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Relations of Morphological Characteristics and Aerobic Durability of Fudbalers of Different Age Categories

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Abstract: *The aim of the study was to analyze if there is a connection between some anthropometric measrements and a test for assessing aerobic ability in footballers of different age categories. 65 players were subjected to these measurements, of which 25 players aged 13-14 years (pioneers); 20 players aged 15-16 years (cadets) and 20 players aged 17-18 years (juniors). By using standard anthropometric instruments, body height, body weight, median volume of the chest and aerobic endurance were measured using a 20m "shuttle run" test. Using linear regression analysis, it was found that there is no statistically significant effect of anthropometric variables on a variable (20m "shuttle run") of all three age players. In these ages, obviously some other characteristics have more influence on the manifestation of aerobic ability. The results of the research can be used by experts in the field of sports in further planning and organizing training contents.*
Keywords: *aerobic ability, anthropometry, football players, connectivity.*

Introduction

Measuring and monitoring the levels of aerobic endurance and morphological characteristics is an integral part of training in most sports (Farraly, 1995a; Farraly, 1995b; Jones, 1997). At Loughborough University, in 1988, a 20m "shuttle run" test was presented as an easy way to measure aerobic ability and aerobic oxygen consumption (Bale, & Doust, 1992). The test has become one of the most popular and most valid tests to date for

Relacije morfoloških karakteristika i aerobne izdržljivosti fudbalera različitih uzrasnih kategorija

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Sažetak: *Cilj istraživanja bio je analizirati da li postoji povezanost između nekih antropometrijskih mara i testa za procenu aerobne sposobnosti kod fudbalera različitih izrasnih kategorija. Merenjima je bilo podvrgnuto 65 fudbalera, od toga 25 fudbalera uzrasta 13-14 godina (pionira); 20 fudbalera uzrasta 15-16 godina (kadeta) i 20 fudbalera uzrasta 17-18 godina (omladinaca). Korisćenjem standardnih antropometrijskih instrumenata izmereni su telesna visina, telesna masa, srednji obim grudnog koša i aerobna izdržljivost pomoću testa 20m „shuttle run". Primenom linearne regresione analize utvrđeno je da ne postoji statistički značajan uticaj sistema antropometrijskih varijabli na varijablu (20m „shuttle run") kod sva tri uzrasta fudbalera. U navedenim uzrastima očito neke druge karakteristike više utiču na manifestaciju aerobne sposobnosti. Rezultati rada mogu poslužiti stručnjacina u oblasti sporta u daljem planiranju i organizovanju trenažnih sadržaja.*
Ključne reči: *aerobna sposobnost, antropometrija, fudbaleri, povezanost.*

Uvod

Merenje i praćenje nivoa aerobne izdržljivosti kao i morfoloških karakteristika je sastavni deo treninga u većini sportova (Farraly, 1995a i Farraly, 1995b; Jones, 1997). Na Loughborough University je davne 1988. godine predstavljen test 20m „shuttle run" kao jednostavan način za merenje aerobne sposobnosti i aerobne potrošnje kiseonika (Bale, & Doust, 1992). Test je postao jedan od najpopularnijih i najvalidnijih testova do danas za

assessing the aerobic ability of athletes and can be used to estimate maximum of oxygenation (aerobic endurance) or $VO_{2max.}$ He has several names by which is known in the sports world, such as *Multistage Fitness Test MSFT, Beep Test, Bleep Test*. The test is mostly for the purpose of finding out the results of aerobic endurance. Aerobic ability is an essential component in most sports. The test-20m "shuttle run" was designed for individuals such as footballers. This test provides scientifically verified information on-site, enabling people who are monitoring and measuring achievements in sports to effectively monitor aerobic endurance.The equipment necessary for this kind of test is minimal, and thus reduces access to laboratory equipment, most commonly used by sports experts, and a full estimate of aerobic capacity can be done without major demands (Wilkinson, & Moore, 1995; Davis, 1996; Brewer & Davis, 1998).

Football features a continuous flow of activities with variable intensity and a very low coefficient of performance according to the time of possession of the ball. A football player during a match runs around 10 km (Reilly, Clarus, & Stibbe, 1993; Mayhew, & Wenger, 1985). In doing so, a light run (less than 11km/h, less than 80% of the maximum oxygen consumption-VO_{2max}) is represented in the largest percentage of overall movements, followed by walking and intense running (11-18 km/h; about 80% VO_{2max}), then sprint (11-27 km/h; <85% VO_{2max}). By the nature of cyclical movements, this corresponds to aerobic needs of about 80% of the maximum oxygen consumption (Helgerud, Engen, & Wisloff, 2001). Maximum oxygen consumption is the largest amount of oxygen a person can take from the inhaled air during dynamic physical activity that engages large muscle groups (Wagner, 1996). Running efficiency represents oxygen debt at a sub-maximal exercise intensity and can vary as much as 20% for athletes with approximate VO_{2max} value. Good aerobic ability undoubtedly influences the performance of explosive movements of the footballers, both in terms of quantity (number of sprints), as well as the quality, that is, the intensity and tempo of cyclical movements. Studies by Reilly, Clarus, & Stibbe (1993b) show that, especially in football, good aerobic capacity of an organism is one of the most important preconditions for achieving top results. A survey conducted by Stankovic, Demir, & Hadziahmetovic (2007a) indicates that pioneers have the worst results in aerobic emdurance, and that cadets have the best average values. The authors also state that the basicanthropometric characteristics were in negative correlations with aerobic endurance in all three age groups of footballers. Also results obtained by Bouchard, Dionne, Simoneau,

procenu aerobne sposobnosti sportista i može se koristiti za procenu maksimalnog unosa kiseonika (aerobne izdržljivosti) ili VO_{2max}. On ima nekoliko naziva preko kojih se poznaje u svetu sporta, kao što su *Multistage Fitness Test*, *MSFT, Beep Test, Bleep Test.* Test je najviše u svrsi saznanja rezultata aerobne izdržljivosti. Aerobna sposobnost je bitna komponenta u većini sportova. Test–20 m „shuttle run" je i bio dizajniran za pojedince kao što su fudbaleri. Taj test daje naučne potvrđene informacije na licu mesta, omogućavajući na taj način ljudima koji se bave praćenje i merenjem dostignuća u sportu da efektivno prate aerobnu izdržljivost. Oprema neophodna za ovakvu vrstu testa je minimalna, te se na taj način smanjuje pristup laboratorijskim uređajima, najčešće korištenim od strane stručnjaka u sportu, a puna procena aerobnog kapaciteta se može obaviti bez većih zahteva (Wilkinson, & Moore, 1995; Davis, 1996; Brewer, & Davis, 1998).

Fudbal karakteriše kontinuiran tok aktivnosti sa promenljivim intenzitetom i veoma niskim koeficijentom uspešnosti prema vremenu posedovanja lopte. Fudbaler u toku utakmice pređe oko 10 km (Reilly, Clarus, & Stibbe, 1993a; Mayhew, & Wenger, 1985). Pri tome je lagano trčanje (manje od 11km/h; manje od 80% maksimalne potrošnje kiseonika-VO_{2max}) zastupljeno u najvećem procentu od ukupnih kretnih radnji, posle čega idu hodanje i intenzivno trčanje (11-18 km/h; oko 80% VO_{2max}), a zatim sprint (11-27 km/h; < 85%VO_{2max}). Po prirodi cikličnih kretnih aktivnosti to odgovara aerobnim potrebama od oko 80% maksimalne potrošnje kiseonika (Helgerud, Engen, & Wisloff, 2001). Maksimalna potrošnja kiseonika je najveća količina kiseonika koju osoba može da preuzme iz udahnutog vazduha tokom dinamičke fizičke aktivnosti koja angažuje velike mišićne grupe (Wagner, 1996). Ekonomičnost trčanja predstavlja kiseonički dug na submaksimalnom intenzitetu vežbanja i može varirati i preko 20% kod sportista sa približnom vrednošću VO_{2max}. Dobra aerobna sposobnost nesumnjivo utiče i na izvođenje eksplozivnih kretnih radnji fudbalera, kako u smislu kvantiteta (broj sprinteva), tako i kvaliteta, odnosno intenziteta i tempa cikličnih kretnji. Istraživanja Reilly, Clarus & Stibbe (1993b) pokazuju da, posebno u fudbalu, dobar aerobni kapacitet organizma predstavlja jedan od najvažnijih preduslova za postizanje vrhunskih rezultata. Istraživanje sprovedeno od strane Stanković, Demir i Hadžiahmetović (2007a) ukazuje da pioniri poseduju najslabije rezultate u aerobnoj izdržljivosti, a da kadeti imaju najbolje prosečne vrednosti. Autori još navode da su osnovne antropometrijske karakteristike bile u negativnim korelacijama sa aerobnom izdržljivošću kod sve tri uzrasne grupe fudbalera. Kođe nalazi do-

Boulay, (1992a) indicate that morphological characteristics have little impact on maximum aerobic endurance.The inheritance can be interpreted as 25-50% of the variation between the individuals,especially when comparing the athletes, the difference in maximum oxygen consumption and aerobic endurance is reduced to around 10% with increasing age (Wilmore, & Costill, 2005). Maximum oxygen consumption decreases with age, and the average drop rate is usually accepted at a level of about 1% per year or 10% per decade after 25 years of age.

The aim of the research is to point out the results based on the relations of individual morphological characteristics and aerobic abilities, from which further suggestions could be given for working with certain age groups of footballers.

Materials and Methods

Measurement of basic morphological characteristics and functional abilities was performed on a sample of 65 respondents, FC 'Radnicki' from Sombor. Out of the total number of respondents, there were 25 footballers aged 13-14 years classified as pioneers; 20 players aged 15-16 years classified as cadets and 20 players aged 17-18 years who made a junior group.

Table 1. *Structure of the sample of footballers*

Age groups	sample
Pioneers (13/14 years)	25
Cadets (15/16 years)	20
Juniors (17/18 years)	20
Total ∑	65

An estimate of anthropometric dimensions included the measurement of one variable for estimating the longitudinal dimension of the skeleton: 1*) Body height* (mm) and two variables for estimating volume and body weight 2) *Body mass* (kg) and 3) *Median circumference of the chest* (mm) considering IBP International Biological Program for each anthropometric measure. The height of the body was measured by an anthropometer after Martin. The respondent was without shoes. He stood on a flat surface, with heels together, his head placed in the position of the "Frankfurt Horizontal". The distance from the surface to the top of the head was measured. The result was expressed in values of 0.1 cm. Body weight was measured by digital medical scale. The respondent was standing on a scale dressed only in underwear. Results are expressed in values of 0.1 kg. The median circumference of the chest was measured by centimeter band. The respondent was stand-

bijeni od strane Bouchard, Dionne, Simoneau, Boulay, (1992a) ukazuju da morfološke karakteristike slabo utiču na maksimalnu aerobnu izdržljivost. Naslednost se može protumačiti od 25-50% varijacije između individua, pogotovo kada se porede sportisti, razlika u maksimalnoj potrošnji kiseonika i aerobnoj izdržljivosti se smanjuje do oko 10% sa porastom godina (Wilmore, & Costill, 2005). Maksimalna potrošnja kiseonika se smanjuje sa godinama, a prosečna mera pada je ponajčešće prihvaćena na nivou oko 1% godišnje ili 10% po dekadi nakon 25 godina starosti.

Cilj istraživanja je da se na osnovu rezultata ukaže na odnose pojedinih morfoloških karakteristika i aerobne sposobnosti pri čemu bi se mogle dati dalje sugestije za rad sa određenim uzrasnim grupama fudbalera.

Materijal i metod

merenje osnovnih morfoloških karakteristika i funkcionalne sposobnosti je bilo izvršeno na uzorku od 65 ispitanika, fudbalera FK „Radnički" iz Sombora. Od ukupnog broja ispitanika bilo je 25 fudbalera uzrasta 13-14 godina klasifikovanih kao pioniri; 20 fudbalera uzrasta 15-16 godina klasifikovanih kao kadeti i 20 fudbalera uzrasta 17-18 godina koji su činili grupu juniora.

Tabela 1. *Struktura uzorka fudbalera*

Uzrasne grupe	uzorak
Pioniri (13/14 god.)	25
Kadeti (15/16 god.)	20
Juniori (17/18 god.)	20
Ukupno ∑	65

Procena antropometrijskih dimenzija uključivala je merenje jedne varijable za procenu longitudinalne dimenzionalnosti skeleta i to 1) *Telesnu visinu* (mm) i dve varijable za procenu volumena i mase tela 2) *Telesnu masu* (kg) i 3) *Srednji obim grudnog koša* (mm) prema poštovanju internacionalnog biološkog programa IBP za svaku antropometrijsku meru. Visina tela merena je antropometrom po Martinu. Ispitanik je bio bez obuće. Stajao je na ravnoj podlozi, skupljenih peta, glave postavljene u položaj „frankfurtske horizontale". Merila se udaljenost od podloge do temena glave. Rezultat se iskazivao u vrednostima od 0,1 cm. Telesna težina merena je digitalnom medicinskom vagom. Ispitanik je stajao na vagi odeven samo u donje rublje. Rezultati se iskazivato u vrednostima od 0,1 kg. Srednji obim gudnog koša merio se centimetarskom trakom. Ispitanik je stajao opruženih ruku niz telo. Merio se obim najšireg dela grudnog

ing his arms streched down the body. The volume of the widest part of the chest was measured. The result was read on the lower part of the chest bone (manubrium stern). The values were expressed in 0.1 cm. Measurement was also performed once. These results were taken from the Sports Dispensary in Sombor, where all these footballers have their own sports/medical cards, and the measurement was done immediately before testing the functional capability.

A 20m "shuttle run" test from the Fitness test group was used to assess functional abilities, and to estimate aerobic endurance, i.e. to check the maximum oxygen intake. This test was performed through a continuous running between two lines of 20m distance to the sound that sounds from the CD player. The person being tested was behind one of the lines and turned to look at another line and started running when instructions from the CD player were heard. The speed at the start of the test was of extremely low intensity.The respondent was continuously running between two lines.He turned around when the signal from the recorded material was being heard. After one minute, the sound was emphasized and the sound signal time was reduced. Such sound signal continued every minute. If the line was not reached at the time of each beep, the respondent had to run to the line and then turned and tried to catch the step and rhythm of the two subsequent sounds, so he had to be timely in any hearing of sound from the tape. In addition, if the line was touched before the sound, the respondent had to wait until the sound was heard. The test was stopped if the respondent failed to reach the line after a beep. There are several versions of this test, but one general version has a starting load of 8.5 km / h, which increases by 0.5 km / h every minute. The result of the test is the number of running distances. As necessary equipment for the performance of this test, it was used: flat, unbroken surface, conical markers, 20 m "shuttle run" adequate audio tape, CD player, notebook for entering results.

Descriptive statistics for the calculation of descriptive statistics of anthropometric and functional variables were used in data processing: arithmetic mean (AS), standard deviation (S), minimum and maximum values of measurement results, coefficient of variation (KV). In order to determine the statistically significant correlation between anthropometric and functional variables, a linear regression analysis was used.

Results

The results of descriptive statistics presented in Table 2 indicate that pioneer age players are homogeneous in terms of body height, body weight and chest development, while this can not be ascertained for the

koša. Rezultat se očitavao na donjem delu grudne kosti (*manubrium sternni*). Vrednosti su se iskazivale u 0,1 cm. Merenje se vršilo takođe jedanput. Ovi rezultati su preuzeti iz Sportskog dispanzera u Somboru, gde svi ovi fudbaleri imaju svoje sporsko/medicinske kartone, a merenje se obavilo neposredno pred testiranje funkcionalne sposobnosti.

Za procenu funkcionalne sposobnosti bio je korišten *20m „shuttle run"* test iz grupe Fitnes testova, a služio je za procenu aerobne izdržljivosti, tj. za proveru maksimalnog unosa kiseonika. Ovaj test se izvodio kroz kontinuirano trčanje između dve linije udaljenosti od 20m na zvuk koji se oglašava sa CD plejera. Osoba koja se testira nalazila se iza jedne od linija i okrenuta je bila tako da gleda ka drugoj liniji i započinje trčanje kada se instrukcije sa CD plejera oglase. Brzina na početku testiranja je bila izuzetno niskog intenziteta. Ispitanik je kontinuirano trčao između dve linije. Okretao se kada se signal sa snimljenog materijala oglašavao. Nakon jednog minuta, zvuk se naglašavao i smanjivalo se vreme oglašavanja zvučnog signala. Takvo oglašavanje se nastavljalo svaki minut. Ako liniju nije dostigao u vreme svakog zvuka, ispitanik je morao trčati do linije i zatim se okrenuti i pokušati da uhvati korak i ritam dva naredna oglašavanja, znači morao je da bude pravovremen pri svakom oglašavanju zvuka sa trake. Sem toga, ako je liniju dotaknuo pre oglašavanja zvuka, ispitanik je morao da sačeka dok se zvuk nije oglasio. Test se zaustavljao ako ispitanik nije uspeo da stigne na liniju nakon zvučnog signala. Postoji nekoliko verzija ovog testa ali jedna uopštena verzija ima startno opterećenje pri trčanju od 8,5 km/h, koje se povećava za 0,5 km/h na svaki minut. Rezultat testa je broj pretrčanih distanci. Kao potrebna oprema za izvođenje ovog testa, koristila se: ravna, neisprekidana površina, kupasti markeri, 20 m „shuttle run" adekvatna audio traka, CD plejer, sveska za upisivanje rezultata

U obradi podataka bila je korištena deskriptivna statistika za izračunavanje deskriptivnih statistika antropometrijskih i funkcionalne varijable: aritmetička sredina (AS), standardna devijacija (S), minimalne i maksimalne vrednosti rezultata merenja, koeficijent variacije (KV). Radi utvrđivanja statistički značajne povezanosti između antropometrijskih i funkcionalne varijable, bila je korištena linearna regresiona analiza.

Rezultati

Rezultati deskriptivnih statistika prikazanih u tabeli 2 upućuju na činjenicu da su fudbaleri pionirskog uzrasta homogeni u pogledu telesne visine, telesne mase i razvijenosti grudnog koša, dok se to ne može konstatovati za

20m "shuttle run" aerobic endurance rating. Cadets are also homogeneous in all three anthropometric variables, while this can not be ascertained as in the pioneers for 20m"shutle run"test.The same conclusions can be found for junior footballers.

varijablu za procenu aerobne izdržljivoti 20m „shuttle run". Kadeti su takođe homogeni u sve tri antropometrijske varijable, dok se to ne može konstatovati kao i kod pionira za test 20m „shutle run". Isti zaključci se mogu konstatovati i za fudbalere juniorskog uzrasta.

Table 2. *Descriptive statistics of variables for all three examined categories of footballers*

Tabela 2. *Deskriptivni statistici varijabli za sve tri ispitivane kategorije fudbalera*

Varijabla / *Variable*	Grupa / *Group*	AS	S	MIN	MAX	KV(%)	SWp
Telesna visina (mm) / *Body height (mm)*	Pioniri / *Pioneers*	1545.27	60.12	1448	1654	3.89	0.52
	Kadeti / *Cadets*	1635.13	60.33	1520	1723	3.69	0.69
	Juniori / *Juniors*	1723.67	45.34	1652	1789	2.63	0.37
Telesna masa (0,5 kg) / *Body mass (0.5 kg)*	Pioniri / *Pioneers*	459.00	30.28	399	502	6.60	0.54
	Kadeti / *Cadets*	526.33	45.48	450	610	8.64	0.96
	Juniori / *Juniors*	605.07	45.72	521	710	7.56	0.93
Srednji obim grudnog koša (mm) / *Median circumference of the chest (mm)*	Pioniri / *Pioneers*	723.47	41.85	650	789	5.78	0.10
	Kadeti / *Cadets*	829.07	44.62	750	888	5.38	0.21
	Juniori / *Juniors*	840.27	52.51	756	927	6.25	0.77
20 m „shuttle run" (frek.) / *20 m "shuttle run" (freq.)*	Pioniri / *Pioneers*	53.00	10.54	39	70	19.89	0.11
	Kadeti / *Cadets*	69.80	11.05	51	90	15.83	0.09
	Juniori / *Juniors*	75.13	12.74	50	91	16.95	0.15

Legend: *AM-arithmetic mean; S-standard deviation; MIN–minimum measurements results; MAX–maximum measurements results; CV – coefficient of variation; SWP - Shapiro Wilk Normality test p-value.*

Legenda: *AS-aritmetička sredina; S-standardna devijacija; MIN–minimalne vrednosti rezultata merenja; MAX–maksimalne vrednosti rezultata merenja; KV - Koeficijent varijacije; SWP - nivo statističke značajnosti Shapiro Wilk testa.*

The results of the regression analysis of 20m "shuttle run" in Table 3 for pioneers indicate that there is no statistically significant effect of the system of anthropometric (predictor) variables on the criterion (P=0.25) at the value of the multiple correlation coefficient R=0.55, which explains 30% of common variability. No anthropometric variables show a statistically significant effect on the test criterion.

Rezultati regresione analize 20m „shuttle run" u tabeli 3 za pionire ukazuju da ne postoji statistički značajan uticaj sistema antropometrijskih (prediktorskih) varijabli na kriterijum (P=0,25), pri vrednosti koeficijenta multiple korelacije R=0,55, što objašnjava 30% zajedničkog varijabiliteta. Nijedn a antropometrijska varijabla ne pokazuje statistički značajan uticaj na ispitivani kriterijum.

Table 3. *Regression analysis of 20m 'shuttle run' for pioneers*

Tabela 3. *Regresiona analiza 20m „shuttle run" za pionire*

Varijabla / *Variable*	r	p	r_{part}	p_{part}	Beta	p_{bete}
Telesna visina / *Body height*	-0.41	0.07	-0.44	0.14	-0.57	0.14
Telesna masa / *Body mass*	-0.08	0.38	0.28	0.35	0.34	0.35
Srednji obim grudnog koša / *Median circum. of the chest*	0.37	0.09	0.30	0.33	0.27	0.33

$R=0.55 \quad R^2=0.30 \quad P=0.25$

Legend: *r - Pirson coefficient of correlation; p - the level of statistical significance for r; rpart - the value of the partial correlation coefficient; pprat - level of statistical significance for rpart Beta - regression coefficient; pbete - level of significance of regression coefficient; R - multi-correlation coefficient; R2 - determination coefficient; P - significance of multi-correlation coefficient.*

Legenda: *r - Pirsonov koeficijent korelacije; p - nivo statističke značajnosti za r; r_{part} - vrednost koeficijenta parcijalne korelacije; p_{prat} - nivo statističke značajnosti za r_{part} Beta - regresijski koeficijent; p_{bete} - nivo značajnosti regresijskog koeficijenta; R - koeficijent multiple korelacije; R^2 - koeficijent determinacije; P - značajnost koeficijenta multiple korelacije.*

Also, for cadet age footballers (Table 4) there is no statistically significant effect on the predictor system of anthropometric variables on the criterion (P=0.55), at the value of the multiple correlation coefficient R=0.41, which explains a total of 17% of the total variability. Also, in this case, there is no effect of any predictor variable on the set criterion.

Takođe ni kod fudbalera kadetskog uzrasta (tabela 4) ne postoji statisički značajan uticaj prediktorskog sistema antropometrijskih varijabli na kriterijum (P=0,55), pri vrednosti koeficijenta multiple korelacije R=0,41, što objašnjava ukupno 17% zajedničkog varijabiliteta, Takođe ni u ovom slučaju ne postoji uticaj nijedne prediktorske varijable na postavljeni kriterijum.

Table 4. *Regression analysis of 20m 'shuttle run' for cadets*

Tabela 4. *Regresiona analiza 20m „shuttle run" za kadete*

Varijabla / *Variable*	r	p	r_{part}	p_{part}	Beta	p_{bete}
Telesna visina / *Body height*	0.29	0.14	-0.09	0.78	-0.16	0.78
Telesna masa / *Body mass*	0.33	0.12	0.16	0.61	0.26	0.61
Srednji obim grudnog koša / *Median circum. of the chest*	0.38	0.08	0.26	0.40	0.34	0.40

R=0.41 *R^2=0.17* *P=0.55*

The results in Table 5 indicate that even in this case, there is no statistically significant effect on the predictor system of anthropometric variables on the criterion (P = 0.14), which in this case explains 38% of the total variability.

Rezultati u tabeli 5 ukazuju da ni u ovom slučaju ne postoji statistički značajan uticaj prediktorskog sistema antropometrijskih varijabli na kriterijum (P=0,14), što u ovom slučaju objašnjava 38% zajedničkog varijabiliteta.

Table 5. *Regression analysis of 20m 'shuttle run' for juniors*

Tabela 5. *Regresiona analiza 20m „shuttle run" za juniore*

Varijabla / *Variable*	r	p	r_{part}	p_{part}	Beta	p_{bete}
Telesna visina / *Body height*	-0.42	0.06	-0.07	0.83	-0.07	0.83
Telesna masa / *Body mass*	-0.23	0.21	-0.09	0.76	-0.08	0.76
Srednji obim grudnog koša / *Median circum. of the chest*	0.61	0.01	0.48	0.10	0.55	0.10

R=0.61 *R^2=0.38* *P=0.14*

Discussion

the results of this study pointed to the fact that the basic anthropometric measures, body height, body mass and median circumferrence of the chest did not show any significant effect on the results of the aerobic endurance test for FC 'Radnicki' from Sombor in all three age categories (pioneers, cadets and juniors). It is probable that the aerobic ability of footballers of these ages is significantly influenced by some other characteristics and abilities that were not the subject of research. In the pioneer age, the effect of earlier experience in the earlier development period of the individual is likely to be predominant (the individual differences in the respondents were evident). In this period, footballers pay more attention to the training of elements of football technique, so the results of the common variability (30%) of the predictor system with the criterion result in the 20m "shuttle run" are easily explained. The aerobic abilities of the pioneer age players are different and vary from the person to person and the level of training. In this period, aerobic capacity is not so emphasized in training, as more atten-

Diskusija

Rezultati ovoga istraživanja ukazali su na činjenicu da osnovne antropometrijske mere, *Telesna visina, Telesna masa* i *Srednji obim grudnog koša*, ne pokazuju značajan uticaj na rezultate testa za procenu aerobne izdržljivosti kod fudbalera FK „Radnički" iz Sombora u sve tri uzrasne kategorije (pioniri, kadeti i juniori). Verovatno da na aerobnu sposobnost fudbalera ovih uzrasta značajno utiču neke druge karakteristike i sposobnosti koje nisu bile predmet istraživanja. U pionirskom uzrastu verovatno preovladava svojim većim delom uticaj ranijeg iskustva u ranijem periodu razvoja jedinke (individualne razlike kod ispitanika su bile evidentne). U ovom periodu kod fudbalera se veća pažnja posvećuje obučavanju elemenata tehnike fudbala, pa su i rezultati zajedničkog varijabiliteta (30%) prediktorskog sistema sa kriterijumom rezultat u testu 20m „shuttle run" lako objašnjivi. Aerobne sposobnosti fudbalera pionirskog uzrasta su različite i zavise od osobe do osobe kao i nivoa treniranosti. U ovom periodu aerobna sposobnost nije toliko naglašena na treninzima, jer se još uvek veća pažnja posvećuje ele-

tion is paid to elements of football technique. Even the game lasts for 80 minutes, and less attention is paid to the development of aerobic ability due to the growth and development of the organism, and the fact that with the intensive development of aerobic spontaneity, it should begin after the intense growth phase of the organism, which is yet to come about in this age category. Some respondents can run 70 distances, and others only 39 in the 20m "shuttle run" test. Ostojic (2006) lists data on the body height and weight of the footballers showing a great variation. The author also states that insufficient height is not a lack of football in itself, although it affects the position on the team. The average values of anthropomorphological parameters are likely to have minimal significance according to the high variability.

In cadet age, aerobic ability is higher than in pioneers and is fairly balanced, although there are also high achievers (90 distances) and those running only 59 distances. In this age development period, special attention is paid to aerobic endurance, so the results of homogeneity can be attributed to the way and method of training. With junior footballers, even more importance is given to the development of aerobic endurance, as the time of the competition increases to 90 minutes. It should also be noted that during this period the energy needs of the organism in the football vary and depend to a great extent on the ranking of the competition, the position on the team, the stages of the training cycle and the age (Reilly, Bangsbo, & Franks, 2000). Such requirements imply the exceptional physical fitness of all the athletes in the field in all age categories. It is known that aerobic ability depends on three essential factors: VO_{2max}, anaerobic threshold and cost-effectiveness (Pate, & Kriska, 1984; Pelemiš, Mitrović, Cicović, & Lolić, 2011), i.e. running economy. For football players aged 15-16 years old, despite turbulent anatomical and physiological changes that shake the body of children, anthropometric characteristics did not have an impact on the test results for assessing aerobic endurance. During this period, great attention is paid to the development of aerobic endurance. Various games are applied withtwo, three, four goals, where players play 2 to 2, 3 to 3, 4 to 4 with and without auxiliary players for 4 to 8 minutes. Such trainings led to the homogeneous results of a selective group of football cadets, as well as junior age. Anthropometric characteristics did not have a significant impact on aerobic capacity, i.e. the results of the test for its assessment, so it is possible that aerobic ability at this age affect other characteristics and level of training of the football player. Such results coincide with the research of Stankovic, Demir, & Hadziahmetovic (2007b). The greatest influence

mentima tehnike fudbala. Čak i utakmica traje 80 minuta, a manja pažnja se posvećuje razvoju aerobne sposobnosti usled zakonista rasta i razvoja organizma i činjenice da se sa intenzivnim razvojem aerobne spoosbnosti treba početi nakon faze intenzivnog rasta organizma, koja tek treba da usledi kod ove uzrasne kategorije. Neki ispitanici mogu da istrče 70 distanci, a neki samo 39 u testu 20m „shuttle run". Ostojić (2006) navodi podatke o telesnoj visini i telesnoj masi fudbalera koji pokazuju veliku varijaciju. Autor takođe navodi da nedovoljna visina nije sama po sebi nedostatak za fudbalski sport, mada utiče na izbor pozicije u timu. Prosečne vrednosti antropomorfoloških parametera verovatno imaju minimalan značaj shodno velikom varijabilitetu.

Kod fudbalera kadetskog uzrasta aerobne sposobnosti su na višem nivou nego kod pionira i prilično su izjednačeni, mada i ovde postoje ispitanici koji ostvaruju izuzetne rezultate (90 pretrčanih distanci), a i oni koji trče svega 59 distanci. U ovom uzrasnom periodu razvoja fudbalera posebna pažnja počinje da se posvećuje aerobnoj izdržljivosti, pa se i rezultati homogenosti mogu pripisati načinu i metodi treninga. Kod fudbalera juniorskog uzrasta, još veći značaj se pridaje razvoju aerobne izdržljivosti, jer se i vreme takmičenja povećava na 90 minuta. Takođe je potrebno napomenuti da u ovom periodu energetske potrebe organizma u fudbalu variraju i u velikoj meri zavise od ranga takmičenja, pozicije u timu, faze trenažnog ciklusa i uzrasta (Reilly, Bangsbo & Franks, 2000). Takvi zahtevi podrazumevaju izuzetnu fizičku pripremljenost svih sportista na terenu u svim uzrasnim kategorijama. Poznato je da aerobna sposobnost zavisi od tri bitna faktora: VO_{2max}, anaerobnog praga i ekonomičnosti rada (Pate & Kriska, 1984; Pelemiš, Mitrović, Cicović i Lolić, 2011), tj. ekonomičnosti trčanja. Kod fudbalera uzrasta 15-16 godina, i pored burnih anatomsko-fizioloških promena koje „potresaju" telo dece, antropometrijske karakteristike nisu imale uticaj na rezultate testa za procenu aerobne izdržljivosti. U ovom periodu se velika pažnja posvećuje razvoju aerobne izdržljivosti. Primenjuju se razne igre na dva, tri, četiri, gola gde igrači igraju 2 na 2, 3 na 3, 4 na 4 sa i bez pomoćnih igrača u trajanju od 4 do 8 minuta. Ovakvi treninzi su doveli do homogenih rezultata selektcionisane grupe fudbalera kadetskog, pa i juniorskog uzrasta. Antropometrijske karakteristike nisu imale značajan uticaj na aerobnu sposobnost, tj. rezultate testa za njenu procenu, pa je moguće da na aerobnu sposobnost u ovom uzrastu imaju uticaj neke druge karakteristike i nivo treniranosti fudbalera. Ovakvi rezultati se poklapaju sa istraživanjem Stankovića, Demira i Hadžiahmetovića (2007b). Na aerobnu spo-

on the aerobic ability of the footballer, is genetic predisposition and level of training. The results of this work are confirmed by the claims that the anthropometric characteristics have little effect on the aerobic ability of the footballers, as confirmed by the studies of Bouchard, Dionne, Simone, & Boulay (1992b).

Also, among the oldest age players (17-18 years old), ie junior, the anthropometric characteristics did not have significant impact on the 20m "shuttle run" test results. In these categories, great attention is paid to the development of aerobic ability, because the respondents have already mastered the elements of tactics, the more complex training of tactics and better physical preparation begins. Players are subjected to more stress, regardless of place in the team. As a consequence of such training, the anthropometric characteristics did not affect the aerobic ability of young people. Good, or sufficiently developed aerobic ability, affects: increase in physical abilities, reduce injuries, increase physical strain, reduce tactical mistakes caused by fatigue, reduce technical errors, maintain a high speed of reaction and action and work on stable health, so it is necessary to develop and train it begins with the completed phase of intensive growth of children. Football is predominantly aerobic sport, so one of the main determinants of success is aerobic endurance defined by maximum oxygen consumption (VO_{2max}). In the last few decades, the high linkage of this parameter to a higher number of football performance indicators (calculated distance, number of repetitions and total distance of high intensity, speed of recovery) has been determined (Ostojić, 2015). What is also important is the anaerobic glycolytic system. As we know, a football player makes 100 to 200 sprints per game in the 5-10 m range (Verheijen, 1997). The principle in which the glycolytic system functions is the use of energy from anaerobic glycolytic depots. This process takes place without the presence of oxygen, with the production of lactate coming. Blood lactate concentration indicator is the activation of glycolytic energy processes. The players are actively activating the glycolytic energy system in situations when they perform several consecutive sprints without a break. In these situations, there is an increase of blood lactate concentration to 8 - 12 mmol / l (Weineck, 1994).

In working with pioneers, cadets and juniors, more attention should be paid to the development of aerobic ability. Further monitoring and development of morphological characteristics and aerobic abilities is recommended, but also the training process should not be so much focused on the influence of morphological characteristics in the process of improving aerobic abilities. The authors recommend that the next research should be

sobnost fudbalera najviše uticaja ima genetska predodređenost i nivo treniranosti. Rezultati ovoga rada potvrđuju i tvrdnje da antropometrijske karakteristike slabo utiču na aerobnu sposobnost fudbalera, što su potvrdila i istraživanja Boucharda, Dionnea, Simonea, Boulay (1992b).

Takođe ni kod fudbalera najstarijeg ispitivanog uzrasta (17-18 godina), tj.juniora, antropometrijske karakteristike nisu imale značajne uticaje na rezultate testa20 m „shuttle run". Kod ovih kategorija se velika pažnja posvećuje razvoju aerobne sposobnosti, jer su ispitanici već savladali elemente taktike, počinje složenija obuka taktike i bolja fizička priprema. Igrači su podvrgnuti većem opterećenju, bez obzira na mesto u timu. Kao posledica takvih treninga, proisteklo je da antropometrijske karakteristike ne utiču na aerobnu sposobnost omladinaca. Dobro, odnosno dovoljno razvijena aerobna sposobnost utiče na: povećanje telesnih sposobnosti, smanjenje povreda, povećanje psihičke opterećenosti, smanjenje taktičkih grešaka uslovljenih umorom, smanjenje tehničkih grešaka, održavanje visoke brzine reakcije i radnji i na stabilnije zdravlje, pa je stoga treba razvijati a njen trening počinje sa završenom fazom intenzivnog rasta dece. Fudbal je sport dominantno aerobnog tipa, pa je jedna od glavnih determinanti uspešnosti aerobna izdržljivost definisana maksimalnom potrošnjom kiseonika (VO_{2max}). U poslednjih nekoliko decenija utvrđena je visoka povezanost ovog parametra sa većim brojem indikatora uspešnosti u fudbalu (pretrčana distanca, broj ponavljanja i ukupna distanca visokog intenziteta, brzina oporavka) (Ostojić, 2015). Takođe se važnost pridaje i anaerobnom glikolitičkom sistemu. Kao što nam je poznato fudbaler napravi od 100 do 200 sprinteva po utakmici u intervalu od 5–10 m (Verheijen, 1997). Princip na kojem funkcioniše glikolitički sistem je korišćenje energije iz anaerobnih glikolitičih depoa. Taj proces odvija se bez prisutnosti kiseonika, pri čemu dolazi do produkcije laktata. Koncentracija laktata u krvi indikator je aktivacije glikolitičkih energetskih procesa. Fudbaleri u velikoj meri aktiviraju glikolitički energetski sistem u situacijama kad izvode više uzastopnih sprinteva bez pauze. U tim situacijama dolazi do povećanja koncentracije laktata u krvi do 8 – 12 mmol/l (Weineck, 1994).

U radu sa pionirima, kadetima i juniorima trebalo bi veću pažnju posveti razvoju aerobne sposobnosti. Preporučuje se dalje praćenje i razvoj morfoloških karakteristika i aerobne sposobnosti, ali se isto tako ne traba u trenažnom procesu toliko osvrtati na uticaj morfoloških karakteristika u procesu poboljšanja aerobnih sposobnosti. Autori preporučuju da se naredna istraživanja baziraju na ispitivanju povezanosti

based on examining the correlation of anaerobic abilities to the body composition because it would provide information on better implementation of the methods of work in the training process. All of this will contribute to better results in the competition of all examined age categories

anaerobnih sposbnosti sa telesnom kompozicijom, jer bi se dobile informacije o boljem sprovođenju metoda rada u trenažnom procesu. Sve ovo će doprineti boljim rzultatima na takmičenju svih ispitivanih uzrasnih kategorija.

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