboljšanom kardiorespiratornom kondicijom, što se može uočiti većom potrošnjom kisika (VO_2max) u ergonometrijskom testu. Pokazalo se da je VO_2max važan pokazatelj za stratifikaciju rizika kirurških komplikacija, intervencija i prijema u bolnicu kod bolesti COVID-19 (Ahmed, 2020). U aktivnoj grupi ispitanika niko nije bio hospitalizovan tokom bolesti, dok kod neaktivnih ispitanika njih 11% je moralo biti hospitalizovano. Vjeruje se da ljudi s većim kardiorespiratornim kapacitetom povezanim s tjelesnim vježbanjem imaju manji rizik od komplikacija i stopu smrtnosti od COVID-19, a uz aerobni kapacitet, veća izvedba snage također je povezana s manjim rizikom od smrtnog ishoda (García-Hermoso 2018).

U aktivnoj skupini najvećem broju ispitanika 66% je trebalo 7 do 14 dana da se oporave. Kod neaktivne skupine najvećem broju ispitanika 31.9% bilo je potrebno 2-3 mjeseca za oporavak. Studija pokazuje kako redovna tjelesna aktivnost ima pozitivan akutni učinak na imunološki sistem i metaboličko zdravlje čovjeka, omogućava brži oporavak i lakše podnošenje simptoma bolesti COVID -19. U studiji (Tavakol i sar. 2021) dobijeni su slični rezultati koji su pokazali da je tjelesna neaktivnost značajno povezana s težinom bolesti COVID-19. Kao ilustracija, pacijenti s nižim razinama tjelesne aktivnosti ili nižim MET.min/tjedan bili su pogođeni težim oblikom bolesti (srednja vrijednost 343.6 naspram 779.3 MET.min/tjedan) (p=0,03). Korelacija između trajanja znakova i simptoma i tjelesne aktivnosti sugerira da pacijenti s niskom tjelesnom aktivnošću pate duže od bolesti u usporedbi sa skupinama s umjerenom do visokom razinom tjelesne aktivnosti. Istraživanje navodi na zaključak da povećanje nivoa tjelesne aktivnosti može djelomično smanjiti težinu bolesti COVID-19 i ubrzati period oporavka nakon bolesti.

Druga istraživanja (Zeigler, 2021), također pokazuju slične rezultate gdje povećana razina tjelesne aktivnosti umjerenog intenziteta može zaštititi od dobivanja većeg

sponse (Laddu et al. 2020.), through vicious circle between inactivity and obesity (Pietiläinen et al. 2008.). Therefore, unhealthy diet, obesity and inactiveness have negative effect on work of immune system and defense of the host.

This study shows that, in sense of preservation and improvement of psycho-physical health of contemporary man, physical activity has an important role and when it is regular it can improve, prevent or reduce the risk of more severe symptoms and accelerate recover after the disease of COVID-19. Since consequences of this disease are long-term and still studied and subjects of scientific and experts community, it is necessary to conduct similar studies on substantially bigger sample subject. Absence of précised parameters of clinical picture of infected people is one of the shortages of the paper and absence of information on quality of exercising of active group of subjects, diet habits, rest and sleeping phases, social interactions and other important factors of healthy lifestyle.

Conclusion

This average study which is conducted with the aim to establish differences of symptoms and rapidity of recovery in individuals who overcame COVID-19 in relation to the previous level of physical activity, can be one of the factors, which contribute to subjective expressed easier symptoms and faster recovery from COVID-19 and as such it should be mandatory part of public health programs, recommendations as non-pharmacy, cheap and sustainable way of prevention and reduce of risk of numerous diseases of the population. The study has shown that physically active individuals had significantly weaker symptoms and faster recovery after the disease. It is necessary to conduct more studies, to raise the awareness on ways to improve health and benefits of regular physical activity, which is emphasized in this paper. Future studies should be focused on life style as variable factor of risk for controlling COVID-19.

broja simptoma COVID-19. Što potvrđuje i istraživanje gdje je tjelesna neaktivnost direktno i indirektno povezana s lošim imunološkim odgovorom (Laddu et al. 2020.), kroz začarani krug između neaktivnosti i pretilosti (Pietiläinen et al. 2008.). Dakle, nezdrava prehrana, pretilost i neaktivnost negativno utječu na rad imunološkog sustava i obranu domaćina.

Ovo istraživanje pokazuje da smislu očuvanja i poboljšanja psihofizičkog zdravlja savremenog čovjeka, tjelesna aktivnost ima izrazito važnu ulogu, a kada je redovna može poboljšati prevenirati ili smanjiti rizik težih simptoma i ubrzati oporavak nakon bolesti COVID-19. S obzirom na to da je riječ o bolesti čije su dugotrajne posljedice i dalje predmetom proučavanja i zanimanja znanstvene i stručne zajednice, potrebno je provesti slična istraživanja na znatno većem uzorku ispitanika. Nepostojanje preciznijih parametara kliničke slike oboljelih je jedan od nedostataka rada, te nepostojanje informacija o kvaliteti vježbanja aktivne grupe ispitanika, prehrambenim navikama, fazama odmora i sna, socijalnim interakcijama kao i drugim važnim faktorima zdravog stila života.

Zaključak

Ova presječna studija koja je provedena s ciljem da se utvrde razlike simptoma i brzine oporavka kod osoba koje su prebolovale COVID-19 u odnosu na prethodni nivo tjelesne aktivnosti pokazuje tjelesna aktivnost može biti jedan od faktora koji doprinose subjektivno izraženim lakšim simptomima i bržem oporavku od COVID -19 i kao takva, trebala bi biti obavezan sastavni dio javno zdravstvenih programa preporuke kao nefarmakološki, jeftin i održiv način prevencije i smanjenja rizika brojnih bolesti stanovništva. Istraživanje je pokazalo da su tjelesno aktivne osobe imale značajno slabije simptome i brži oporavak nakon bolesti. Potrebno je sprovoditi više istraživanja koja podižu svijest o načinima unapređenja zdravlja i benefitima redovne tjelesne aktivnosti na što ovaj rad posebno upućuje. Buduće studije trebale bi se usredotočiti na stil života kao promjenjivi faktor rizika za kontrolu COVID-19.

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The Sociological Perspective of Transhumanism Through the Prism of the Sports-Marketing Industry

Социолошка перспектива трансхуманизма кроз призму спортско-маркетиншке индустрије

Борис Латиновић[1], Бојана Остојић[2], Оља Крчадинац[1]

[1]University „Union – Nikola Tesla“, Belgrade, Serbia
[2]University „Educons“, Belgrade, Serbia

Correspondence:
Boris Latinović
University „Union – Nikola Tesla“, Belgrade, Serbia
boris.latinovic1984@gmail.com

[1]Универзитет „Унион – Никола Тесла“, Београд, Србија
[2]Универзитет „Едуконс“, Београд, Србија

Korespondencija:
Борис Латиновић
Универзитет „Унион – Никола Тесла“, Београд, Србија
boris.latinovic1984@gmail.com

Abstract: *The paper draws a parallel between sociological and transhumanist ideas. Transhumanism is an intellectual, cultural, scientific and artistic movement, which, based on the scientific coupling of technology and economy, supports and encourages the development and use of new scientific and technological solutions for the improvement of human physical, mental and other abilities. In this research, transhumanism was considered from four aspects: sociological, sports, marketing and artificial intelligence aspects. Sociological perspectives include recognizing and evaluating the effects of social relations, as well as social structures and forces, considering the present in a historical context that encourages critical thinking. We tried to analyse how the production, distribution and perception of sports can best be understood precisely from a sociological perspective. In the future, transhumanist marketing will be essential in convincing consumers that this change is very important. Transhumanism in future artificial intelligence can help humans overcome their limitations.*

Keywords: *sociology, transhumanism, sport, marketing, artificial intelligence.*

Apstrakt: *У раду је направљена паралела између социолошких и трансхуманистичких идеја. Трансхуманизам је интелектуални, културни, научни и уметнички покрет, који, темељен на научним спрегама технологије и економије, подр(а)жава и потиче развој и употребу нових научних и технолошких решења за побољшање људских физичких, менталних и других способности. У овом истраживању трансхуманизам је размотрен са четири аспекта: социолошког, спортског, маркетиншког и аспекта вештачке интелигенције. Социолошке перспективе укључују препознавање и процену ефеката друштвених односа, као и друштвених структура и сила, с обзиром на садашњост у историјском контексту које подстичу на критичко размишљање. Покушали смо да рашчланимо како се производња, дистрибуција и перцепција спорта најбоље могу разумети управо из социолошке перспективе. Трансхуманистички маркетинг ће у будућем периоду бити од суштинске важности при уверавању потрошача како је та промена веома важна. Трансхуманизам у будућој вештачкој интелигенцији може помоћи људима у превазилажењу својих ограничења.*

Ključne reči: *социологија, трансхуманизам, спорт, маркетинг, вештачка интелигенција.*

Introduction

Understanding the sociological perspective of transhumanism through the prism of the sports-marketing industry is crucial for understanding the field of social theory itself, and the way sociologists conduct research on the topic we are dealing with in this paper.

In order to venture into the field of transhumanism, it is necessary to define its very concept. Transhumanism is an intellectual, cultural, scientific and artistic movement, which is based on the scientific coupling of technology and economy, supports and encourages the development and use of new scientific and technological

Увод

Разумевање социолошке перспективе трансхуманизма кроз призму спортско-маркетиншке индустрије, пресудно је за разумевање самог поља друштвене теорије, те начина на који социолози спроводе истраживање на тему којом се бавимо у о овом раду.

Да бисмо се упустили у поље трансхуманизма, неопходно је да дефинишемо сам његов појам. Трансхуманизам је интелектуални, културни, научни и уметнички покрет, који се заснива на научним спрегама

solutions to improve human physical, mental and other abilities (Mičunović & Bosančić, 2020). Transhumanism spectacularly opened a new dimension of humanity and firmly took its place in many branches of science today. It has set a trend that mainly concerns the mind and body of a human being, so its influence on humanity is very significant. In many discussions about transhumanism, sports science is also included, because it fundamentally involves the human being. In this regard, technological development and progress in recent years have brought new discussions in the field of sports, thus appearing as a factor that helps human life and makes it easier. Transhumanists, i.e. people who are involved in the development of computers and artificial intelligence, believe that they are only a little short of reaching their ideals - the creation of an electronic collective consciousness of humanity. Regarding the future of the humanities from the perspective of transhumanism and its value system, it is possible to single out two main insights or links. The first concerns the positioning of the humanities, i.e. its relationship to the natural and technical sciences, while the second relates to the issue of values and skills that the humanities want to propagate, especially in relation to the challenges brought by the scientific and technological revolution (Mičunović & Bosančić, 2020).

Is there a possibility that in the future the ethical rules known so far will be violated indiscriminately, and will transhumanism affect them and to what extent? Do interventions on people, i.e. athletes, endanger sport in the known classical sense? What are the current fields of sociological perspectives on transhumanism and its effects on the world of sports? By searching for answers to such questions, this paper aims to highlight a different perspective for the future of sports. Current developments in the field of transhumanism will inevitably reflect on the development of sports, which mainly concern people. Given the essential fact that success and progress in sports is achieved within a time frame and with extreme efforts, the reflections of transhumanism in the field of sports were examined, and an attempt was made to evaluate its advantages and disadvantages. From all of the above, we can conclude that the sociological perspective of transhumanism can move sports towards unimagined heights, but at the same time it can pose a threat to today's sports and athletes, if the necessary precautions are not taken in time.

Sociological Perspectives in Sports

Sociological perspectives look at society through a lens without personal opinion. They generalize the causes

технологије и економије, подр(а)жава и подстиче развој и употребу нових научних и технолошких решења за побољшање људских физичких, менталних и других способности . Трансхуманизам је спектакуларно отворио нову димензију човечанства и чврсто заузео своје место у многим данашњим гранама науке. Поставио је тренд који се углавном тиче ума и тела људског бића, тако да је његов утицај на човечанство веома значајан. У многим расправама у вези трансхуманизма укључена је и спортска наука, јер у основи укључује људско биће. У том погледу, технолошки развој и напредак последњих година донео је нове расправе у области спорта, те се тако појављује као фактор који помаже људском животу и олакшава га. Трансхуманисти, односно људи који се баве развојем рачунара и вештачке интелигенције, верују да им још само мало недостаје до достизања њихових идеала – стварања електронске колективне свести човечанства. О будућности хуманистичких наука из перспективе трансхуманизма и његовог система вредности, могуће је издвојити два главна увида или повезнице. Први се тиче позиционирања хуманистике, односно њеног односа према природним и техничким наукама, док се други веже за питање вредности и вештина које хуманистичке науке жели пропагирати, посебно у односу на изазове које доноси научно-технолошка револуција .

Постоји ли могућност да се у будућности беспризпрно крше до сада позната етичка правила и да ли ће на њих и у којој мери утицати трансхуманизам? Да ли интервенције на људима, дакле спортистима, угрожавају спорт у познатом класичном смислу? Која су тренутна поља социолошких перспектива трансхуманизма и њени ефекти на свет спорта? Трагајући за одговорима на таква питања, овај рад има за циљ да истакне другачију перспективу за будућност спорта. Актуелна дешавања у области трансхуманизма ће неминовно да се рефлектују на развој спорта, који се углавном тиче људи. С обзиром на суштинску чињеницу да се успех и напредак у спорту остварује у временском оквиру и екстремним напорима, испитане су рефлексије трансхуманизма у области спорта, те су се покушале оценити његове предности и мане. Из свега наведеног, можемо закључити да социолошка перспектива трансхуманизма може покренути спорт према неслућеним висинама, али и да истовремено може представљати претњу за данашње спортове и спортисте, уколико неопходне мере предострожности не буду предузете на време.

Социолошке перспективе у спорту

Социолошке перспективе посматрају друштво кроз

and actions of individuals into patterns and categories. However, they not only observe these social patterns, but also try to explain such patterns or behaviours. One of the main goals of the sociological perspective is to find and understand the patterns behind recurring features of social interaction, as well as to examine the social impacts of these (Ruthu, 2021). They include recognizing and evaluating the effects of social relations, as well as social structures and forces, considering the present in a historical context. These are perspectives that encourage critical thinking, but also asking critical questions and searching for solutions.

The role of sport in the creation of community and collective identity requires a detailed sociological review (Giullianotti, 2008). It is very important to examine social relationships, because when we look at the world and try to understand why things are the way they are, we are looking for relationships and not necessarily only those between people. We look for relationships between individuals and social groups with which we identify, e.g. on race, gender, class, nationality, choosing a sports team to support, etc. We look for connections between individuals, communities and institutions with which we live or are connected, such as family, religion, media, sports teams, etc. At the heart of sociology, which is "irreparably multiparadigmatic" (Skembler, 2007) is the recognition that social structures and forces shape views, beliefs, values, expectations, and a sense of the normal. It must not be ignored that social structures and constraints shape our experiences, but also the ways of cooperating with other people, and ultimately the trajectories and outcomes of our lives. For sociologists, sport represents a colorful field of reflection and dynamics of changes in values, interests and activities of modern humanity (Sekot, 2018).

The contemporary development of the sociology of sport is in an ambivalent relationship to sport (and many social activities related to it). While, on the one hand, there is an extremely high interest of people in sports (as well as in increasingly diverse information about sports activities), the field of knowledge about sports (approaches, analyses, explanations) "branches out" in several separate directions, which lead to " crumbling" of the initial ideas about the sociology of sport as a complete sociological discipline (Milovanović & Radenović, 2020).

Transhumanism In Sports

As in sports, at the centre of transhumanist studies are people. Sport, due to its competitive nature, deals with the physical and psychological development of

сочиво без личног мишљења. Оне уопштавају узроке и поступке појединаца у обрасце и категорије. Међутим, оне не само да посматрају ове друштвене обрасце, већ и покушавају да објасне такве обрасце или понашања. Један од главних циљева социолошке перспективе је да се пронађу и разумеју обрасци који стоје иза понављајућих карактеристика друштвене интеракције, као и да се испитају друштвени утицаји истих . Оне укључују препознавање и процену ефеката друштвених односа, као и друштвених структура и сила, с обзиром на садашњост у историјском контексту. То су перспективе које подстичу на критичко размишљање, али и постављање критичких питања и потрага за решењима.

Улога спорта у стварању заједнице и колективног идентитета захтева детаљан социолошки преглед . Веома је битно да испитамо социјалне односе, јер када гледамо на свет и покушавамо да схватимо зашто су ствари такве какве јесу, ми тражимо односе и то не само нужно оне између људи. Тражимо односе између појединаца и друштвених група са којима се идентификујемо, нпр. по питању расе, пола, класе, националности, одабира спортског тима за који навијамо итд. Тражимо везе између појединаца, заједница и институција са којима живимо или смо повезани, као што су породица, религија, медији, спортски колективи итд. У срцу социологије, која је „непоправљиво мултипарадигматска" је признање да друштвене структуре и снаге обликују погледе, веровања, вредности, очекивања и осећај нормалног. Не сме се занемарити да друштвене структуре и стеге обликују наша искуства, али и начине сарађивања са другим људима, а на крају и путање и исходе наших живота. За социологе спорт представља шарено поље рефлексије и динамике промена вредности, интересовања и активности савременог човечанства .

Савремени развој социологије спорта налази се у амбивалентном односу према спорту (и многим друштвеним активностима које су у вези са њим). Док се, с једне стране, запажа изузетно велико интересовање људи за спорт (као и за све разноврсније информације о спортским активностима), дотле се сазнајно поље о спорту (приступи, анализе, образлагања) „разгранава" у више засебних праваца, који воде „мрвљењу" почетне замисли о социологији спорта као целовитој социолошкој дисциплини .

Трансхуманизам у спорту

Као и у спорту, у центру трансхуманистичких студија налазе се људи. Спорт се, због своје такмичарске природе, бави физичким и психичким развојем људи, али је истовремено и арена за суочавање са тешким

people, but at the same time it is an arena for facing difficult physical challenges, which leads us to the fact that ascetic defiance is an unequivocally fundamental and praiseworthy element of sports activities (Aggerholm, 2020). The philosophy of transhumanism also includes the physical and mental development of human beings with the contributions of various technologies. In this regard, it is quite possible that both concepts will be influenced by developments in similar fields (Ross, 2020). Although both concepts produce arguments in the same direction about human development, sports and transhumanism differ from each other on some moral points. It is a general opinion that sport takes place through natural development, while transhumanism deals with artificial development. However, there are some points where natural and artificial technologies intersect and simply cannot be avoided. At the moment, scientific and technological developments lead us to moral debates related to sports. In this context, with a brief overview of scientific and technological developments, which allow human beings to develop artificially, it is easier to understand and understand the points of intersection and divergence of sports and transhumanism. On the one hand, in the direction of transhumanism, the connection between current technological development and sport will be under eternal scrutiny, while on the other hand, the impact of possible future technological development on sport will be able to be evaluated. The transhumanist point of departure is what humanists considered the "great" human being, which transhumanists consider imperfect, seeking to improve it through technology (Asis, 2021). For humanists, human excellence was the goal, while according to transhumanists, such an ideal of human excellence is the starting point. The transcendental use of technology in sport would lead to transhumanist sport (Monasterio Astobiza, 2020). Dealing with the concept of transhumanism, D. Grano in his book "The Eternal Present of Sport: Rethinking Sport and Religion" argues that: "there is a point of rupture that emerges around the boundary between athletes and technology and that sport, competitive or not, is always associated with the transgression of boundaries" (Grano, 2017). . Today we see an increased use of not only doping, but also enhancement techniques, such as e.g. prostheses. Natural body enhancements in the world of sports raise the question of the meaning of competition between natural and cyborgized athletes (Greguric, 2012). These new phenomena lead us, among other things, to discuss the boundary line that exists between care and growth, which is often described as the gateway to transhumanism in the field of health. If, along

физичким изазовима, што нас наводи на чињеницу да је аскетски пркос недвосмислено фундаменталан и хвале вредан елемент спортских активности . Филозофија трансхуманизма такође укључује физички и ментални развој људских бића уз доприносе различитих технологија. С тим у вези, сасвим је могуће да ће на оба концепта утицати развоји из сличних области . Иако оба концепта производе аргументе у истом правцу о људском развоју, спорт и трансхуманизам се разликују један од другог по неким моралним тачкама. Уопштено је мишљење да се спорт одвија природним развијањем, док се трансхуманизам бави вештачким развојем. Ипак, постоје неке тачке где се природне и вештачке технологије укрштају и просто не могу да се избегну. У овом тренутку, научни и технолошки развој нас доводе до моралних дебата везаних за спорт. У том контексту, кратким прегледом научног и технолошког развоја, који омогућавају људским бићима да се вештачки развијају, лакше је схватити и разумети тачке пресека и дивергенције спорта и трансхуманизма. С једне стране, у правцу трансхуманизма, повезаност актуелног технолошког развоја са спортом биће у вечитим преиспитивањима, док ће с друге стране, утицај могућег будућег технолошког развоја на спорт моћи да се оцењује. Трансхуманистичко полазиште је оно што су хуманисти сматрали за „одлично" људско биће, које трансхуманисти сматрају несавршеним, настојећи да га побољшају кроз технологију . Хуманистима је људска изврсност била циљ, док је према трансхуманистима, такав идеал људске изврсности - полазна тачка. Трансцендентална употреба технологије у спорту довела би до трансхуманистичког спорта. Бавећи се појмом трансхуманизма, Д. Грано у својој књизи „Вечна садашњост спорта: преиспитивање спорта и религије" тврди да: „постоји тачка руптуре која се појављује око границе између спортиста и технологије и да је спорт, такмичарски или не, увек повезан са прекорачењем граница" . Данас видимо повећану употребу не само допинга, већ и техника повећања, као што су нпр. протезе. Побољшања природног тела у свету спорта поставља питање о смислу такмичења између природних и киборгизованих спортиста . Ови нови феномени нас наводе, између осталог, да разговарамо о граничној линији која постоји између бриге и раста, која се често описује као капија ка трансхуманизму у области здравља. Ако се уз (све значајније) увођење технологија, па чак и виртуелних, дода такав култ перформанси у области спорта, то нас може навести да се запитамо - да ли ће спорт заправо постати

with the (increasingly significant) introduction of technologies, even virtual ones, such a cult of performance in the field of sports is added, it may lead us to wonder - whether sport will actually become a "Trojan horse" of transhumanism (Besnier, Massacrier, & Petit, 2020).

Sport has a traditional role in the societies of many countries around the world. It also causes strange loyalties, extreme ideologies and contradictory emotions (Trifonas, 2003). Certain sports have dominated due to high participation and high publicity, which have allowed those who work in them to rely on this traditional connection with many aspects of society, such as e.g. class. Sports organizations have been using new technologies to improve the playability of their sport for several years. There are instances where these advances in technology have helped the sport by making it more attractive and therefore more marketable to a wider audience. However, there are also cases where advances in technology have taken away the element of human error that made sports attractive in the past (Maguire, Jarvie, Bradley, & Mansfield, 2002). Technological advances in scoring and timing systems have enabled many local sports teams to equip their facilities with accurate and consistent game-assistance devices that add to the sports experience for spectators and players. These advantages have resulted from the rapid expansion and reduction of the cost of technology, which has placed much of the technology within the reach of local organizations and sport participants. However, technology has the ability to reduce some of the predictability necessary for sports marketing. All sports have used technology developments to improve their ability to market and administer their product offerings and extensions (Miah, 2019).

The use of communication technology has enabled sports organizations to communicate with members across geographical distances. While face-to-face meetings and mailings are still used, their frequency may be reduced with the availability of cheaper long-distance phone calls, e-mail, text/video messages, video conferencing, etc. For local sports clubs, some of these new technologies are not always needed, but for organizations that work across long distances around the world, these technologies are proving increasingly necessary (Kim, Chiu, & Chow, 2019). The use of the Internet has made it possible for sports organizations of any size to have a global presence. This is the only way organizations can create a virtual online environment that allows them to interact with members and potential customers, get feedback, post discussions and news, watch shows, market products and earn advertising revenue if they are able to.

„тројански коњ" трансхуманизма .

Спорт има традиционалну улогу у друштвима многих земаља широм света. Такође проузрокује чудне оданости, екстремне идеологије и контрадикторне емоције . Одређени спортови су доминирали захваљујући великом учешћу и великом публицитету, који су омогућили онима који раде у њима да се ослоне на ову традиционалну везу са многим аспектима друштва, као што су нпр. класе. Спортске организације већ неколико година користе нове технологије да побољшају игривост свог спорта. Постоје случајеви у којима је овај напредак у технологији помогао спорту чинећи га привлачнијим и стога тржишно заступљенијим широј публици. Ипак, постоје и случајеви у којима је напредак у технологији одузео елемент људске грешке, који је спорт чинио атрактивним у прошлости . Технолошки напредак у системима за бодовање и мерење времена омогућио је бројним локалним спортским тимовима да опремају своје објекте прецизним и доследним уређајима за помоћ у игри, који доприносе спортском искуству за гледаоце и играче. Ове предности су произашле из брзог ширења и смањења трошкова технологије, која је ставила велики део технологије на дохват локалне организације и учесника у спорту. Ипак, технологија има способност да смањи део предвидљивости која је неопходна за маркетинг спорта. Сви спортови су користили развој технологије како би побољшали способност да пласирају на тржиште и администрирају своју понуду производа и проширења .

Употреба комуникационе технологије омогућила је спортским организацијама да комуницирају са члановима на различитим географским растојањима. Док се састанци на лицу места и слање поште још увек користе, њихова учесталост се може смањити доступношћу јефтинијих међуградских телефонских позива, електронске поште, текстуалних/видео порука, видео-конференција итд. За локалне спортске клубове неке од ових нових технологија нису увек потребне, али за организације које раде на великим удаљеностима широм света, ове технологије се показују све потребнијима . Коришћење интернета омогућило је спортским организацијама било које величине да имају глобално присуство. Само на тај начин се омогућава организацијама да створе виртуелно онлајн окружење, које им омогућава да комуницирају са члановима и потенцијалним купцима, добијају повратне информације, постављају дискусије и вести, гледају емисије, производе на тржишту и зараде приход од реклама, уколико су у могућности

attract sponsors to the site. While these capabilities are still tied to an organization's ability to attract customers from a specific potentially global area, they provide the sports marketer with a constantly evolving marketing development tool.

Transhumanism From the Point of View of Futuristic Marketing

Opinions are growing louder that conscious evolution will be a serious competitor to natural evolution. Some sociologists have even proposed the expediency of conscious evolution, because information derived from the past is explicitly included in the decision-making process, while unconscious evolution has implicit information and is encoded in genes and the natural environment (Sabiston, Pila, & Gilchrist, 2020). From there we can derive the premise that this revolutionary information means that we are arriving at a new term - futuristic marketing. We can see this conscious evolution taking place in our everyday world, where people use tools and information to change our environment and make it more welcoming.

Proponents of transhumanism argue that life extension may soon become as routine as the technologies we take for granted today. For them, the scenario is not only worth pursuing, but also feasible. Transhumanism is a research program on artificial intelligence, but also a movement with its own set of values and beliefs, which has gradually developed over the last two decades. Through the responsible use of science, technology and other rational means, going through a "transhuman" work in progress, we will eventually succeed in becoming posthuman. This would mean extending human lifespan, eradicating disease, eliminating unnecessary suffering and increasing human intellectual, physical and emotional capacities (Lazzaris, 2023). Transhumanism, in addition to being observable in future artificial intelligence, can systematically help humans overcome their own limitations. Technological solutions were a part of social development, because their use made everyday activities easier. The adoption of virtual reality can play an influential role in our ability to understand perspectives that we cannot currently reach (Singh, 2017).

It is certain that the need for human labour will be drastically reduced, forcing humans to compete with AI and at the same time forcing computational integration between the human brain and the AI brain (Barrat, 2013). This thought seems much more likely to be the tipping point towards transhumanism rather than the need for designer bodies - which seems a bit egotistical and against

да привуку спонзоре на сајт. Иако су ове могућности још увек повезане са способношћу организације да привуче купце из одређеног потенцијално глобалног подручја, оне пружају спортском маркетеру алат за развој маркетинга који константно напредује.

Трансхуманизам са становишта футуристичког маркетинга

Све су гласнија мишљења да ће свесна еволуција бити озбиљан конкурент природној еволуцији. Неки социолози су чак предложили сврсисходност свесне еволуције, јер информације изведене из прошлости су експлицитно укључене у процес доношења одлука, док несвесна еволуција има имплицитне информације и кодирана је у генима и природном окружење . Одатле можемо извести премису да ове револуционарне информације значе да долазимо до новог појма – футуристички маркетинг. Можемо видети како се ова свесна еволуција одвија у нашем свакодневном свету, где људи користе алате и информације да би променили наше окружење и учинили га гостопримљивијим.

Присталице трансхуманизма тврде да би продужавање живота ускоро могло постати једнако рутинско као и технологије које данас узимамо здраво за готово. За њих, сценарио не само да је вредан потраге, већ је и изводљив. Трансхуманизам је истраживачки програм о вештачкој интелигенцији, али и покрет са својим скупом вредности и веровања, који се постепено развијао у последње две деценије. Одговорном употребом науке, технологије и других рационалних средстава, пролазећи кроз „трансхумани" рад у току, на крају ћемо успети да постанемо постљуди. То би значило продужење људског животног века, искорењивање болести, елиминисање непотребне патње и повећање људских интелектуалних, физичких и емоционалних капацитета . Трансхуманизам, осим што се може уочити у будућој вештачкој интелигенцији, може систематично помоћи људима у превазилажењу сопствених ограничења. Технолошка решења су чинила део друштвеног развоја, јер је њиховом употребом омогућено олакшавање свакодневних активности. Усвајање виртуелне стварности може да игра утицајну улогу у нашој способности да разумемо перспективе које тренутно не можемо досегнути .

Извесно је да ће се потреба за људским радом драстично смањити, присиљавајући људе да се такмиче са вештачком интелигенцијом и да истовремено присиљавају рачунарску интеграцију између људског мозга и мозга вештачке интелигенције . Ово мисао изгледа као много вероватнија за преломну тачку ка трансхумани-

human morality. The problem is that the spiritual evolution of the mind and the physical evolution of technology are two completely different processes. The technetronic development of civilization in general, and the technogenic transformation of man in particular, is hindered by the evolution of the spiritual nature of the mind. And this is not just a hypothesis, but, unfortunately, a real fact whose scientific validity grows with the development of the information society (Wilson, 2021).

Conclusion

In the near future, transhumanism will affect many sectors and economic structures, and its influence on many branches of science, which concern humanity and its nature, such as: medicine, sociology, philosophy, religion and ultimately - sports, will be inevitable. Any kind of work aimed at increasing the physical and cognitive abilities of a person will undoubtedly have positive and negative contributions that are expected in sports and its sector. Since the sports sector basically consists of people, it is predicted that sports and its environment will be influenced and transformed by the trend of transhumanism. It is undoubtedly important to be able to predict the place of transhumanism in the future of sports, as well as the very methods by which sports will be shaped under its auspices. In this regard, it is important to examine the possible reflections, advantages and disadvantages of transhumanism through the prism of the sports marketing industry, and shed light on the future of today's sports.

This paper also deals with the discussion of the sports model, in order to see how and in what way the cult of exceeding the limits weakens sport and paves the way for a technological proposal whose goal is not only sport, but also the whole transhumanist project of overcoming the human, through the prism of the sports-marketing industry. We aim to draw attention to the opportunities and threats that may arise in sport with the development of transhumanism research in the future. Transhumanism, unlike true knowledge, draws man deeper into the world of matter and illusion. How and in what way transhumanism in symbiosis with artificial intelligence will ultimately (re)shape our planet leaves significant room for new revolutionary research.

зму, а не потреби за дизајнерским телима - што се чини помало егоистично и противно људском моралу. Проблем је у томе што су духовна еволуција ума и физичка еволуција технологије два потпуно различита процеса. Технотронички развој цивилизације уопште, а посебно техногена трансформација човека, онемогућава еволуција духовне природе ума. И ово није само хипотеза, већ, нажалост, и стварна чињеница чија научна валидност расте са развојем информационог друштва.

Закључак

У блиској будућности трансхуманизам ће утицати на многе секторе и привредне структуре, а биће неизбежан и његов утицај на многе гране науке, које се тичу човечанства и његове природе, као што су: медицина, социологија, филозофија, религија и у коначници - спорт. Било која врста рада усмерена на повећање физичких и когнитивних способности човека, несумњиво ће имати позитивне и негативне доприносе који се очекују у спорту и његовом сектору. Будући да се у спортском сектору, у основи, налазе људи, предвиђа се да ће спорт и његово окружење бити под утицајем и трансформацијом тренда трансхуманизма. Несумњиво је важно да се може предвидети место трансхуманизма у будућности спорта, као и самих метода путем којих ће се спорт обликовати под његовим окриљем. С тим у вези, важно је испитати могуће рефлексије, предности и недостатке трансхуманизма кроз призму спортско-маркетиншке индустрије, те расветлити будућност данашњег спорта.

Овај рад се бави и расправом о спортском моделу, да бисмо видели како и на који начин култ прекорачења граница слаби спорт и отвара пут технолошком предлогу чији циљ није само спорт, већ и цео трансхуманистички пројекат превазилажења људског, кроз призму спортско-маркетишке индустрије. Имамо за циљ да скренемо пажњу на могућности и претње које могу настати у спорту са развојем истраживања трансхуманизма у будућности. Трансхуманизам, за разлику од истинског знања, увлачи човека дубље у свет материје и илузије. Како и на који начин ће трансхуманизам у симбиози са вештачком интелигенцијом у коначници (пре)обликовати нашу планету, оставља значајан простор за нова револуционарна истраживања.

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Physical Activity of Students

Dušan Stupar, Igor Beretić, Bojan Međedović
Faculty of Sport and Psychology, TIMS, Novi Sad, Serbia

Correspondence:
Bojan Međedović, Faculty of Sport and Psychology, TIMS, Novi Sad, Serbia
medjedovic.bojan@gmail.com

Abstract: *Research has shown and constantly confirms the fact that people are less and less physically active due to rapid technological development, which has a direct consequence of an increased risk of developing various diseases, especially non-infectious chronic ones. Reduced levels of physical activities were equally observed, both in children and young people and in adults. The aim of the work is to point out the problems that arise due to the physical inactivity of the student population and point out possible solutions that can be applied in practice. To some extent, the education system in the Republic of Serbia, which abolished regular physical education classes at universities, contributed to this, which worsened the situation even more. Some faculties include sports and recreational activities in their curricula and teaching plans. The conclusion is that there are examples of good practices and solutions that promote the physical activity of students, but everyone should be involved, starting from state institutions, clubs, and associations, and all the way to the family.*
Keywords: *movement, physical activity, students.*

Introduction

Movement as a basis of physical activity

A permanent man's need to make his way of living easier is significantly affected by computer technologies and the oncoming of the internet. Multiple human-performed operations that require enormous energy are replaced by computers, which implies minimum energy inputs allocated predominantly for many-hour sitting. Thus, contemporary technology has reduced human activity mostly to intellectual work, with a direct consequence of decreased physical activity that has activated the potential risks of adverse effects on health (Hollmann & Hettinger, 2000). At the same time, it is just with this modernization that the man has imposed on himself, consciously or unconsciously, a specific style of life that can significantly cause many diseases, predominantly chronic noncontagious ones (obesity, hypertension, bad posture, and postural disorders, diabetes, bad mental condition). Noncontagious chronic diseases whose treatment requires significant material costs are the most frequent reason for using health care services. Research carried out in Serbia (Milić et al., 2021) shows that the majority percentage of the examined population has hypertension 29.6%), then the lower spinal deformity or another chronic back problem (17.2%), neck deformity or another chronic cervical spine problem (12.1%), increased lipids in the blood (10.8%), coronary heart disease or angina pectoris (8.9%), diabetes (7.8%), allergy (7.3%), degenerative joint disease or arthrosis (6.9%), depression (4.3%) and kidney problems (3.9%).

Besides, throughout the history of human existence, we have been exposed to different diseases that, each in its way, have taken its toll in terms of human lives. For this reason, doctors and scientists have continuously strived for medications that could generally affect a longer life expectancy. Based on the present state of affairs, they are on the right track since there is an increasing tendency toward longer life with more good-health years. Accordingly, the global life expectancy at birth rose from 66.8 years in 2000 to 73.3 years in 2019, while the healthy life expectancy (HALE) went up from 58.3 years to 63.7 (WHO, 2022). Decades of effort and work were necessary to achieve such results. In turn, there is an absurd situation in which, in the quest for new solutions for disease elimination and additionally increased life expectancy, the man has deprived himself of the accessibility of natural medication, i.e., movement. Its benefit is, first of all, in prevention since by „consuming" it, we can decrease the probability of occurrence of the above chronic noncontagious diseases.

Even though life officially begins with childbirth, by using ultrasound probes, pediatricians can evaluate the quality of the human fetus during pregnancy, among other things, on the basis of its *movement*. Immediately after

childbirth, more specifically, after the first and the fifth minute of its life, the baby's vitality is estimated using the APGAR test, one part of which, i.e., ACTIVITY is essentially based on the movement of muscles (muscular tonus). At the beginning of the millennium, particular researchers (Casey, McIntire, & Leveno, 2001) found that the APGAR scoring system remained relevant for the prognosis of neonatal survival during the former 50-year period.

The movement is, among other things, the basis of further estimation of the child's motor development; thus, there are criteria for monitoring motor development (head posture control, sitting and standing) in the first year of life, which should be spontaneous (Dimitrijević, Čolović, 2005). During childhood, as well as in other ages in life (puberty, youth, middle age, and elderly age), the movement has an equally important significance, both for performing everyday activities and preservation of health, prevention of different noncontagious diseases, and also for top sports achievements. Also, when dealing with the elderly, their vitality is frequently equalized with the ability to perform by themselves particular activities for which engagement of specific movements is required (e.g., getting up, taking a bath, getting dressed, walking, and running). In that sense, there are certain tests for the estimation of the physical capacities of elderly people for performing everyday activities (Rikli, Jones, 2013). But then again, the ability to perform fast, precisely, and vigorously specific movements in the sport can bring an individual a solution to existential problems, enrichment, and fame by means of which preconditions (but not the only ones) get created for a quality life. How high the significance of the movement is, not only in the physical sense but also in the psychological one, is probably best understood by persons who have survived traumatic injuries (of the spina cord, brain, etc.). The quality of their life is conditioned directly by the ability to perform particular movements through physical exercises. In accordance with this, for each life age mentioned above, i.e., depending on the characteristics of each life age, it is necessary to practice movement as a basis for different physical activities but also physical exercising.

The concept and importance of physical activities

According to the most frequently mentioned definition, *physical activities* are any kind of bodily *movements* produced by skeletal muscles that result in energy consumption. (Caspersen, Powell, Christenson, 1985). Essentially the same, but the slightly corrected definition is supported by the World Health Organization (WHO), according to which the activities requiring energy consumption are replaced by bodily movements "requiring energy expenditure" (Piggin, 2020). Criticizing the existing definition, the same author believes it is not holistic enough, so he offers the following one, which says that physical activity includes people who move, act, and perform something within a culturally specific space and context and under the influence of a unique set of interests, emotions, instructions, ideas, and relationships (Pigin, 2019. A group of authors (Ostojić, Veljović, Stojanović, Međedović, Ahmetović, 2009) gives a precise definition of the difference between physical activity and physical exercising. In that context, physical activity represents all movements that affect higher energy consumption than at rest and includes everyday activities such as walking, cycling, climbing stairs, housework, and going shopping. Exercising, on the other side, represents a planned and fit-for-purpose activity whose primary aim is the improvement of health and physical fitness. The common denominator for both is definitely the movement.

In contemporary terminology, the absence of physical activities means physical inactivity. An estimate based on findings of the World Health Organization (WHO) suggests that 3.2 million death outcomes per year have to do with insufficient physical activity, as well as that it is the fourth leading risk factor of the occurrence of noncontagious diseases. Globally speaking, 1 in 4 adult persons and 3 in 4 adolescents (11-17 years of age) do not follow current global recommendations for physical activity defined by the WHO. The current recommendation for adult persons is at least 50 minutes of physical activity of moderate intensity per week (both paid and non-paid work: housework, going for a walk, cycling, and some form of recreation that also includes sports activities) and 60 minutes of moderate or intensive physical activity per day, for adolescents. Along with the economic development, the levels of physical inactivity go up so that they are twice as much in high-income countries than in low-income ones due to the change in transport services, increased use of technology, and urbanization (WHO, 2018).

Physical activity of students

The Law on Youth of the Republic of Serbia (2011) defines youth or young people as persons from 15 to 30 years of age and including it. Also, the student population account for the most part of it. Concerning psychophysical abilities of that age, a logical conclusion is that it is a physically active population. However, research shows the op-

posite is true since young people spend more time in sedentary behavior and high consumption of alcohol and tobacco during the university period (Kwan et al., 2012, Ortega et al., 2013), and they are physically inactive (Hase et al., 2004, Irvin, 2004). Serbia is no exception (Macanović et al., 2013, Malčić, Marić-Jurišin, 2018). Some researchers have shown that the highest drop in physical activities occurs right during university studies, i.e., during the transition from youth age to the age of adults (Kwan, Cairney, Faulkner & Pullenayegum, 2012). Others (Grim, Hortz, Petosa, 2011) confirm that the steepest curve showing the drop in physical activities can be observed at the very beginning of academic studies so that the level of recommended physical activities goes down after the 24th year of age.

At the same time, a serious problem incurs with encouraging students to participate in physical activities every day in order to gain health benefits. Research results indicate that the current higher education does not encourage students to become physically active adults (Keating, Guan, Piñero, Bridges, 2005).

The situation is similar in Serbia. Until 1998, physical activities at universities in Serbia could have been practiced through physical education and sports (competitive) activities that formed part of the curriculum of each faculty. As exemplified by the University of Belgrade, during these years but before passing the Law, one could notice a system in which each first-year student had to pass a swimming test. Different sports activities were on offer: various fitness programs, sports games, cross-country running, and skating, as well as an organized walking tour to Avala and a sports-recreative day at Ada Ciganlija. Classes of physical education (two classes per week) were held at sports centers. Classes attendance was certified by a signature and stamp in the student booklet, and it was not possible to verify a semester without a sufficient number of these activities. Students absent from classes for any reason had a chance to compensate for the missed classes during the weekend, taking care not to exceed the number of activities, i.e., to avoid disrupting the continuity of regular exercising (Mitić, 2008). The organization of kinesiological activities in neighboring Croatia was similar, i.e., they used to be part of compulsory student content during a particular semester (Gelemović & Svoboda, 2010; Granić, Hraste & Marković, 2014).

Even though being quite clearly recognized within the context of Serbian academic circles, the problem of youth physical (in)activity has still not received proper attention, neither in terms of systematic and empirical research nor adequate active institutional support (especially at the level of higher education institutions). Although education "authorities" declaratively advocate and formally emphasize the importance of university sports, a clear and timely scheduled development concept of sports (regular physical exercising) at higher education institutions in Serbia is still missing. This has resulted in a still visible, spontaneous, and chaotic existence of certain forms of sport at universities. Success in student sports competitions is due to sports organizations outside the education system rather than an organized sports life within the university. Among other things, students have neither sports facilities for exercising and competition at their faculties nor a clearly and expertly formed system for performing sports activities matching their interests and needs (Nešić, Nešić, 2020, pp. 18). In this light, research results indicate that there is a significant difference relevant to the faculty at which they study so that intensive physical activities are predominantly practiced by students of the Faculty of Sport and Physical Education, whereas the least engagement in these activities is reported for students of the Faculty of Sciences and Mathematics (Malčić, Marić-Jurišin, 2018).

In research conducted with an aim to examine students' perception of physical activities, more specifically, the perception of sports activities (Nešić, Nešić, 2020), the highest number of examinees clearly indicated the factor of sports infrastructure at higher education institutions (poor or non-existent), as well as lack of information (knowledge) on values and benefits of regular physical exercising as principal reasons for non-practicing physical activities. The solution to the problem could probably be found in relevant government institutions that could provide the funds needed for the construction of new sports and recreation facilities or refurbishment of the existing ones. As for the issue of informedness on the values of physical exercise, it is something government institutions can arrange within the systems they manage. Also, these issues do not require great material resources, whereas particular types of workshops and lectures can be organized by hiring professors and experts in the relevant fields. However, the more striking issue is the Government's attitude towards these issues since they do not pay due attention to them. The very fact that the last Sports Development Strategy of the Republic of Serbia has been mapped out for the period 2014-2018 shows that concrete action concerning this segment is also considerably delayed. Taking into account the fact that an almost four-year Olympic cycle has passed without the Strategy for the 2019-2023 period, as well as that the new 2023-2027 should have long since been announced, the conclusion logically imposed is that the issue of university sport is not in the focus of the Government. Even though the above document (2014-2018 Sports Development Strategy) foresaw

particular improvements in university sports (material and technical conditions, increased number of sports sections, and facilitating studies of top athletes), nothing has been realized practically. The relevant proof lies in the Implementation Analysis of the expected outcomes defined by the 2014-2018 Sports Development Strategy in the Republic of Serbia, in which the prime aim was the development of the sport of children and youth, including school sports too. University sport was mentioned as a part of this aim, but its realization is only described scantly in the detailed analysis of the Strategy. However, we do not have the relevant data for the university population, so giving the exact breakout report at this moment is not possible. Therefore, albeit conditionally, we can conclude that this expected outcome was realized (cf. Implementation Analysis of expected outcomes defined by 2014-2018 Sports Development Strategy of the Republic of Serbia, pp. 17). In fact, the above estimation of outcome realization is based on a single piece of information in the Analysis, i.e., the percentage of students engaged in sports competitions amounting to an extremely low 6.8% in 2018 (versus only 3% in 2015) and 7.2% at the municipality level (versus 4% in 2015).

Examples of good practice

The example of Novi Sad City Authorities for Sport and Youth that supported the 2013-2019 youth-focused project entitled "Make haste slowly", whose leader was a sports association "Super Active" from Novi Sad, speaks in favor of the fact that there are solutions that are also applicable. The Project involved free-of-charge sports and recreational activities that the young practiced under the supervision of professionals, professors of sports and physical education, and licensed coaches. As exemplified by the Project, cooperation in all factors that can affect the promotion of physical activity is possible, as well as creating a work matrix for the future. On the top of the pyramid are City Authorities, which provided the necessary funds, as well as the facilities and timing for particular sports and recreation activities (swimming pool and ice rink). Even though research findings (Kordić, Babić, 2011) indicate that most students state that the main reasons for non-practicing physical activities are shortage of time (26%) and faculty obligations (23%), with the lowest importance given to insufficient funds (2%), it is evident that the implementation of such a project is not possible without the material help of local authorities. The obtained funds were used for purchasing sports apparatuses necessary for the Project implementation but also for payments of fees of professionals as a means of extra motivation for making the Project successful. Apart from the City Authorities, sports clubs, and sports associations also contributed to the Project implementation, even though by helping the animation of youth for sports and recreation activities, they also gained their own benefits directly. Clubs also could offer free-of-charge exercise timelines for the young according to their estimation and capabilities. In this way, they could indirectly attract potential users of their services since there is practical evidence that those who liked such activities used to become regular club members. That is especially true of less popular sports, so clubs were interested in getting promoted this way. In addition to providing professional staff, the Project leader had to recognize the wishes and interests of the young, so they conducted occasional surveys through the most accessible social networks for the young people, which provided answers on the type of sports and recreation activities they wished to perform. In this way, besides standard sports like swimming, skating, and running, other sports were included too, such as fencing, badminton, darts, sports dance, Nordic walking, hiking and tracking, sports climbing, table tennis, golf, folklore, aqua aerobics, Zumba, cycling, martial arts (boxing, aikido, capoeira), archery, shooting, parachuting, bowling, diving, and horse riding. The fact that 5000 young people participated in the Project implementation, predominantly students of the Novi Sad University, suggests that interest in the Project was evidently high.

Conclusions

The irrevocable fact is that the young, more exactly, students making up part of this population, are not sufficiently physically active. Lots of research works tried to find out the actual reasons for this, with only a few that gave concrete suggestions for solving the problem of insufficient physical activities. With research into these issues and an overview of the accessible literature, the authors have drawn the following conclusions.

The problem of insufficient physical activity in youth, concretely students, must be solved synchronically and in several directions. All relevant factors should be involved in it, such as government authorities in this field (Ministry of Youth and Sports of the Republic of Serbia, local self-governing authorities, city authorities for sport and youth, faculties and higher schools), sports clubs and associations, marketing experts, psychologists, but also families.

Government institutions and local self-governing authorities should provide material resources rather than only

declarative support for all activities (projects) that could yield positive effects in terms of making students recognize, understand, and get involved in particular physical activities. Besides, government institutions should monitor those issues and include them timely in Sports Strategy since any delay aggravates the situation, as exemplified by turbulent times during which the Korona virus pandemic has further diminished the level of physical activity of the whole global population and not only students.

Faculties and higher schools should not reconcile to the current situation for which they are not directly responsible since the 1998 Law relieved them from compulsory classes of sport and physical education at tertiary education. Thus, an urgent change is necessary concerning the current situation in which students do not get in touch with organized physical activities (except for faculties of sport and physical education and academic institutions that have recognized the importance of physical activities and included them in their curricula). Actually, all academic institutions should introduce some organized physical activities, either on a mandatory basis or an optional one. For these activities, students could also get credits in accordance with their engagement and effort. A key component in the physical activities on offer should be the interest of students themselves, meaning that they do not have to take a strict form of the class of physical education that maintained some relics from the past times such as red shorts, white T-shirts, strict discipline, class timing, and duration, as well as prescribed sports events for practicing. That practically means that organized physical activities should result from monitoring students' needs through different surveys via social networks that could provide information on the activities students are actually interested in, rather than being reduced to playing football and basketball only. In this light, some other less "known" and less publicly practiced sports events can be much more interesting than, let's say classic gymnastics, such as darts, archery, aqua aerobic, parachuting, dance, countryside outings, boating, and kayaking.

Sports clubs have enormous potential for recreational activities but they do not recognize them since they are primarily interested in the competitive-oriented population alone. Such a harsh reality in most sports clubs is exemplified by the fact that a 19-year-old applicant for admission at a swimming or volleyball club is rejected, by default, since s/he is late for the competition. On the other hand, there is a noticeable increase of recreation runners globally, as well as at home where they, in fact, predominate in organized races, and by paying their participation fees, they help the organization of races in which professional runners take part too.

The youth, i.e., the student population, are very active in social networks, which should be exploited for more intensive action, marketing actions, workshops, dialogues, blogs, and lectures, all aimed at paying closer attention to physical activities. Besides, the use of particular mobile applications for sport, fitness, etc., can motivate some of them for taking moves to take action.

Concerning motivation through the use of psychological tools such as a motivational interview, significant progress in practicing physical activity was reported in examinees surveyed using this technique (Lundahl, Kunz, Brownell, Tollefson, Burke, 2010). A group of authors (Karnes, Meyer, Berger, Brondino, 2015) also explored the possibility of using motivational interviews to increase the intensity of physical activity through the Internet, which yielded promising results. The authors also believe that this form of motivation is also an effective means of intervention aimed at health promotion.

Even though the family is listed at the very end, it should actually be the prime factor in deciding whether or not children will be physically active in the future. Children brought up in the environment, i.e., in families where parents attach high significance to physical activities, become physically active themselves. It is deemed that the period of academic studies is the last chance for a person to embrace a healthy lifestyle.

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Short notice
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Relations of Body Dimensions and Specific Motor Abilities of Female Volleyball Players in Relation to the Playing Position

Tamara Karalić[1], Aleksandra Vujmilović[2], Nikolina Gerdijan[1]
[1]Faculty of Physical Education and Sports University of Banja Luka, Bosnia and Herzegovina
[2]Public Institution Medical School, Banja Luka, Bosnia and Herzegovina

Correspondence:
Tamara Karalić, Faculty of Physical Education and Sports, University of Banja Luka Bosnia and Herzegovina
tamara.karalic@ffvs.unibl.org

Abstract: *The subject of research is the physical dimensions and motor abilities of young volleyball players, and the problem is the relationship between these anthropological characteristics and specific playing positions in volleyball. The study included 55 female volleyball players aged 14 to 16 who had been actively training for at least 2 to 4 years. Five (5) dimensions were tested to assess volleyball players' morphological status, as well as the parameters of 5 specific motor tests to assess explosive power, dexterity, and flexibility. Correlation analysis revealed a strong, statistically significant relationship between specific body dimensions and specific motor abilities from various tests. This is especially true for volleyball players' body height (ATV) and arm span (RAR), as well as their maximum, reach a height of the arms (MD1RM) and (MD2RM), in the spike (MDSM), and in the block (MDBLZ). Only the female volleyball sample's body weight (ATT) was unaffected and had no relations to any of the observed parameters.*
Keywords: *correlation, volleyball, motor skills, body dimensions, positions.*

Introduction

Volleyball is recognized as an extremely complex phenomenon throughout the sports system. It arose from the need to solve practical human behavior problems caused by the modern way of life. (Bogojević, 2018, Karalić & Vujmilović, 2018).

An individual who chooses to play volleyball should be aware that modern volleyball requires a young person to have specific morphological and functional abilities, such as being extremely tall, having long limbs, having a high aerobic and anaerobic capacity, having motor intelligence, being able to overcome fatigue and stress, and so on. Secondly, the potential of motor skills is sought (speed, explosive power, coordination, flexibility, precision, endurance, reaction speed, dexterity, agility), whose correct disposition and interaction would ensure not only a quality player but also game success (Vujmilović, 2013).

Creating a volleyball player model has always piqued the interest of researchers and volleyball experts, especially now that science and training techniques have advanced to the point where it is possible to know exactly how fast, strong, tall, agile, and so on promising volleyball player must be. As a result, the essential components of the volleyball player model and their mutual relationship are researched and analyzed, laying the groundwork for a successful selection and training process in general. (Vrbik, Čižmek & Gruić, 2011; Milić, Nešić, Trajković & Radenković, 2012; Perko, 2021). Because this sport has several playing positions, determining the model of the volleyball player we are discussing extends to determining the model in relation to the playing position (setter, opposite, libero, receiver, middle blocker) in order to form a team, a team based on that model (Janković, Đurković & Rešetar, 2009; Mirković, 2018; Karalić, 2021).

The physical dimensions and motor abilities of young volleyball players are the subjects of study, and the problem is the relationship between these anthropological characteristics and specific volleyball playing positions. The purpose of this study is to see if there is a statistically significant relationship between volleyball players' body dimensions and specific motor abilities in relation to their playing position.

Methods

The study included 55 female volleyball players aged 14 to 16 who had been actively training for at least 2 to 4 years. The respondents were divided into five groups based on their position on the field: group 1: opposites (11), group 2: middle blockers (13), group 3: receivers (17), group 4: setters (9), and group 5: liberos (5).

The morphological status of volleyball players was evaluated using five dimensions: body height (ATV), body weight (ATT), arm span (RAR), maximum one-handed reach (MD1RM), and maximum two-handed reach (MD2RM). Maximum reach in the spike (MDSM), maximum reach in the block from a place (MDBLM), and maximum reach in the run-up block (MDBZ) were among the criteria of five particular motor tests used to measure the kind of jumping's explosive force, dexterity, and flexibility they are used in volleyball practice as a modified Sargent test and tests 9-3-6-3-9 (93639) and forward bend on the bench (PRKL). The correlation of two specific systems anthropological status of female volleyball players was tested using standard statistical procedures.

Results

Table 1 shows a strong correlation between body height (ATV) and tests for the **Opposite** group: maximum reach in the spike (MDSM =**0.73**), maximum reach in the block from a place (MDBLM =**0.84**), and maximum reach in the run-up block (MDBLZ) =**0.72**). There was also a very high correlation of arm span (RAR) with the tests: maximum reach in the spike (MDSM = **0.88**), maximum reach in the block from a place (MDBLM = 0.88), and with the test maximum reach in the run-up block (MDBLZ) =**0.84**). The one-handed maximum reach (MD1RM) test is associated with the test's maximum reach in the spike (MDSM=**0.71**), maximum reach in the block from the place (MDBLM=**0.75**), maximum reach in the run-up block (MDBLZ=**0.76**) and forward bend on the bench (PRKL=**0.64**). The tests maximum reach in the spike (MDSM=**0.73**), maximum reach in the block from the place (MDBLM=**0.76**), maximum reach in the run-up block (MDBLZ=**0.77**), and forward bend on the bench (PRKL=**0.63**) showed a high correlation of body dimensions maximum reach with two hands from the place (MD2RM). Bodyweight (ATT) did not show a correlation with specific motor ability tests.

Table 1. *Correlation of morphological and motor space variables for the OPPOSITES group*

Marked correlations are significant at the level p = .05; N=11; r= .553 OPPOSITES					
	MDSM	**MDBLM**	**MDBLZ**	**93639**	**PRKL**
ATV	0.73	0.84	0.72	0.23	0.26
RAR	0.88	0.88	0.84	-0.00	0.47
ATT	0.18	0.35	0.37	0.09	-0.05
MD1RM	0.71	0.75	0.76	-0.11	0.64
MD2RM	0.73	0.76	0.77	-0.10	0.63

A review of Table 2, for the group **Receivers**, showed a very high correlation between body height (ATV) and tests: maximum reach in the block from a place (MDBLM=**0.47**) and maximum reach in the run-up block (MDBLZ=**0.47**). Body dimension arm range (RAR) is weak but statistically significantly associated with the maximal reach test in the block from a place (MDBLM=**0.48**). The one-hand maximum reach test (MD1RM) is related to the test maximum reach in the block from a place (MDBLM=**0.67**), the maximum reach in the run-up block (MDBLZ=**0.60**). Significant correlation with the body dimension of the two-hands maximum reach from the place (MD2RM) is indicated by the values of the coefficients of the maximum of the variable reach in the block from the place (MDBLM =**0.60**) and maximum reach in the run-up block (MDBLZ=**0.53**). Bodyweight (ATT) also did not show a significant relationship with one variable of specific motor space in the group of Receivers.

Table 2. *Correlation of morphological and motor space variables for the RECEIVERS group*

Marked correlations are significant at the level p =.05; N=17; r= .456 RECEIVERS					
	MDSM	**MDBLM**	**MDBLZ**	**93639**	**PRKL**
ATV	0.22	0.47	0.47	0.25	-0.23
RAR	0.34	0.48	0.44	0.13	-0.33
ATT	0.04	0.08	0.02	0.20	0.32
MD1RM	0.45	0.67	0.60	0.28	-0.20
MD2RM	0.37	0.60	0.53	0.31	-0.19

A review of Table 3, for the group of **Middle Blockers**, showed a slightly weaker but significant correlation between body height (ATV) and the maximum reach in the spike test (MDSM= **0.63**) but high with tests maximum reach in the block from a place (MDBLM=**0.83**) maximum reach in the run-up block (MDBLZ=**0.85**) while it is significant with a forward bend on the bench test (PRKL=**-0.53**). A significant association was also observed by arm span (RAR) with tests: maximum reach in the spike (MDSM=**0.63**), maximum reach in the block from the place (MDBLM=**0.68**), and forward bend on the bench test (PRKL=**-0.66**). The one-hand maximum reach test (MD1RM) is significantly related to tests maximum reach in the spike (MDSM=**0.65**) and forward bend on the bench (PRKL=**-0.61**), and very high related to tests maximum reach in the block from the place (MDBLM=**0.80**), maximum reach in the run-up block (MDBLZ=**0.82**). A high correlation of body dimensions and the two-hand maximum reach from a place (MD2RM) was observed with maximum reach in the spike test (MDSM=**0.67**), maximum reach in the block from the place test (MDBLM=**0.80**), maximum reach in the run-up block test (MDBLZ= **0.81**) and with a forward bend on the bench test (PRKL=**-0.60**). In the Middle Blockers group, there was no correlation between body weight (ATT) and specific motor space tests.

Table 3. *Correlation of morphological and motor space variables for the MIDDLE BLOCKERS group*

Marked correlations are significant at the level p = .05; N=13; r= .514 MIDDLE BLOCKERS					
	MDSM	**MDBLM**	**MDBLZ**	**93639**	**PRKL**
ATV	0.63	0.83	0.85	0.30	-0.53
RAR	0.63	0.68	0.74	0.35	-0.66
ATT	0.38	0.34	0.44	0.39	-0.13
MD1RM	0.65	0.80	0.82	0.42	-0.61
MD2RM	0.67	0.80	0.81	0.46	-0.60

A review of Table 4, for the **Setters** group, showed a significant correlation between body height (ATV) and the tests: maximum reach in the block from a place (MDBLM=**0.66**) and maximum reach in the run-up block (MDBLZ=**0.64**). A significant relation of arm span (RAR) with the maximum reach in the spike (MDSM=**0.70**) and maximum reach in the run-up block (MDBLZ=**0.72**) was also observed.

Table 4. *Correlation of morphological and motor space variables for the SETTERS group*

Marked correlations are significant at the level p =.05; N=9; r=.602 SETTERS					
	MDSM	**MDBLM**	**MDBLZ**	**93639**	**PRKL**
ATV	0.52	0.66	0.64	0.20	0.22
RAR	0.48	0.70	0.72	0.20	0.47
ATT	0.42	0.07	0.11	0.27	0.26
MD1RM	0.66	0.76	0.79	0.15	0.46
MD2RM	0.57	0.76	0.77	0.09	0.45

The one-hand maximum reach test (MD1RM) is significantly related to the maximum reach in the spike test (MDSM=**0.66**), the maximum reach in the block from a place (MDBLM=**0.76**), and the maximum reach in the run-up block (MDBLZ=**0.79**). Significant correlation of the body dimension two-hands maximum reach from the place (MD2RM) was observed with the tests maximum reach in the block from the place (MDBLM=**0.76**), maximum reach in the run-up block (MDBLZ=**0.77**). In the Setters group, was no correlation between body weight (ATT) and motor tests.

A review of Table 5, for the **Liberos** group, showed a very high correlation of body height (ATV) with the tests: maximum reach in the spike (MDSM=**0.86**), maximum reach in the block from the place (MDBLM=**0.92**), and maximum reach in the run-up block (MDBLZ)= **0.79**). There was also a strong correlation between arm span (RAR) and the following tests: maximum reach in the spike (MDSM=**0.90**), maximum reach in the block from a place (MDBLM=**0.92**), and maximum reach in the run-up block (MDBLZ=**0.83**), while bodyweight (ATT) is only strongly correlated with test 9-3-6-3-9. (**-0.82**). The one-hand maximum reach test (MD1RM) is strongly related to the test's maximum reach in spike (MDSM=**0.85**), maximum reach in a block from a place (MDBLM=**0.94**), and maximum reach in the run-up block (MDBLZ=**0.90**).

Table 5. *Correlation of morphological and motor space variables for the LIBEROS group*

Marked correlations are significant at the level p = .05; N=5; r= .754 LIBEROS					
	MDSM	**MDBLM**	**MDBLZ**	**93639**	**PRKL**
ATV	0.86	0.92	0.79	0.10	0.50
RAR	0.90	0.92	0.83	0.13	0.53
ATT	-0.06	-0.09	-0.24	-0.82	0.55
MD1RM	0.85	0.94	0.90	0.52	0.08
MD2RM	0.87	0.95	0.90	0.48	0.14

Furthermore, the two-handed maximum reach test (MDOH2RM) is related to the maximum reach in the spike test (MDSM=**0.87**), the maximum reach in the block from a place (MDBLM=**0.95**), and the maximum reach in the run-up block (MDBLZ=**0.90**).

Discussion

To better understand the role of the player in the position of ***Opposites***, a few important details from the area of technical and tactical requirements of this specialist must be stated. In women's volleyball, an alternative, "female" type of opposite whose role is to receive service in five rotations (except rotation 6) and thus frees one attacker from zone 4 or out of the second line. In technical terms, the opposite player must have a diverse repertoire of spike techniques because, as the best striker, he frequently participates in a set or match deciding points. He usually performs a strong rotational jump service with a high degree of risk, but also a short, placed service with the aim of changing the rhythm of the service and making it harder for the opponent to receive the service. As a result, the technical and tactical demands of this role heavily influence the morphological characteristics of volleyball players who specialize in this role. This playing position "seeks" high volleyball players (jump service, reach a height in the spike, reach a height in the block), as evidenced by the high correlation obtained between body height (ATV) for the group Correctors and explosive power tests of jumping type, and demonstrates that body height and upper extremity length are important parameters that also determine retrieval height in a spike or block (González-Ravé & Clemente-Suarez, 2011; Đurković, Marelić & Rešetar, 2012).

The forward bend on the bench test (PRKL) had a significant relationship with the maximum one-handed reach (MD1RM =0.64) and maximum two-handed reach (MD2RM =0.63) tests. The data appears logical because, at some point during the measurement of body dimensions and performance of these two tasks, each volleyball player performed active stretching. Second, the obtained connection indicates that no limiting (internal and external) factors of flexibility existed. In morphological terms, this means that volleyball players in this position are well prepared (Grgantov, Katić, and Janković, 2006; Gabbett and Georgieff, 2007; Rašidagić, Manić, and Vidović, 2010; Konstan-

tinos, Panagiotis, and Ioannis, 2019; Bojanić, Ljubojević, Krivokapić, and Nokić, 2020), that their bone structure does not restrict their movement and that their bone structure did not limit their movement and that their tendons, ligaments, and muscle structure were elastic enough.

When we select the role of the ***Receiver*** in the game, it is critical to consider the status of abilities and characteristics critical to this player's success. The ability to have excellent eyesight (visibility in the game) and the ability to maximally connect the forearms in the technique of playing with a "hammer" (forearm play) are both required (Janković, Đurković & Rešetar, 2009).

If the aforementioned requirements are met, this player is predisposed to be successful and accurate in receiving a variety of services and defending the field. Bodyweight (ATV) and arm span (RAR), as well as maximum range tests, were also found to be significantly related to performing tests that simulate blocking as a typical technical-tactical element of defense in this group. According to research, this was most likely due to previously well-established movement patterns (Pérez-Turpin, Cortell-Tormo, Suárez-Llorca, Chinchilla-Mira & Cejuela-Anta (2009), Gortsila, Theos, Nešić & Maridaki (2013), Horicka, Hianik & Simonek (2014) and Sopa & Szabo (2015), and they can be directly related to the specified specific motor tests.

Given that the group of ***Middle Blockers*** found a correlation between body weight (ATV) and arm span (RAR) with tests of maximum reach in the spike and block, it is clear how important the flexibility of the whole body and longitudinal dimensionality of both upper and lower extremities volleyball. The importance of this ability in team sports has been proven and emphasized Bazett-Jones, Gibson & McBride (2008), Acero, Sánchez & Fernández-del-Olmo (2012), Aslam (2016), Gulati, Jajin, Lehri & Kumar (2021) in their research. The first three specific motor space tests simulate blocking technique, which means that agility in frontal (spike, half-high ball, I tempo) and lateral (stepping, and later cross) movement, as well as a vertical rebound in blocking, are tested (Barnes, Schilling, Falvo Weiss, Creasy, & Fry, 2007; Schaal, Ransdell, Simonson, & Gao, 2013). In addition to the lateral agility (left and right) that precedes the blocking action, they must have a developed sense of timing of the block jump for maximum reach ("timing").

Considering that there is no longer any growth of short players in modern volleyball positions, selection, this trend is maintained in this sample of female volleyball players. The average body height for the ***Setters*** sample is ATV = 175.44 cm, which means that the Setters group belongs to the category of very tall volleyball players (if Martin's catechization of body height is accepted). In this sense, it is entirely logical to significantly correlate body height (ATV) with maximum reach in the block from a place (MDBLM=**0.66**) and maximum reach in the run-up block (MDBLZ=**0.64**), arm span (RAR) with maximum reach in the block from a place (MDBLM=**0.70**) and maximum reach in the run-up block (MDBLZ=**0.72**). What these tests have in common is that they all involve moving and retrieving objects. As a result, in this section, the flexibility of the entire body, particularly the shoulder girdle, and the length of the upper and lower extremities were expressed again, resulting in a significant, i.e. high connection of the variables mentioned. The authors Cabral de ArajoTonico, B.G., Cabral de Arajo Tonico, S., de Miranda, & Dantasi Reis came to a similar conclusion (2011).

Perhaps the most attention is drawn to the results in Table 5, which can be explained by the fact that the ***Liberos*** group consisted of only 5 volleyball players, which could be one of the reasons for the high interconnectedness of individual variables. According to these data, the Liberos group achieved the best average results in the maximum reach tests not only in comparison to other groups but also in comparison to the entire sample of respondents. Only in the test of maximum reach in the run-up block (MDBLZ=**35.2**) were slightly weaker results obtained. This means that the volleyball players in the Liberos group compensated for any physical deficiencies (body height and arm span) with a strong bounce. It's also worth noting that there was a strong negative correlation between body weight (ATT) and test 9-3-6-3-9 in this group (-**0.82**). The lower body weight of the volleyball players in the Liberos group conditioned and influenced the higher task speed and greater mobility on the volleyball court, and they most likely performed better in this test compared to other groups in the sample. Other abilities include the ability to stop, start, and change the direction of the whole or parts of the body in a fast and controlled manner, as well as the ability to stop, start, and change the direction of the whole or parts of the body in a small space (Karalić, 2010).

Conclusion

The analysis of the relations between body dimensions and specific motor abilities revealed a strong relationship between specific body dimensions and the manifestation of specific motor abilities during the execution of selected tests. The correlation is statistically significant as well. This is especially true of volleyball players' body height and arm span, as well as their reach height in the spike and block. Only the body weight of the volleyball players in the sample is unaffected and has no relationship to any of the observed parameters.

The optimal morphological characteristics of athletes are heavily dependent on the sport of choice; however, those whose body structure is adapted to the requirements of a specific sport generally achieve better results. Because the athlete is competing at a higher level, the need for adjustment is more pronounced. In this context, this study confirms the conclusion (Marelić, Đurković & Rešetar, 2007) that success in volleyball is unquestionably dependent on the morphological characteristics of the formed volleyball player, the most basic of which are body height and weight, which are valued based on the volleyball player's current age.

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Specifics of implementing health and recreational objectives in outdoor education

Specifičnosti realizacije zdravstveno-rekreativnih ciljeva u školi u prirodi

Mirsada S. Zukorlić[1], Vladan M. Pelemiš[1], Slobodan Lj. Pavlović[2]

[1]University of Belgrade Teacher Education Faculty
[2]University of Kragujevac, Faculty of Education, Užice

Correspondence:
Slobodan Pavlović
PhD University of Kragujevac, Faculty of Education, Užice,
Republic of Serbia
slobodan.b.pavlovic@gmail.com

[1]Univerzitet u Beogradu Učiteljski fakultet, Beograd, Republika Srbija
[2]Univerzitet u Kragujevcu Pedagoški fakultet Užice, Republika Srbija

Korespondencija:
Slobodan Pavlović
Univerzitet u Kragujevcu Pedagoški fakultet Užice,
Republika Srbija
slobodan.b.pavlovic@gmail.com

Abstract: *In this paper, the specifics and opportunities for attaining the objectives of physical and health education in outdoor schools are examined. A well-organized outdoor school offers the chance for students' personalities to develop holistically and acts as a form of pedagogical opposition to the overemphasis on schools' educational roles, where its educational purpose is neglected. Due to the existence of physical activities and the exposure of pupils to the outdoors, an outdoor school is unmatched in accomplishing health and recreational goals, making up for certain shortcomings in the educational role of schools generally. The foundations of outdoor education can be found in the writings of illustrious pedagogical pioneers like John Locke, Pestalozzi, and J.J. Rousseau. Its importance in modern pedagogical science is rising as a result of its potential for an integrative approach, interactive educational activity, and integrated attainment of educational and ecological goals.*

Keywords: *outdoor school, holistic personal development, health and recreational goals, interactive education.*

Apstrakt: *U radu se analiziraju specifičnosti i mogućnosti ostvarivanja ciljeva i zadataka fizičko-zdravstvenog vaspitanja u školi u prirodi. Dobro organizovana, škola u prirodi pruža mogućnost celovitog razvoja ličnosti učenika i predstavlja svojevrstan pedagoški otpor prenaglašenoj obrazovnoj ulozi škole, pri čemu se njena vaspitna funkcija marginalizuje. Osim toga što škola u prirodi kompenzuje određene slabosti u ostvarivanju vaspitne uloge škole uopšte, zbog prisutnosti fizičkih aktivnosti i boravka učenika u prirodi ona je neprikosnovena kada je reč o realizaciji zdravstveno-rekreativnih ciljeva. Ideja o nastavi u prirodi ukorenjena je u učenjima čuvenih pedagoških klasika od XVII do XIX veka (J.A.Komenski, Dž. Lok, Ž. Ž. Ruso i J. H. Pestaloci) a zbog mogućnosti integrativnog pristupa, interaktivnog vaspitnog rada, kao i integrisanog ostvarivanja vaspitnih sa ciljevma ekološkog vaspitanja njena aktuelnost u savremenoj pedagoškoj nauci sve više dobija na značaju.*

Ključne reči: *škola u prirodi, celovit razvoj ličnosti, zdravstveno-rekreativni ciljevi, interaktivni vaspitni rad.*

Introduction

The implementation of physical and health education involves the participation of family, preschool institutions, schools, physical education organizations, sports clubs, and mass media. When it comes to meeting the goals and objectives of physical and health education in schools, the most significant role belongs to physical education classes. However, it is more than evident that schools (including physical education classes) are losing their monopoly in achieving the goals and objectives of physical and health education, leading to increasingly vocal appeals from teachers for the improvement of physical education classes. It is evident that the level of physical activity among school-age

Uvod

U realizaciji fizičko-zdravstvenog vaspitanja učestvuju porodica, predškolske ustanove, škole, organizacije za fizičku kulturu, sportska društva, klubovi kao i mas-mediji. Kada je reč o ostvarivanju zadataka fizičko-zdravstvenog vaspitanja u školi najznačajnije mesto pripada nastavi fizičkog vaspitanja. Ipak, više je nego očigledno da škola (i nastava fizičkog vaspitanja) gubi monopol po pitanju ostvarivanja cilja i zadataka fizičko-zdravstvenog vaspitanja pa su kod nas sve „glasniji" apeli učitelja i nastavnika koji se odnose na unapređivanje nastave fizičkog vaspitanja. Evidentno je da nivo fizičke aktivnosti dece školskog uzrasta opada sa pove-

children decreases as they grow older, with the problem starting when they enter elementary school and becoming most pronounced during adolescence. Physical education teachers argue for the subpar state of the school population based on the results of recent studies, which show that one in five children has poor posture, one in four is overweight or obese, and as much as 70% of students are not engaged in sports activities outside of school. In a letter addressed to the responsible authorities in education, the Serbian Association of Physical Education and Sports Teachers notes that over the past three decades, there has been a consistent deterioration in the health status of children, reflected not only in an increased percentage of postural disorders (such as curved spine, flat feet) but also a significant rise in the percentage of diabetes and hypertension among children. That is why their demand is that physical and health education should be a mandatory subject at all levels of education, and it should be given a cross-curricular status. They advocate for allocating more class hours for physical education in the curriculum and, in cases of larger classes, working in smaller groups with fewer students. This is the essence of the Initiative for the Improvement of Physical and Health Education, which the Serbian Association of Physical Education and Sports Teachers (SSPFVS) has addressed to the educational authorities. Alongside these criticisms, there is also an increasing number of concerns directed at schools regarding their overemphasis on the educational role, while marginalizing or partially fulfilling their educational function. However, these issues are not limited to the present day; these are the issues that numerous teachers have faced throughout history. The idea of implementing outdoor schools is deeply rooted in the teachings of renowned pedagogical humanists and classics. The implementation of this model of instruction is supported by the fact that physical activity and being in nature are essential factors for the growth and development of children. Their contribution is reflected in maintaining good health and the overall functioning of the organism. Taking into account the arguments mentioned above, this paper examines the pedagogical justifications for implementing physical and health education in outdoor schools as an organizational model of instruction.

Main Characteristics of Outdoor Schools

Outdoor school is an organizational model of instruction that is specific and mandatory for the first cycle of primary education and is part of the primary education curriculum. It is implemented once during the school year for primary school students and involves one-day or multi-day trips and the students' stay accompanied

ćanjem njihovih godina – problem započinje polaskom u osnovnu školu, a najizraženiji je u adolescenciji. Da stanje školske populacije nije na zavidnom nivou, argumentuju profesori fizičkog vaspitanja inicijativom u koju je „Politika" imala uvid, te rezultatima najnovijih studija (Simić-Miladinović, 2023.) koje pokazuju da svako peto dete ima loše držanje tela, svako četvrto je gojazno, a čak 70 odsto školaraca se ne bavi sportskim aktivnostima van škole. U istom tekstu, objavljenom u „Politici", objavljeno ja da je Srpski savez profesora fizičkog vaspitanja i sporta (SSPFVS) uputio dopis najodgovornijima za obrazovanje u kome se konstatuje se da je u poslednje tri decenije evidentirano konstantno narušavanje zdravstvenog statusa dece koje se ogleda ne samo u povećanju procenta posturalnih poremećaja (kriva kičma, ravni tabani), već i značajnom povećanju procenta dijabetesa i hipertenzije kod dece. Zato je njihov zahtev da fizičko i zdravstveno vaspitanje treba da bude obavezan predmet na svim nivoima obrazovanja, kao i da mu treba dodeliti natpredmetni status, osigurati više časova za fiskulturu u đačkom rasporedu, a kada su odeljenja brojnija i rad u grupama s manje učenika. Uporedo sa pomenutim kritikama sve su češće i one koje se školi upućuju zbog prenaglašene obrazovne uloge, pri čemu se njena vaspitna funkcija marginalizuje ili delimično ostvaruje. Međutim, ovo nisu problemi koji se odnose samo na problem današnjice, već pitanja sa kojima su susretali mnogobrojni pedagozi kroz istoriju. Tako je u učenjima čuvenih pedagoških humanista i klasika od XVII do XIX veka (J.A. Komenski, Dž. Lok, Ž. Ž. Ruso i J. H. Pestaloci) ukorenjena ideja o realizaciji škole u prirodi. Realizacija ovog modela vaspitno-obrazovnog rada potkrepljena je činjenicom da su fizička aktivnost i boravak u prirodi neophodni faktore za rast i razvoj dece, a njihov doprinos se ogleda i u očuvanju dobrog zdravlja i funkcionisanju celokupnog organizma. Uzevši u obzir navedene argumente, u ovom radu razmatramo pedagoške opravdanosti realizacije fizičko-zdravstvenog vaspitanja u školi u prirodi kao organizacionom modelu vaspitno-obrazovnog rada.

Osnovne odrednice škole u prirodi

Škola u prirodi je organizacioni model vaspitno-obrazovnog rada koji je specifičan i obavezujući za prvi ciklus osnovnog obrazovanja i vaspitanja i proizilazi iz nastavnog plana i programa osnovnog obrazovanja. Realizuje se jedanput u toku školske godine za učenike osnovne škole, a podrazumeva jednodnevna ili višednevna putovanja i boravak učenika u pratnji učitelja (nastav-

by teachers in nature, with suitable indoor and outdoor teaching and learning conditions (Omerović & Zukorlić, 2019). Outdoor school allows the health and recreational, educational, and social goals to be achieved (Dictionary of educational terms, 2014:486).

Based on the natural-geographical specifics of where the outdoor school takes place, it can be organized as a coastal model, mountain model, or star grove model. In pedagogical theory and practice, we encounter different names for outdoor education. In Germany, the prevailing terms are "Waldschulen" and "Freiluftschulen," while in England and the United States, it is referred to as "Open Air Schools." In France, it is known as "Ecoles de plein-air" or "Ecole au soleil," and in Italy, it is called "Scuola all'aperto." In our country, alternative names exist such as nature education, forest school, fresh-air school, open-air school, rural education homes, summer school, field classroom, fresh air school. Recreational education is often used as an alternative term for outdoor school, but it is considered inadequate because it does not express the essence and does not encompass all forms of education that are otherwise included in such activities. Since this approach encompasses both teaching and instructional activities, as well as numerous extracurricular activities, leisure activities, and collaboration with the local community, it is more justifiable to use the term "outdoor school" (Ilić, Nikolić, Jovanović, 2006:253). Therefore, we will further discuss the pedagogical benefits and justifications of outdoor school, with a particular focus on activities that allow for the realization of health and recreational goals.

Pedagogical Benefits of Outdoor Education

The idea of developing outdoor schools is rooted in the works of humanist philosophers and educational classics. Vittorino da Feltre built his "House of Delight" in nature and is credited with the first practical implementation of the idea of outdoor schools, while Comenius emphasized the importance of learning in nature, sensory learning, and learning through personal experience, advocating for learning "first-hand." Jean-Jacques Rousseau called for a return to the mother nature. In his work "Emile, or On Education," he describes education that enables individuals to develop their natural abilities without hindrance, with a particular emphasis on the individual's relationship with nature and the influence of nature on the formation of a child's personality. According to his view, an immediate return to nature is necessary because it is the foundation for the development of a healthy individual and a healthy society (Roth-Čerina, 2011:62). A completely new

nika) u prirodnom ambijentu, prilagođen uzrastu učenika s odgovarajućim uslovima zatvorenog i otvorenog prostora za poučavanje i učenje (Omerović & Zukorlić, 2019). Realizacijom škole u prirodi ostvaruju se: zdravstveno-rekreativni, obrazovno-vaspitni i socijalni ciljevi (Leksikon obrazovnih termina, 2014:486).

Prema prirodno-geografskim uslovima gde se odvija škola u prirodi može biti organizovana kao primorski model, planinski model i model zvjezdani gaj. U pedagoškoj teoriji i praksi susrećemo različite nazive za nastavu u prirodi. U Nemačkoj prevladava naziv " Waldschulen", "Freiluftschulen", u Engleskoj i SAD-u " Open Air Schools", u Francuskoj " Ecoles de plein-air", "Ecole au soleil ", u Italiji " Scuola all' aperto". Kod nas postoje alternativni nazivi: nastava u prirodi, šumska škola, vazdušna škola, škola u slobodnoj prirodi, seoski vaspitni domovi, letnja škola, poljska učionica, škola na čistom vazduhu. I rekreativna nastava se često koristi kao alternativni naziv za školu u prirodi, međutim, „smatra se neadekvatnim jer ne izražava suštinu i ne obuhvata sve vidove pedagoškog rada koji su inače obuhvaćeni stvarnim aktivnostima. S obzirom da ovaj vid obuhvata i nastavu i nastavne aktivnosti, ali i brojne vannastavne aktivnosti, aktivnosti u slobodnom vremenu i saradnju sa lokalnim okruženjem i dr., opravdanije je koristiti termin škola u prirodi"(Ilić, Nikolić, Jovanović, 2006:253). Zato ćemo u nastavku razmotriti pedagoške vrednosti i opravdanosti škole u prirodi sa posebnim osvrtom na aktivnosti koje doprinose realizaciji zdravstevno-rekreativnih ciljeva.

Pedagoške vrednosti škole u prirodi

Ideja o razvoju škole u prirodi ukorenjena je u delima filozofa humanista, Vitorina de Feltrea koji je svoj „Dom radosti" sagradio u prirodi i njemu se pripisuju zasluge za prvo praktično ostvarivanje ideje o školi u prirodi, kao i J.A. Komenskog koji je naglašavao važnost učenja u prirodi, učenja čulima i kroz vlastito iskustvo, te se zalagao za učenje „iz prve ruke". Pedagoški klasik, Žan Žak Ruso zatražio je povratak majci prirodi. U svom delu „Emil ili o vaspitanju" opisuje vaspitanje koje pojedincu omogućava neometani razvoj prirodnih sposobnosti, pri čemu poseban akcenat stavlja na čovekov odnos prema prirodi i uticaj prirode na formiranje ličnosti deteta. Stoga se prema njegovom mišljenju bez odgađanja treba vratiti prirodi, jer je ona osnova za razvoj zdravog čoveka i zdravog društva (Roth-Čerina, 2011:62). Sasvim novo polazište sintetizovano je u Rusoovoj izreci – „Vratimo se prirodi"– jer priroda deteta treba da se ispoljava onakvom kakva jeste, a učenje je

approach was synthesized in Rousseau's statement - "Let us return to nature" - as the nature of the child should be allowed to manifest as it is, and learning is understood as the active utilization of the child's natural capacities. The renowned Swiss pedagogue J.H. Pestalozzi believed that the path to understanding the environment is through perceptual activities. He encouraged the creation of "lessons about things," the establishment of school museums, and the organization of educational trips in nature, thus becoming one of the pioneers of outdoor learning. He built the "New Home" in nature. Georg Kerschensteiner and other representatives of the active school advocated for instruction to take place in natural and real-life conditions. Ideas for abandoning the narrow school framework and the class-subject-lesson forms can be found among numerous educators who advocated for greater student freedom and education aligned with life (L.N. Tolstoy, M. Montessori, E. Claparède, O. Decroly, A.S. Neill, and many others), as well as representatives of pragmatic pedagogy and reformist movements within the "new school" framework. As a response to the passive role of students in education and the teacher's focus on lecturing and material transfer, educational reform movements or new school movements emerged at the turn of the 19th and 20th century.

As part of the "New School" reform movement in the late 19th and early 20th century, outdoor schools were primarily established for children with poor health conditions, aiming to improve their health and provide education outside of major cities, where they could be exposed to fresh air and sunlight (Roth-Čerina, 2011:63). One of the first such schools mentioned is the school founded by S. Reddie in Great Britain in 1889 under the name "New School." Following the example of this school, a large number of "rural educational homes" were opened in Germany. At the beginning of the 20th century, "forest schools" were established in the suburb of Berlin - Charlottenburg, for children from lower social classes whose health was compromised, preventing them from attending regular classes. Due to the children's illnesses, classes lasted for three hours with half-hour breaks, and the remaining time was spent in extracurricular activities organized in the forest. The classrooms were located in separate pavilions with sliding walls, allowing for a continuous connection with nature. The classrooms had folding wooden chairs, each of which was unique, reflecting the contemporary pedagogical principle of respecting the individuality of each student. With a small number of students not exceeding 20 and a curriculum that excluded less essential content, outdoor schools provided an individualized approach to each student.

shvaćeno kao aktivno korišćenje prirodnih mogućnosti deteta. Čuveni švajcarski pedagog J. H. Pestaloci, smatra da put do spoznaje okoline vodi kroz perceptivne delatnosti. On podstiče stvaranje "nastave o stvarima", otvaranje školskih muzeja i organizaciju pedagoških izleta u prirodi i time postaje jedan od utemeljivača učenja na otvorenim prostorima. Sagradio je „Novi dom" u prirodi. Georg Keršenštajner i drugi predstavnici radne i aktivne škole tražili su da se vaspitno-obrazovni rad sa učenicima odvija u prirodnim i radnim (životnim) uslovima. Ideje za napuštanje uskoškolskog šablona i razredno-predmetno-časovnih formi, nalazimo kod brojnih pedagoga koji su se zalagali za veću slobodu učenika, za nastavu primerenu životu (L.N. Tolstoj, M. Montesori, E. Klapared, O. Dekroli, A. S.Nill i mnogi drugi), kao i kod predstavnika pragmatističke pedagogije i predstavnika reformskih pravaca u okviru „nove škole". Kao reakcija na pasivan položaj učenika u nastavi i usmerenost nastavnika na predavačku funkciju i prenošenje sadržaja, na prelazu iz 19. u 20. vek javljaju se reformni pedagoški pokreti ili pokreti za novu školu.

Kao deo reformnih pokreta „Nove škole", krajem 19. i početkom 20. veka škole na otvorenom su se otvarale prvenstveno za decu lošeg zdravstvenog stanja s ciljem njihovog ozdravljenja i obrazovanja izvan velikih gradova, gde će biti izloženi čistom zraku i suncu (Roth-Čerina, 2011:63). Među prvim takvim školama pominje se škola u Velikoj Britaniji koju je osnovao S.Redi 1889. godine pod nazivom „nova škola". Po ugledu na ovu školu u Nemačkoj se otvara veliki broj škola – „seoski vaspitni domovi". Na inicijativu lekara i pedagoga, početkom 20. veka otvaraju se „šumske škole" u predgrađu Berlina – Šarlotenburgu (Charlottenburg) za decu nižih slojeva a čije je zdravlje ugroženo zbog čega nisu mogla pratiti redovnu nastavu. Zbog bolesti dece nastava je trajala tri sata s pauzama od pola sata, a ostatak vremena provodili su u vannastavnim aktivnostima koje su se organizovale u šumi. U barakama su se nalazile sklopive drvene stolice od kojih je svaka bila unikat, u čemu se ogledalo savremeno pedagoško načelo poštivanja individualnosti svakog učenika. Brojem učenika koji nije prelazio 20 i programom iz kojeg su izbačeni manje bitni sadržaji škola u prirodi je omogućavala individualni pristup svakom učeniku. Svaka učionica je bila u odvojenom paviljonu koji je bio obložen kliznim zidovima, što je omogućavalo neprekidnu vezu s prirodom.

Pod uticajem ovih ideja širom sveta otvarane su slične škole, pa ih je 1934. godine u SAD-u bilo preko 5000. O tome koliki je značaj pridavan školi u prirodi

Each classroom was housed in a separate pavilion with sliding walls, enabling a continuous connection with nature. Under the influence of these ideas, similar schools were opened worldwide, and by 1934, there were over 5,000 such schools in the United States. The significance attributed to outdoor schools is evident in the formation of National Committees for Fresh Air Schools in some countries (e.g., France, 1920) and the fact that the first international congress was held in Paris in 1923 with the aim of advancing the work of these schools.

The first school of this kind in Serbia was opened by Sreten M. Adžić in 1908 in Jagodina. He claimed that no country in Europe had outdoor classrooms arranged in such a manner, emphasizing that domestic outdoor classrooms were built "primarily as a preventive measure, that is, to counteract the negative effects of traditional classrooms on still healthy students, while German and English outdoor classrooms were primarily therapeutic, aimed at treating already weakened children" (Adžić, 1924:4). In the early 1960s, there was a growing need in our region to protect children's health, and solutions were sought in occasional stays of elementary school students in nature to recuperate and engage in recreation, mitigating the consequences of urban living. There was also a need for children to spend time in nature during the school year while learning in accordance with the curriculum and learning objectives.

Due to its health and pedagogical benefits, this type of instruction, that is, outdoor school, is increasingly being embraced with appropriate financial support. It is now impossible to estimate the precise number of outdoor schools globally due to their widespread usage (Nikolić, 2005). All of this indicates that this form of instruction is highly accepted in primary schools.

The pedagogical benefits of outdoor schools are evident because they enable the achievement of numerous educational objectives that cannot be accomplished through traditional education alone but require other activities and different circumstances (Nikolić, 1994). There are growing criticisms directed towards schools for being "detached" from real life and (the most severe criticism) for focusing solely on the educational role while marginalizing their role in character development. Authors Bognar and Matijević emphasize that schools do not provide real conditions for achieving educational objectives. "Educational objectives involve creating diverse educational scenarios that cannot be created within the school environment, where children, in a spontaneous and friendly social climate, meet their basic needs (sense of belonging, love, security, self-affirmation)" (Bognar, Matijević, 1993:107). On the other hand, De Zan highlights that outdoor schools meet this criterion

svedoči i formiranje Nacionalnih komiteta škola na svežem vazduhu u nekim zemljama (npr. Francuska, 1920), kao i činjenica da je održan prvi međunarodni kongres u Parizu 1923. godine sa ciljem unapređivanja rada ovih škola.

Prva školu ovakvog tipa, u Srbiji, otvorio je Sreten M. Adžić, 1908. godine u Jagodini. On je tvrdio da tako uređene poljske učionice nije imala ni jedna zemlja u Evropi, ističući da su domaće poljske učionice podignute „u celji profilaktičkoj to jest da se kod redovnih još zdravih učenika preduprede rđavi uticaji zidanih učionica, a nemačke i engleske su u celji terapeutičkoj tj. da se već slabunjava deca leče"(Adžić, 1924:4). Tako se početkom 60-tih godina 20.veka na našim prostorima osetila veća potreba za zaštitom dečijeg zdravlja, pa su se u cilju ublažavanja posledica života u urbanim sredinama rešenja nalazila u povremenim boravcima učenika osnovnih škola u prirodi, radi opravka i rekreacije. Takođe, javila se potreba da deca borave u prirodnoj sredini i tokom nastavne godine, uz realizaciju obaveznih programskih sadržaja i vaspitno-obrazovnih zadataka.

Zbog svojih zdravstvenih i pedagoških vrednosti i opravdanosti ovaj oblik vaspitno-obrazovnog rada škole je sve masovnije prihvatan uz odgovarajuću materijalnu podršku. Danas je, zbog svoje velike rasprostranjenosti, konačan broj škola u priodi u svetu nemoguće pobrojati (Nikolić, 2005). Sve ovo nam govori da je ovaj vid vaspitno-obrazovnog rada u praksi osnovnih škola veoma prihvaćen.

Pedagoške vrednosti škole u prirodi su evidentne jer omogućava ostvarivanje brojnih pedagoških učinaka koje nije moguće ostvariti samo nastavom već i drugim aktivnostima i u nekim drugim okolnostima (Nikolić, 1994). Sve su češće kritike upućene školi jer je „otrgnuta" od realnog života i (najstrožija kritika škole) da realizuje samo obrazovnu funkciju, dok je njena vaspitna uloga marginalizovana. Tako, autori Bognar i Matijević naglašavaju da u školi ne postoje realni uslovi za ostvarivanje pedagoških ciljeva. „Pedagoški ciljevi podrazumijevaju stvaranje raznovrsnih pedagoških situacija kakve nije moguće stvoriti u školskim uvjetima, a u kojima djeca uz spontanu i prijateljsku socijalnu klimu zadovoljavaju svoje osnovne potrebe (pripadanje, ljubav, sigurnost, samopotvrđivanje" (Bognar, Matijević, 1993:107). Dok De Zan ističe da škola u prirodi ispunjava taj kriterijum, i da je kao oblik vanučioničkih aktivnosti pedagoški učinkovita i interesantna s obzirom na ciljeve savremenog obrazovanja (De Zan, 1999). Rezultati istraživanja koja su izvedena sa ciljem da se ispita efikasnost ovog modela vanučioničkog rada

and that, as a form of out-of-class activities, they are pedagogically effective and interesting considering the goals of modern education (De Zan, 1999). Research studies conducted to examine the effectiveness of this model of out-of-class learning show positive effects in terms of forming attitudes, beliefs, interpersonal relationships, social skills, positive self-image, and creativity development (Rickinson et al., 2004; Fiennesst et al., 2015). They also show positive effects on student achievements (Rickinson et al., 2004; Christie, Higgins & McLaughlin, 2014). Furthermore, existing models of outdoor schools have educational benefits, and all of these models meet the objectives of the five educational components that have been monitored (Nikolić, 2005:163). The author, Nikolić, adds that outdoor schools established worldwide have justified their existence and have had a positive impact on the psychophysical development of children, the acquisition of knowledge through perception and practical work in the immediate environment.

Suharevska states that a well-organized outdoor school provides real conditions for a comprehensive educational approach (the school meets its educational mission) and the possibility of integrating learning material at multiple levels: intra-subject, interdisciplinary, medium, and inter-systemic (Suharevska, 2003). Author Anđić also favors outdoor schools, stating that "for every topic learned in such a setting, students become more motivated, and the teaching itself is not monotonous and boring but becomes an adventure and a game that stimulates new ideas and problem-solving among students" (Anđić, 2006:11). Domestic educators express their views on outdoor schools, stating that "knowledge acquired through activities in this form of education has the characteristics of planned, systematic, organized, and creative knowledge acquisition through learning, play, and entertainment, and it is based on diverse sources of knowledge, student activities in the nature and real-life, in an authentic environment, outside the classroom" (Ilić, Nikolić, Jovanović, 2006:254). Research conducted by Stanojlović B. and Stanojlović S. showed that outdoor schools predominantly emphasize the pedagogical values related to meeting the upbringing-related function of outdoor schools. In other words, outdoor schools compensate for certain shortcomings of regular schools in meeting the educational role (Stanojlović and Stanojlović, 1999). This compensation primarily refers to values that contribute to student socialization, improved student health, better teacher-student relationships, the development of love for nature, the development of independence, the development of friendships, adaptation to collective life, the development of hygiene habits, more effective and easier mastering of learning material, and more successful systematization of learning content. It should not

pokazuju da su pozitivni efekti izraženi kada je reč o formiranju stavova, uverenja, međuljudskih odnosa i socijalnih veština, pozitivne slike o sebi, razvoju kreativnosti (Rickinson et all. 2004; Fiennesst et all., 2015), postignućima učenka (Rickinson et all.,2004; Christie, Higgins & McLaughlin, 2014), kao i da postojeći modeli škole u prirodi imaju pedagoške vrednosti, odnosno da se u svim modelima škole u prirodi ostvaruju zadaci pet vaspitnih komponenti koje su praćene (Nikolić, 2005:163). Autorka, Nikolić dodaje da su sve škole u prirodi osnovane širom sveta opravdale svoje postojanje i povoljno delovale na psihofizički razvoj deteta na sticanje znanja putem percipiranja i praktičnih radova u neposrednoj okolini. Suharevska navodi da u dobro organizovanoj školi u prirodi postoje realni uslovi za celovit vaspitni pristup (škola ostvaruje svoju vaspitnu misiju) i mogućnost integracije nastavnih sadržaja na više nivoa: unutarpredmetnom, međupredmetnom, srednjem i međusistemskom (Suharevskaя, 2003). I auorka Anđić favorizuje školu u prirodi navodeći da „za svaku tematiku koja se usvaja u njoj, učenici bivaju više motivisani, te takva nastava nije monotona i dosadna, već postaje avantura i igra koja kod učenika podstiče nove ideje i rešavanje problema" (Anđić, 2007:11). Stav o školi u prirodi iznose domaći pedagozi navodeći da „zananja koja se usvajaju kroz aktivnosti u ovom obliku organizacije, imaju odlike planskog, sistematskog, organizovanog i stvaralačkog usvajanja znanja kroz učenje, igru, zabavu, ali koje je zasnovano na raznovrsnim izvorima znanja, učeničkim aktivnostima u slobodnoj prirodnoj sredini i neposrednoj stvarnosti, u autentičnom ambijentu,očigledno, van učionice" (Ilić, Nikolić, Jovanović, 2006:254). Istraživanje koje su obavili Stanojlović B. i Stanojlović S. pokazalo je da u školi u prirodi dominiraju one pedagoške vrednosti koje se odnose na ostvarivanje vaspitne funkcije škole u prirodi. Drugim rečima, škola u prirodi kompenzuje određene slabosti u ostvarivanju vaspitne uloge škole uopšte (Stanojlović i Stanojlović, 1999). Kompenzacija se prevashodno odnosi na vrednosti koje doprinose socijalizaciji učenika, poboljšanju zdravlja učenika, boljem upoznavanju nastavnika sa učenicima, razvijanju ljubavi prema prirodi, razvoju samostalnosti, razvoju drugarskih odnosa, navikavanju na kolektivni život, razvijanju higijenskih navika, efikasnijoj i lakšoj obradi nastavnih sadržaja, uspešnijem utvrđivanju i sistematizaciji nastavnih sadržaja. Ne treba zanemariti činjenicu da ovaj organizacioni model nudi mogućnost integrisanog ostvarivanja vaspitnih ciljeva (razvoj celokupne ličnosti učenika) i ciljeva ekološkog vaspitanja (jedin-

be overlooked that this instruction model offers the possibility of integrated achievement of learning objectives (the development of student's personality) and environmental education objectives (the unity of environmental knowledge, environmental awareness, and environmental practical action and behavior). Taking into account all the specificities of instruction mentioned above, we discuss the possibilities for meeting health and recreational goals and objectives within this instruction model.

Activities in Outdoor Schools That are Aimed at Achieving Health and Recreational Objectives

Achieving the physical and health education objectives entails the implementation of health and hygienic, educational, developmental, and recreational objectives (Jovanović, 1998). Outdoor schools are expected, as part of their educational mission and physical and health education, to help the realization of health and recreational goals, which include promoting proper growth and development of children, strengthening their health and physical abilities, alleviating the consequences of prolonged indoor stays (reduced physical activity, irregular nutrition), fostering hygiene habits, and raising awareness about the harmful effects of psychoactive substances. This would mean compensating for the shortcomings that are evident in schools' educational role. The integration of physical education with other subjects, which is still uncommon in our schools, or physical education classes, which do not produce satisfactory results, are expected to play the biggest roles in achieving the goals of physical and health education. Physical education classes are not the only ones in schools that incorporate physical activity; an interdisciplinary approach is frequently used to incorporate physical activity into other subjects. Additionally, they occur when courses are momentarily interrupted to allow for students' rest and relaxation during required breaks (Nikoli, 2005). Additionally, physical activities are incorporated into the independent activities and free time of the pupils.

Instruction, as an integral part of the activities organized in outdoor schools, aims to meet the physical education objectives based on the curriculum for a specific age group (Ibidem, 2005). The material and resources used to meet these objectives are adapted to the environmental conditions, including material and climate factors, as well as the terrain configuration and nature and climate conditions (Jovanović, 2006). The methods (such as verbal explanation, demonstration, illustration, practical exercises, sports training, competitive methods) and resources (gymnastic exercises, sports activities, and games) (Branković, Ilić,

stvo između ekoloških znanja, ekološke svesti i ekološkog praktičnog delovanja i ponašanja). Uzevši u obzir sve navedene specifičnosti vaspitnog rada, razmatramo mogućnosti realizacije zdravstveno-rekreativnih ciljeva i zadataka u okviru ovog organizacionog modela.

Aktivnosti u školi u prirodi koje doprinose realizaciji zdravstveno-rekreativnih ciljeva

Ostvarivanje cilja fizičko-zdravstvenog vaspitanja podrazumeva realizaciju zdravstveno-higijenskih, obrazovnih, vaspitnih i rekreativnih zadataka (Jovanović, 1998). Od škole u prirodi se očekuje da u okviru svoje vaspitne misije i fizičko-zdravstvenog vaspitanja, kao dela te misije, doprinese realizaciji zdravstveno –rekreativnih ciljeva, odnosno, pravilnom rastu i razvoju dece, jačanju njihovog zdravlja i telesnih sposobnosti, ublažavanju posledica višemesečnoga boravka u zatvorenom prostoru (umanjene telesne aktivnosti, nepravilne ishrane), razvijanju higijenskih navika, upoznavanju štetnih dejstava psihoaktivnih supstanci…To bi značilo kompenzaciju onih slabosti koje su evidentne u ostvarivanju vaspitno-obrazovne uloge škole. Činjenica je da se očekuje da za ostvarivanje zadataka fizičko-zdravstvenog vaspitanja u školi najznačajnija uloga pripada nastavi fizičkog vaspitanja (ne daje zadovoljavajuće rezultate) ili putem integrativne nastave fizičkog vaspitanja sa nastavom drugih predmeta (što u našim školama još uvek nije zaživelo kao praksa). Fizičke aktivnosti u školi u prirodi, osim u nastavi fizičkog vaspitanja zastupljene su i u nastavi drugih predmeta, integrativnim pristupom i tokom obaveznih pauza kada se prekida nastava radi odmora i opuštanja učenika (Nikolić, 2005), kao i kroz samostalan rad učenika i aktivnosti u slobodnom vremenu.

Nastava kao sastavni deo strukture aktivnosti koje se realizuju u školi u prirodi ima za cilj ostvarivanje zadataka fizičkog vaspitanja po planu i programu vaspitno-obrazovnog rada za dati uzrast (Ibidem, 2005). Sadržaji rada, kao i sredstva koja se koriste za realizaciju zadataka prilagođeni su uslovima sredine – materijalnim i klimatskim, a potom i konfiguraciji terena, odnosno prirodnim i klimatskim uslovima (Jovanović, 2006). Metode (metoda žive reči, objašnjavanja; metoda pokazivanja; metoda ilustracije; praktičnog vežbanja; sportskog treninga; takmičarski metod) i sredstva (gimnastičke vežbe;sportske aktivnosti i sportske igre) (Branković, Ilić, 2003) rada u školi u prirodi, u funkciji su savladavanja školskog programa. Obzirom da većina ovih metoda podseća na školski rad, valja naglasiti da u suštini to nije niti sme biti preslikavanje školskog rada. To znači,

2003) used in outdoor schools are aimed towards mastering the school curriculum. However, it is important to note that although many of these methods resemble classroom instruction, the essence of outdoor schools is not and should not be a replication of traditional classroom instruction. This means that there are no lectures, examinations, grading, or similar features of traditional instruction. The acquisition of knowledge, skills, and habits, as well as the development of psychological and physical abilities of students, primarily occur through play and practical work (Omerović & Zukorlić, 2019). In addition to providing exceptional opportunities for exploring new content and assessing learning, outdoor schools also enable the reinforcement, practical application, and improvement of previously acquired knowledge, such as motor skills. As stated by Nikolić, fundamental motor and manipulative skills are covered in outdoor schools. Therefore, it can be expected that second-grade students will learn roller skating, third-grade students will master rotational vertical jump, and fourth-grade students will acquire football-playing skills and learn to swim (Nikolić, 2005:59). The implementation of physical education classes in nature can also serve as an optimal solution for online instruction, addressing the completely different requirements compared to the traditional mode of instruction, including the transition to online learning and subsequently blended learning (Milanović, Milić, 2022:279).

Physical education classes organized in nature provide for a comprehensive and integrative approach due to the nature of the learning process and practical application of knowledge. The curriculum for younger grades in primary school includes numerous topics that allow for the integration of physical education with other subjects such as science, mathematics, language arts, music, and art. The integration of two or more subjects, such as science, language, dance, and art, with physical education has been implemented worldwide. Learning through movement allows students to utilize natural forms of movement (jumping, walking, crawling) while learning, engaging multiple learning modalities (visual, auditory, motor, and kinesthetic). Even the simplest, lively, and familiar movements such as elementary games, field games, imitative exercises, crawling and running between trees, jumping over natural obstacles, forest walks, rocking, and swinging, or depending on the season, snow games (winter) and swimming and water games (summer), contribute to children becoming stronger, making better progress, and improving their agility and adaptability in various situations. According to Cekić-Jovanović and Milanović, learning based on movement enhances brain function and memory in students, and there is a connection between physical activity and their achievements, behavior, nema predavanja, ispitivanja, ocenjivanja i sličnih osobina nastavnog i školskog rada. Sticanje znanja, veština i navika te razvijanje psihičkih i telesnih sposobnosti učenika, odvija se prvenstveno kroz igru i praktični rad (Omerović & Zukorlić, 2019). Osim toga što škola u prirodi pruža izuzetne mogućnosti obrade novih sadržaja, kao i proveravanje,ona omogućava i utvrđivanje i praktičnu primenu kao i usavršavanje ranije stečenih znanja, npr. motoričkih. Kako navodi autorka Nikolić, u školi u prirodi precizirana su elementarna kretanja motornog i manipulativnog karaktera. Pa bi, trebalo očekivati da učenici drugog razreda ovladaju vožnjom koturaljki, učenici trećeg razreda skokovima u mestu sa rotacijom oko vertikalne ose, dok bi učenici četvrtog razreda trebalo da „ovladaju tehnikom igranja fudbala i da nauče da plivaju“ (Nikolić, 2005:59). Realizacija nastave fizičkog vaspitanja u prirodi može biti optimalno rešenje i za realizaciju onlajn –nastave, shodno zahtevu, potpuno različitom od „dosadašnjih zahteva u okviru tradicionalne realizacije nastave – prelazka na onlajn-nastavu, a potom i kombinovanu nastavu“ (Milanović, Milić, 2022:279).

Nastava fizičkog vaspitanja realizovana u školi u prirodi zbog karaktera saznajnog procesa i praktične primene znanja omogućava celovit (integrativni) pristup. Nastavni plan i program mlađih razreda osnovne škole ima veliki broj nastavnih tema koje omogućavaju integrisan pristup nastavi fizičkog vaspitanja sa drugim nastavnim predmetima (priroda i društvo, matematika, maternji jezik, muzičko i likovno vaspitanje). Integracija dva ili više predmetna područja ,npr. nauke, jezika, plesa i umetnosti sa fizičkim vaspitanjem je širom sveta našla svoju primenu. S tim u vezi, učenje putem pokreta omogućava učenicima da koriste prirodne oblike kretanja (skakanje, hodanje, puzanje) dok uče, tom prilikom koriste mnoge modalitete učenja (vizuelni, slušni, motorički i kinestetički) (Koontz, 2010; Coral & Lleixa, 2016, prema, Cekić-Jovanović i Milanović, 2020:85). Čak i ona najjednostavnija, živahna i deci poznata kretanja (elementarne igre, terenske igre, vežbe podražavanja, provlačenje i trčanje između drveća, preskakanje prirodnih prepreka, šetnje kroz šumu, klackanje, ljuljanje) ili pak, u zavisnosti od godišnjeg doba, igre na snegu (zima) i plivanje i igre na vodi (leto) omogućavaju da dete postane snažnije, da bolje napreduje, a istovremeno postaje sve spretnije i bolje se snalazi u raznim situacijama. Autorke, Cekić-Jovanović i Milanović navode da učenje zasnovano na pokretu poboljšava rad mozga i pamćenje učenika, te da postoji povezanost između fizičke aktivnosti i njihovih postignuća, ponašanja, kognitivnih veština i stavova. To praktično znači da obavljanje motoričkih zadataka, dok

cognitive skills, and attitudes. Essentially, performing motor tasks while engaging in cognitive tasks related to other subjects can be beneficial for students. Various types of games involving aerobic activities increase blood and oxygen flow to all parts of the body, including the brain, leading to more efficient brain functioning. Incorporating recreational breaks filled with games involving running, field games, forest walks, lasting 15 to 20 minutes during regular classes, is of great importance as they not only bring about physiological changes but also contribute to improving mood and strengthening the overall well-being of students.

Independent student activity in outdoor schools implies that they work on assignments arising from educational and other activities completely on their own. Depending on the level of autonomy, student activity can be partially or fully independent. In outdoor schools, students cannot rely on parental assistance when completing the assignments but can rely on teacher's support. The teacher must encourage self-initiative and a sense of responsibility, appreciate their modest achievements, and tailor activities according to the individual student's inclinations and abilities. In order to achieve health and recreational objectives, outdoor schools provide a rare opportunity to assess the level of development of hygiene habits (personal hygiene, clothing and footwear hygiene, and living space) and work on their establishment or improvement through students' independent activity (Nikolić, 2005). Physical exercises can also be included in students' independent activities and efforts. The role of the teacher is to reinforce students' understanding of the purpose and objectives of specific exercises, thereby increasing their interest in achieving the expected results. It is invaluable that students can help each other. It is particularly important to ensure that the time allocated for independent student activity is realistic and that the assignments themselves are engaging and appropriate.

Leisure activities encompass numerous and diverse activities (sports, recreational, cultural, entertainment, work-related, and service-oriented), and what characterizes them is that each activity represents a contribution to the holistic development of an individual (Nikolić, 2005). Additionally, this is supported by the fact that these activities are carried out under the guidance of professionals from various fields (collaborators, animators), which represents an expanded pedagogical approach. These activities are generally favored by students and help develop their awareness of physical activity as an integral part of modern life. Recreational and sports activities in outdoor schools can be conducted whenever conditions allow, regardless of the season, as each season can provide unique pleasures and new experiences that benefit a child's well-being. These activi-

se bave kognitivnim zadacima u oblasti drugih nastavnih predmeta, može biti korisno za učenike (Kitchen, Kitchen, 2013; GomezPinilla, Hillman, 2013, prema: Cekić-Jovanović i Milanović, 2020), jer razne vrste igara koje uključuju aerobne aktivnosti povećavaju protok krvi i kiseonika u sve delove tela, uključujući i mozak, što dovodi do njegovog efikasnijeg funkcionisanja (Ibidem, 85). Praktikovanje rekreativnih pauza ispunjenih igrom sa elementima trčanja, terenskim igrama, šetnjama kroz šumu…u trajanju od 15 do 20 minuta tokom redovne nastave od velikog su značaja jer osim fizioloških promena, doprinose i popravljanju raspoloženja i jačanju organizma u celini.

Samostalan rad učenika u školi u prirodi podrazumeva da oni potpuno samostalno rešavaju obaveze koje proizilaze iz nastavnih i drugih aktivnosti. Obzirom na stepen samostalnosti rad učenika može biti delimično i potpuno samostalan. U školi u prirodi učenik ne može računati na pomoć roditelja prilikom izvrašavanja zadatih obaveza, ali može računati na nastavnikovu pomoć. Nastavnik mora podsticati samoinicijativnost i osećaj odgovornosti, uvažavati njihove najskromnije uspehe i odmeriti aktivnosti shodno sklonostima i sposobnostima učenika kao pojedinca. U cilju ostvarivanja zdravstveno-rekreativnih ciljeva, škola u prirodi predstavlja retku priliku da se utvrdi nivo razvijenosti higijenskih navika (telesne i higijena odeće i obuće i prostora u kojem se boravi) i da se radi na njihovom izgrađivanju, odnosno dograđivanju (Nikolić, 2005) kroz samostalni rad učenika. Telesne vežbe se takođe mogu uvrstiti u aktivnosti i zalaganja učenika u vidu samostalnog rada. Uloga nastavnika je da kod učenika potkrepi razumevanje smisla i zadataka određenih vežbi kako bi povećao zainteresovanost da postignu očekivane rezultate. Od neprocenjive je važnosti i to što se učenici mogu međusobno pomagati. Posebno treba voditi računa da vreme koje je predviđeno za samostalan rad učenika bude u realnim okvirima, a da sami zadaci budu zanimljivi i prigodni.

Aktivnosti u slobodnom vremenu podrazumevaju brojne i raznolike aktivnosti (sportsko-rekreativne, kulturno-zabavne, radno-uslužne...), a ono što ih karakteriše jeste da svaka aktivnost predstavlja svojevrstan doprinos celovitom razvoju ličnosti (Nikolić, 2005). Takođe, tome ide u prilog i činjenica da se izvode pod stručnim rukovodstvom lica različitih profila (saradnici, animatori) što predstavlja vid proširenog pedagoškog delovanja. Za ove aktivnosti važi pravilo da su učenicima omiljene kao i da razvijaju kod učenika svest o fizičkoj kulturi kao integralnom delu života savremenog čoveka. Rekreativne i sportske aktivnosti u školi u prirodi mogu se realizovati

ties evoke pleasant emotions in students (joy, enthusiasm, satisfaction, cheerfulness, excitement, optimism, sympathy, love for nature and homeland) and through them, students get to know each other better, learn to collaborate, and respect the rights, interests, needs, freedoms, and integrity of others (Jovanović, 1998).

In addition to their diverse nature depending on the terrain configuration (meadows, forests, mountains, seaside, lakes), activities in outdoor schools can be divided into those carried out in winter conditions and those conducted during spring and summer. During the winter period, snow activities are organized, which are significant for children's proper physical development. Spending time in the snow and fresh air has a positive impact on children's health, particularly on their musculoskeletal system, respiratory organs, heart and circulation, nervous system, thermoregulation, as well as improving coordination, balance, dexterity, precision, self-confidence, and creativity (Zrnzević, 2015:692). The winter air not only strengthens children's bodies but also influences the development of their willpower and character. There are various activities that can be carried out in snow. In places where there is snow during winter, games such as sledding, ice skating, skiing, and snowboarding should be organized because children enjoy the snow. Above all, it is possible to engage in all natural forms of movement (walking, running, jumping, throwing, lifting, carrying, pulling, pushing, dragging) on the snow. Numerous elementary and relay games can be organized on the snow as well (running after the biggest snowflake, weaving around trees, jumping over snowballs, snowball fights, aiming at moving and stationary targets, sledding, imitating animals, walking in deep snow) (Ibidem, 2015).

The most important thing is to avoid excessive standing in one place, lengthy explanations, and the games should be dynamic and cheerful. When implementing the mentioned activities, it is important to keep in mind that low air temperature significantly reduces the body's working capacity. Additionally, moist air is a good heat conductor, so in lower temperatures, the body cools down faster. Therefore, it is necessary for the teacher to adjust the exercises to provide appropriate exertion and to ensure that children are dressed adequately, able to stay in the snow for longer periods of time, have waterproof footwear, and are dressed in layers. This also highlights the fact that the teacher's guidance in dosing the activities must be based on knowledge of physiology and psychology, as well as the ability to timely recognize fatigue in students. By possessing expertise in their field, the teacher will earn the respect of their students, while disinterest in their work, neglecting weaker students, subjectivity, or failure to recognize achievements can pro-

kad god postoje uslovi, bez obzira na godišnje doba, jer svako doba može pružiti posebna zadovoljstva i doživljavanje nečeg lepog i novog što će prijati dečijem organizmu. Ove aktivnosti snažno bude prijatna osećanja kod učenika (radost, oduševljenje, zadovoljstvo, vedrina, ushićenje, optimizam, simpatija, ljubav prema prirodi i domovini) i kroz njih učenici se bolje upoznaju, uče da sarađuju i poštuju prava, interese, potrebe, slobode i integritete drugih (Jovanović, 1998).

Osim toga što su raznolike shodno konfiguraciji terena (livada, šuma, planina, morska obala, jezero), aktivnosti u školi u prirodi se dele na one koje se realizuju u zimskim uslovima i one koje se realizuju tokom proleća i leta. U zimskom periodu realizovaće se aktivnosti na snegu koje su značane za pravilan fizički razvoj dece. Boravak na snegu i sviježem vazduhu pozitivno utiče na zdravlje dece, a pre svega na aparat za kretanje, na organe za disanje, na srce i krvotok, na nervni sistem, na termoregulaciju, na poboljšanje koordinacije, ravnoteže, spretnosti, preciznosti, samopouzdanja, kreativnosti (Zrnzević, 2015:692). Zimski vazduh, osim što jača dečji organizam utiče i na razvoj dečije volje i karaktera. Postoji veliki izbor aktivnosti koji se mogu realizovati na snegu. U mestima gde u toku zime ima snega treba organizovati igre kao što su sankanje, klizanje, skijanje i smučanje jer deca vole sneg, a pre svega moguće je realizovati sve prirodne oblike kretanja (hodanje, trčanje, skakanje, bacanje, dizanje, nošenje, nadvlačenje, potiskivanje, vučenje). Na snegu se mogu organizovati i mnoge elementarne i štafetne igre (trčanje za najvećom pahuljom, vijugavo trčanje oko drveća, preskakanje preko grudve, grudvanje, gađanje pokretnih i nepokretnih ciljeva, sankanje, oponašanje životinja i hodanje po dubokom snegu) (Ibidem, 2015). Najvažnije je da nema mnogo stajanja u mestu, predugog objašnjenja, a igre trebaju biti dinamične i vesele. Prilikom realizacije navedenih aktivnosti treba imati na umu da niska temperatura vazduha znatno smanjuje radnu sposobnost organizma. Takođe, vazduh zasićen vlagom dobar je provodnik toplote, tako da kada su niže temperature telo se brže rashlađuje. Zato je potrebno da nastavnik prilagodi vežbe koje će izazavati adekvatno opterećenje i da vodi računa da deca budu adekvatno obučena, da mogu duže da borave na snegu, da imaju nepromočivu obuću i budu slojevito obučena. Ovo ukazuje i na to da nastavnikov putokaz u doziranju aktivnosti mora biti poznavanje fiziologije i psihologije kao i to da blagovremeno opazi umor na učenicima. Nastavnik (učitelj) će poznavanjem svoje struke steći poštovanje svojih učenika, dok će nezainteresovanošću za svoj rad, zapostavljanjem slabijih učenika, neobjek-

voke resistance, not only towards themselves personally but also towards physical education for children, which will significantly diminish the physiological and pedagogical effectiveness of the overall activities (Kragujević, 1978).

When it comes to organizing outdoor schools in the summer period, water activities are of invaluable importance as they allow for maintaining proper body posture, improving joint mobility, engaging the entire musculature, relaxing the neuro-vegetative system, and positively affecting the cardiovascular and respiratory systems, functional and motor skills, thermoregulatory system, as well as correcting body deformities and reducing body weight. Getting accustomed to water and engaging in activities in it help develop perseverance, strengthen willpower, persistence, and self-discipline in children (Zrnzević, 2015).

Leisure activities in outdoor schools aim to relax the body, replenish and increase vitality and optimism. Along with other activities such as classes and independent student activity, they help overcome the negative consequences of prolonged indoor stays, limited movement and physical activity, improper nutrition, and exposure to polluted urban environments for children. In nature, the level of motor and functional skills is elevated, and the adaptability of the cardiovascular and respiratory systems to physical exertion, which children experience through various activities, is improved.

Conclusion

In modern living conditions, school-age children are less physically active, which inevitably results in depleted motor skills and disrupted biological and psychological balance of the body. Relying solely on school and physical education classes to achieve physical and health education goals does not yield satisfactory results. Although outdoor schools are organized once a year, they compensate for certain shortcomings of the traditional school system through a comprehensive educational approach. The greatest benefit of outdoor schools lies in the realization of health and recreational objectives. Outdoor schools will undoubtedly alleviate the consequences of children's lack of physical activity, their exposure to polluted environments, and improper nutrition. Students are affected for a long time by the educational influences that are applied throughout their time at nature schools. This model of educational practice presupposes that teachers have received enough pedagogical-didactic-methodological preparation. In that regard, it is obvious that integrated instruction approaches must be implemented in teacher education programs and that future teachers must get systematic training and development of interdisciplinary skills. It is possible to make this

tivnošću ili nepriznavanjem rezultata izazvati otpor, ne samo prema sebi lično, već i prema fizičkom vaspitanju dece, što će osetno smanjiti fiziološki i pedagoški učinak celokupnih aktivnosti (Kragujević,1987).

Kada je reč o organizovanju škole u prirodi u letnjem periodu, sasvim je sigurno da su aktivnosti na vodi od neprocenjivog značaja jer utiču na pravilno držanje tela, na poboljšanje pokretljivosti svih zglobova, angažuje se celokupna muskulatura, relaksira neuro-vegetativni sistem, utiče pozitivno na kardiovaskularni i respiratorni sistem, funkcionalne i motoričke sposobnosti, termoregulacioni sistem i otklanjanje telesnih deformiteta i smanjenje telesne težine. Navikavanje na vodu i aktivnosti u njoj razvijaju kod dece istrajnost u radu, jačanje volje, upornosti, samodiscipline (Zrnzević, 2015).

Slobodne aktivnosti u školi u prirodi imaju za cilj realaksaciju organizma, obnavljanje i povećanje životne energije i optimizma. Zajedno sa drugim aktivnostima (nastava,samostalan rad učenika) omogućavaju prevazilaženje negativnih posledica dugog boravka dece u zatvorenom prostoru, ograničenog kretanja i bavljenja fizičkim aktivnostima, nepravilne ishrane i boravka u zagađenim gradskim sredinama. U prirodnom okruženju podiže se nivo motoričkih i funkcionalnih sposobnosti, ali i poboljšava adaptiranost kardiovaskularnog i respiratornog sistema na fizički napor kome su deca izložena kroz razne aktivnosti.

Zaključak

U savremenim uslovima življenja deca školskog uzrasta su manje fizički aktivna što neminovno ima za posledicu osiromašene motoričke sposobnosti i narušenu biološku i psihološku ravnotežu organizma. Oslanjanje na školu i nastavu fizičkog vaspitanja u smislu ostvarivanja zadataka fizičko-zdravstvenog vaspitanja ne daje zadovoljavajuće rezultate. Iako se škola u prirodi organizuje jednom godišnje celovit vaspitni pristup u njoj kompenzuje određene slabosti škole. Najveći doprinos škola u prirodi daje na polju realizacije zdravstveno-rekreativnih ciljeva. Škola u prirodi će zasigurno ublažiti posledice nekretanja dece, njihovog boravka u zagađenim sredinama, i nepravilne ishrane, a vaspitni uticaji primenjivani tokom boravka dece u njoj imaju dugoročne efekte na učenike. Ovaj model vaspitno-obrazovnog rada podrazumeva dobru pedagoško-didaktičko-metodičku pripremu učitelja. S tim u vezi, evidentno je da postoji potreba da se na učiteljskim fakultetima omogući sistemsko osposobljavanje i razvijanje međupredmetnih kompetencija budućih učitelja za primenu integrativne nastave. Usavršavanjem učitelja i jačanjem njihovih kompetencija za

organizational model thrive in the domestic educational practice, as is the case in many developed countries around the world, by enhancing teachers' professional development and strengthening their competencies for organizing lessons in outdoor schools, as well as by promoting family pedagogy (in terms of raising parents' awareness of the importance of organized outdoor activities for children).

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Statement
We affirm that each author made an equal contribution to the paper.

Conflict of interest
There is no conflict of interest between the authors.

realizaciju škole u prirodi i pedagogizacijom porodice (u smislu jačanja svesti roditelja o značaju organizovanog boravka dece u prirodi) može se postići da ovaj organizacioni model zaživi u domaćoj vaspitno-obrazovnoj praksi kao što je to slučaj u mnogim razvijenim zemljama širom sveta.

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Izjavljujemo da su autori podjednako doprineli radu.

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Između autora ne postoji interesni konflikt.

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- 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.

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