DIFFERENCES IN CERTAIN DIMENSIONS OF ANTHROPOLOGICAL STATUS OF YOUNG SOCCER PLAYERS OF DIFFERENT CHRONOLOGICAL, BIOLOGICAL AND TRAINING AGE

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Abstract

The main goal of the study was to determine the differences in anthropological status of young soccer players of different chronological, biological and training age. The subject sample included 47 young male soccer players whose mean chronological age was 14.79±1.17 years, mean biological age 14.67±1.20 and mean training age 7.09±1.47 years. Three morphological measurements were taken: body height, sitting height and body mass. Body mass index (BMI) and Peak height velocity (PHV) were calculated subsequently. By applying the K-means taxonomic analysis, two clusters were defined with categorical variables chronological age, indicator of biological age and training age, and by applying the univariate analysis of variance (ANOVA), significant differences were found in all the observed variables of anthropological status. All the applied variables differentiated the formed clusters significantly. Further analysis determined descriptive parameters of anthropometric characteristics, motor abilities and the results of functional test which was represented by three variables. The obtained results indicate that chronologically and biologically more mature soccer player, who have been included in the training process longer, have greater body and sitting height, they are heavier and have better results in all the measured motor abilities, as well as the functional test applied.

Key words: *soccer, K-means, peak height velocity – PHV*

Introduction

Soccer is one of the most popular sports today and it is being played on a professional level in over two hundred countries around the world. Over 250 millions of men and women play soccer, either professionally or as amateurs, and there are around 40 million registered active male and female players. As such, it draws broad public interest and major sponsors. In vast competition in soccer, it is hard to evaluate and select the greatest talents among a great number of children. There are significant differences at the beginning of puberty between children of the same chronological age. Children who mature earlier are physically more developed and superior to their peers, and have greater chance of being selected during team selection. During the time of their growth and development, biological maturity affects their sports achievements, but also their results in tests by which their talent is evaluated. The age at which the peak height velocity occurs represents an indicator of child's biological maturity and it coincides with the age of the greatest growth of most of the child's conditional abilities (Philippaerts et al., 2006; Erceg et al., 2013). Biologically more mature children play more important roles in teams and are often selected as talents for the best and most successful teams (Malina et al., 2000; Chibane et al., 2007; Figuerido et al., 2009; Malina et al. 2010). Even though they have been selected as talents or superior to their peers, biologically more mature children do not always achieve better results in non-specific and specific motor tests (e.g., Malina et al., 2005; Figuerido et al., 2009; Figuerido, Coelho E Silva & Malina, 2011). Young soccer players are categorized into certain competition categories according to their chronological age. Within a category chronological age may vary up to two years, and biological maturity may display even greater differences. Various authors (Vincent & Glamster, 2006; Carling et al., 2009; Delorme, Boiche & Raspud, 2010) claim that children who were born at the beginning of a year are physically superior and more experienced than children born later, and that they have greater chances of being selected for the team. The main goal of this study was to determine the differences between young soccer players of different chronological, biological and training age in anthropometric characteristics and motor and functional abilities.

Methods

The subject sample for this study included 47 young male soccer players aged 13 to 16 years, players of NK Šibenik from Šibenik, Croatia. Subjects' mean chronological age was 14.79±1.17 years and their mean training age was 7.09±1.47years. All subjects are included in the training process 4 x 1.5 hours per week and participate in competitions on weekends. Three morphological measures were taken: *body height*, *sitting height* and *body mass*. Body mass index (*BMI*) and *Peak height velocity* (*PHV*) were calculated subsequently. After obtaining the variable *individual deviation from mean PHV value*, it was added to or subtracted from *chronological age* and the *indicator of biological age* variable was

defined according to Milić (2014). The training age was defined by the value between the beginning of kinesiological engagemenet in soccer and the date of measurement. The measurements were repeated three times, and the result was their mean value. Functional abilities were measured by the *Yo-Yo* intermittent recovery test level 1, whereas the battery of tests for assessing non-specific and specific motor abilities included 7 tests. To assess speed, *5-m* and *20-m sprint* were applied. *Standing long jump*, *vertical jump* (*sargent test*) and *medicine ball squat throw* were used to assess explosive power; and *9-3-6-3-9* and *Zig-zag test* were used to assess agility. All measurements were repeated three times. The best result was used as the final result in all motor tests. The methodological approach to calculating the *indicator of biological age* was used according to Milić (2014). According to the method of Mirwald et al. (2002), the variable *mean PHV value* was calculated for all subjects. Categorical variable was defined by applying the *K-means* taxonomic analysis with a predetermined number of two *cluster* (subgrous) on variables: *chronological*, *biological* and *training age*. Univariate analysis of variance (ANOVA) was used to determine the differences between the predetermined clusters, with the level of significance set at p≤0.05. The data were analysed by the Statistica Ver.12.0 software package and the PHV calculator (https://kinesiology.usask.ca/growthutility/phv_ui. php).

Results

Table 1. Descriptive indicators of chronological age, indicator of biological age and training age of young soccer players for the total sample and the pertaining clusters

Variables	Total sample N=47 M±SD	Cluster K_1 M±SD	Cluster K_2 M±SD	p
Chronological age (years)	14.79± 1.17	13.87± 0.94	15.59± 0.62	0.00
Indicator of biological age (years)	14.67± 1.20	13.73± 0.99	15.49± 0.62	0.00
Training age (years)	7.09± 1.47	5.86± 0.83	8.16± 0.99	0.00

Legend: N – number of subjects, M – arithmetic mean, SD – standard deviation, p – level of significance of differences between the clusters by using ANOVA

The results of descriptive indicators of *chronological age*, *indicator of biological age* and *training age* of young soccer players on the total sample (N=47) and the pertaining clusters K_1=22 and K_2=25, defined by applying the *K-means* taxonomic analysis, are presented in Table 1. The mean *indicator of biological age* of subjects in both subgroups matched the mean *chronological age*. The first cluster included soccer players who were chronologically and biologically younger and had averagely 2.30 years less experience in the soccer

training process. All the applied variables differentiated the formed clusters significantly.

Table 2. Descriptive parameters and analysis of differences between variables of taxonomic clusters

Variables	Cluster K_1=22 M±SD	Cluster K_1=25 M±SD	F test	p
Body height (cm)	166.06±7.32	181.12±5.23	35.46	0.00
Body mass (kg)	53.19±7.25	66.5±8.29	23.35	0.00
Sitting height (cm)	85.17±4.46	92.83±3.51	29.51	0.00
Body mass index (kg/m^2)	19.21 ±1.57	20.33±2.33	12.66	0.00
5-m sprint (sec)	1.17±0.07	1.09±0.06	12.66	0.00
20-m sprint (sec)	3.50±0.19	3.25±0.19	7.25	0.01
Standing long jump (m)	1.97±0.18	2.19±0.16	19.51	0.00
Vertical jump (Sargent test)(cm)	37.60±7.76	44.23±4.60	10.61	0.00
Medicine ball squat throw (3 kg)	7.91±1.16	10.00±1.34	16.23	0.00
ZIG-ZAG test (sec)	6.62±0.24	6.43±0.23	4.44	0.04
9-6-3-6-9 test (sec)	8.12±0.32	7.78±0.26	8.78	0.01
Yo-Yo (level)	15.31±0.85	15.99±0.75	5.73	0.02

Legend: K – number of subjects, M – arithmetic mean, SD – standard deviation, F test – coefficient of F test, p – level of statistical significance of differences of taxonomic clusters

By analysing the Table 2 and after applying ANOVA, it can be seen that all the observed variables of anthropological status significantly differentiated the taxonomic clusters categorized by criterion variables *chronological age*, *indicator of biological age* and *training age*. All chronologically and biologically more mature soccer players with longer engagement in the training process had greater body and sitting height, they were heavier and had a higher body mass index. They also achieved better results in all the observed motor abilities, as well as the functional test which was defined by three variables.

Discussion

By applying the K-means taxonomic analysis, two clusters were defined with categorical variables *chronological age*, *indicator of biological age* and *training age*, and by using univariate analysis of differences (ANOVA), significant differences were found in all the observed variables of anthropological status. The mean *indicator of biological age* of subjects in both subgroups matched the mean *chronological age*. The first cluster included soccer players who were chronologically and biologically younger, with averagely 2.30 years less experience in the soccer training process. All the applied variables significantly differentiated the formed clusters. Detailed analysis determined the descriptive parameters of anthropometric characteristics, motor abilities and the results of functional test represented by four variables. The obtained results indicate that chronologically and biologically more mature soccer players with longer engagement in

the training process had greater body and sitting height, they were heavier and had a higher body mass index, and they had better results in all the observed motor abilities, as well as the functional test applied. These results are fully congruent with those of Malina et al. (2004), who determined the impact of biological maturity on height and on results of speed, explosive power and aerobic abilities. Biologically more mature soccer players also had statistically better results in all variables assessing speed (30 m), power (standing long jump) and aerobic endurance (yo-yo test) in relation to the biologically less mature peers. More recent studies carried out by Chibane et al. (2007), Figuerido et al. (2009), Chuman et al. (2010), Le Gall et al. (2010), etc., whose aim was to determine significant impact of biological age on success in motor and functional abilities in young soccer players, have also been confirmed by the present study. Based on the differences found within the defined taxonomic clusters, and based on the impact of indicator of biological age on differentiation of soccer players in the applied anthropometric variables, all the results of motor tests as well as the functional test, it can be concluded that, in this age group, greater biological maturity and training experience obviously represent a great competitive advantage.

Conclusion

The main goal of this study was to determine the differences in certain dimensions of anthropological status of young soccer players of different chronological, biological and training age.

The defined clusters determined by the K-means taxonomic analysis differed significantly in the following results: in all three morphological measures, in all seven motor tests and in aerobic endurance results. It is evident that the differences at the beginning of puberty exist among children of the same chronological age. Furthermore, children who mature faster (biologically older children) are physically superior to their peers and have considerably greater chances of being selected for the team. These indicators are also indicators of potential problems during selection, therefore the primary aim of training in younger age groups should be preparation for achievement of the best possible results in senior competition, rather than success at present competition.

Biologically younger soccer players with shorter training experience are not given enough chances to play during competitions, so they cannot gain necessary competitive experience. Coaches who work with younger age groups should be aware of the fact that greater biological maturity and training experience do not imply greater talent for soccer. The obtained results have great importance for understanding and improving the process of detection, identification, selection and development of young soccer players. Given that the results identified the impact of *chronological age*, *indicator of biological age* and *training age* on their differentiation in the applied variables, there is a real danger in the aforementioned process to underestimate the ultimate abilities of biologically younger soccer players, which could finally result in their dropping out from sport too early.

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RAZLIKE U ODREĐENIM DIMENZIJAMA ANTROPOLOŠKOG STATUSA MLADIH NOGOMETAŠA RAZLIČITE KRONOLOŠKE I BIOLOŠKE DOBI TE DOBI TRENIRANJA

Sažetak

Glavni cilj istraživanja bio je odrediti razlike u antropološkom statusu mladih nogometaša različite kronološke, biološke dobi i trenažne dobi. Uzorak ispitanika obuhvatio je 47 mladih nogometaša čija je srednja kronološka dob bila 14.79+1.17 godina, srednja biološka dob 14.67+1.20 i srednja trenažna dob 7.09+1.47 godina. Primijenjene su tri morfološke mjere: tjelesna visina, sjedeća visina i tjelesna masa. Zatim su izračunati indeks tjelesne mase (BMI) i dob maksimalne vrijednosti brzine rasta (PHV). Primijenjujući taksonomsku analizu K-means, dvije grupe su definirane s kategorijskim varijablama kronološke dobi, indikatora biološke dobi i trenažne dobi, te primijenjujući univarijantnu analizu varijance (ANOVA), pronađene su značajne razlike u svim promatranim varijablama antropološkog statusa. Sve primijenjene varijable značajno su razlikovale formirane klastere. Daljnja analiza utvrdila je deskriptivne parametre antropometrijskih karakteristika, motoričkih sposobnosti i rezultate funkcionalnog testa, koji je bio predstavljen pomoću tri varijable. Prikupljeni rezultati ukazuju da kronološki i biološki zreliji nogometaši, koji su bili dulje uključeni u proces treninga, imaju veću vrijednost tjelesne visine i sjedeće visine, teži su i imaju bolje rezultate u svim mjerenim motoričkim vještinama, kao što je funkcionalni test i prijavio.

Ključne riječi: *nogomet, K-means, dob maksimalne vrijednosti brzine rasta - PHV*