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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

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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.

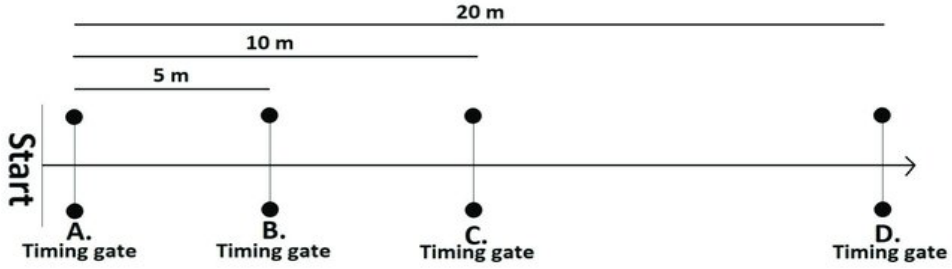

Figure 1. *Diagram of the 5, 10, and 20 m sprint speed test protocol (Sinclair et al., 2021).*

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).

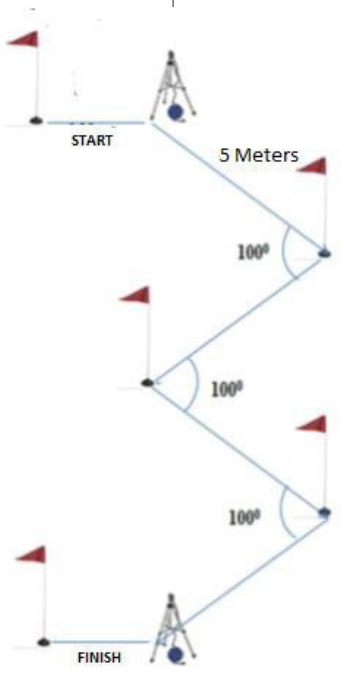

Figure 3. *Diagram of the agility test protocol - Zig-Zag (Little and Williams, 2005)*

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).

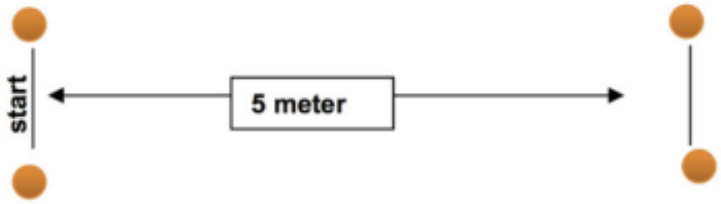

Figure 4. *Agility test protocol diagram - 10x5m (Reilly, Bangsbo and Franks, 2000)*

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.

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.

Table 1. *Central and dispersion parameters of variables*

Tabela 1. *Centralni i disperzioni parametri varijabli*

***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*

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

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

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

***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*

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 vrijabli 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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