ANTHROPOLOGICAL PROFILE OF U16 BASKETBALL PLAYERS

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Abstract

The purpose of this study was to analyse the anthropological profile of top level U16 basketball players, members of the Croatia U16 men's national team, with the aim of defining model values that shall in the future serve the purpose of directing and developing basketball players in the chosen age group. Eleven (11) potential members of the U16 men's national basketball team participated in this research, with an average age of15.72±0.44 years. The variable sample was composed of morphological characteristics and tests for evaluating motor and functional skills. Data processing was implemented by applying the statistical software package Statistica for Windows, ver. 12. Basic descriptive statistical parameters were calculated and demonstrated for each variable. On the basis of the obtained results for the measured morphological characteristics, the conclusion can be made that, already in the U16 age category, a difference can be noticed between the longitudinal and transverse dimensionality of the skeleton between the guard – forward – centre player positions, although a complete specialisation for each single player position is very often not final at that age. Likewise, results obtained for the percentage of body fat indicate that all players in this sample group of examinees have an optimal body composition. In almost all motor skill tests, the best results are achieved by guards, whereas the biggest differences between players in different positions are noticeable in tests for examining speed, agility and explosive strength. Aerobic and anaerobic capacities are well developed in all players and they meet the high demands of playing modern basketball.

Key words: *basketball, morphological characteristics, motor and functional skills, U16.*

Introduction

In terms of its structure as a game, basketball is a complex sports activity. During a basketball game, activities of very high intensity alternate with those of lower intensity so that it can easily be concluded that in order to be successful in playing basketball, in addition to primary technical and tactical skills, a player must also have his physical conditioning level and motor skills and abilities developed at a very high and enviable level.

Motor skills are often presented as the starting point of each motor action, and in basketball some of those motor skills have a high predictive value in a successful final performance of specific motor movement (knowledge). With regard to the complexity of motor movements (techniques) which players perform with and without the ball, it can be concluded that coordination is one of the more relevant motor abilities in basketball (Kamandulis et al., 2013). In addition to coordination, during various changes of direction, both when in defence (movement in the defensive stance or while avoiding a player's screen attempt), as well as when in offence (while opening up for a pass or changing direction while dribbling the ball), movement agility is also exceptionally significant. The aspect of basketball precision covers two important elements – passing precision and shooting precision.

Shooting precision by all means greatly determines a player's efficiency, however nowadays the segment of passing precision also has a high predictive value (Matković, R.B., Matković, B., Knjaz, D., 2005; Matković, B., Knjaz, D., Rupčić, T., 2014). Along with the previously mentioned ones, certain other motor abilities also highly influence the level of playing efficiency, such as speed, particularly reaction time, strength (explosive strength of upper and lower extremities), as well as balance which is manifested during almost all specific movements during a basketball game (shooting, passing, moving in the defensive stance, landings, etc.). Upon observing basketball from the physiological viewpoint, the conclusion can be made that players require both a well-developed aerobic and anaerobic capacity.

The aerobic capacity is mostly represented in connection with fast organism recovery during short break periods (time out, free throw(s), etc.), whereas the anaerobic capacity is mostly represented during the game by way of continual accelerations, changes of direction, defensive and offensive rebounds, i.e. in all types of movements that are characterised by a high movement intensity. In the process of analysing morphological characteristics from the aspect of longitudinal and transverse dimensionality of the skeleton in basketball players, their emphasis is a long-known fact, as well as their impact on playing efficiency in basketball (Matković, B. and Matković, R.B., 1986). The aim of this study was to determine and analyse the anthropological profile of top level U16 basketball players according to player positions with the purpose of defining model values that shall in the future then serve as a means for directing, developing and correcting training plans and programmes for all basketball players in the mentioned age category (U16).

Methods

The sample of examinees was composed of eleven (11) potential candidates for members of the Croatia U16 national team (average age of 15.72±0.44 years) who were preparing for the European Championship. The participants were informed in advance, both verbally and in written, on the manner of implementation, application and the purpose of each individual test. Prior to taking any of the tests, all the examinees filled out a questionnaire on their health status and signed an informed consent permitting the implementation of the tests. According to their playing positions, the participants were categorized as 1,2 – guards (n=5), 3,4 – forwards (n=4) or 5 – centres (n=2). The variable sample was composed of morphological characteristics and tests for evaluating motor and functional skillsthat contain validated metric characteristics (Metikošet al., 1982; Blašković, Milanović and Matković, 1982; Jukićet al., 2008), while the battery of tests was standardized at the Diagnostics Centre of the Faculty of Kinesiology University of Zagreb. Out of the various morphological characteristics, body weight and height were measured, the percentage of body fat was estimated by using the bioelectric impedance method and the body mass index was calculated for all the examinees. For the purpose of evaluating agility, the 20-yard test (20Y), the Side-Step test (SSTEP) and the 4x5 meter test (4x5M) were used, whereas for assessing explosive strength in sprint performance, the examinees were subjected to the 20-meter running test. The explosive strength in vertical jumps was estimated based on test results from the countermovement jump test (without arm swing) (CMJ) which was applied by using theKistler force platform. During the assessment of functional skills, thebeep test (BEEP) was applied for calculating aerobic endurance, while the 300-meter sprint test (300M) was used for evaluation of the examinees' anaerobic endurance capacity. Data processing was implemented by applying the statistical software package Statistica for Windows, ver. 12. The following parameters were calculated for each variable: arithmetic mean (AM), standarddeviation (SD), minimumvalue (MIN) andmaximumvalue (MAX).

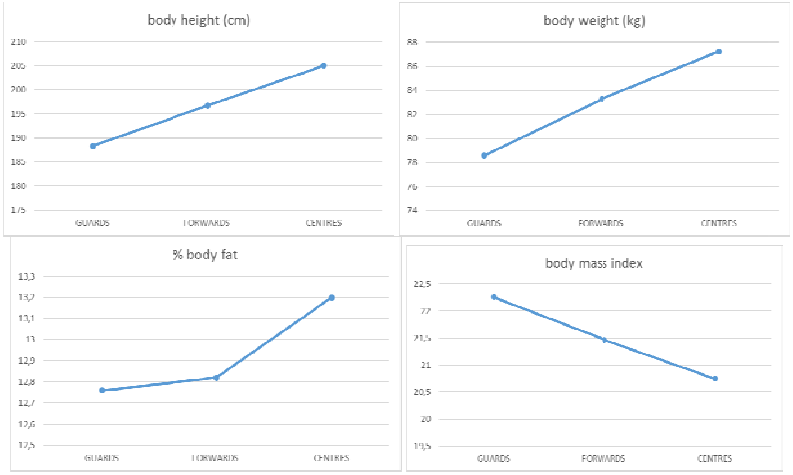
Results and discussion

Table 1. demonstrates descriptive statistical parameters of the measured morphological characteristics for basketball players in guard, forward and centre positions.

Table 1. – Descriptive statistical parameters of guard, forward and centre morphological characteristics

GUARDS (n=5)	AM	SD	MAX	MIN
BH (cm)	188.34	2.92	192.2	184.3
BW (kg)	78.58	5.44	83.9	75.5
% body fat	12.76	2.31	15.4	10.4
BMI	22.26	1.89	23.8	19.2
FORWARDS (n=4)	AM	SD	MAX	MIN
BH (cm)	196.77	4.29	200.7	192.0
BW (kg)	83.3	8.32	92.0	74.9
% body fat	12.82	1.62	15.1	11.4
BMI	21.47	1.35	23.0	19.8
CENTRES (n=2)	AM	SD	MAX	MIN
BH (cm)	205.05	0.21	205.20	204.90
BW (kg)	87.25	11.66	95.5	79.0
% body fat	13.2	0.28	13.4	13.0
BMI	20.75	2.75	22.7	18.8

AM – arithmetic mean; SD – standard deviation; MIN – minimum value; MAX – maximum value; BH – body height; BW – body weight; BMI – body mass index; % body fat – percentage of body fat



Figures 1-4. – Relation between morphological characteristics of guard, forward and centre players

After analysing the results obtained from the tests for assessing morphological characteristics, there are noticeable differences between each playing position. Table 1. clearly demonstrated that the average height of guards was188.34±2.92 cm, while their body weight was 78.58±5.44 kg, which is considerably lower than in forwards with 196.77±4.29 cm and 83.3±8.32 kg, as well as in centres 205.05±0.21 cm and 87.25±11.66 kg. In 2006, Ostojić, Mazić and Dikić conducted an analysis of morphological characteristics of top level senior basketball players according to their playing positions during the game. The measured results for body height were quite similar to the ones of the examinees in this study; guards (190.7±6.0 cm), forwards (200.2±3.4 cm) and centres (207.6±2.9 cm), which shows an extremely high and potent U16 player population. Meanwhile, there were some greater differences in discrepancy in terms of results for body weight; guards (88.6±8.1 kg), forwards (95.7±7.1 kg) and centres (105.1±11.5 kg), however, it should be mentioned that these are adult senior players with better developed muscle mass. According to the classification of the World Health Organization, the average results of body mass index of guards 22.26±1.89 kg/m², forwards 21.47±1.35 kg/m² and centres 20.75±2.75 kg/m² classify this group, as it was expected, as persons with normal body weight (Wilmore et al.; 2008). Upon observing the results from a research by Leitni et al. (2011), which was conducted on a sample of top level U16 basketball players (aged between 14 and 16) who participated as members of national teams, the conclusion can be made that there are smaller discrepancies in measurements of body height (191.0±0.05 cm) and body weight (80.7±11.1 kg), whereas the average body mass index does not vary significantly (22.2±2.5 kg/m²) when compared to examinees in this research.

A similar analysis was also conducted by Kollos and Tache (2013) with Romanian U16 basketball players. Some greater differences can be noticed in results of measured body height (182.0±0.08 cm) and weight (72.3±10.88 kg), while the body mass index (21.97±3.70 kg/m²) showed to be comparable with observed examinees. Another study of morphological characteristics according to playing positions during a basketball game was also implemented by Erol et al. (2014) on a sample of players aged 13 and 14, who were candidates for the Turkey U15 national team. Potential members of the Turkish national team had a somewhat lower body mass index, comparing guards (20.3±2.1 kg/m²) and forwards (20.6±3.4 kg/m²), excluding players on the center position(21.0±2.6 kg/m²), however, it should be taken into account that these are all players only entering into the U16 age category so that the presumption can be made that their muscle mass is still somewhat less developed.

The percentage of body fat in guards (12.76±2.31%), forwards (12.82±1.62%) and centres (13.2±0.28) show standard values comparing them with other athletes, but not as low as in senior basketball players (Ostojić et al., 2010). This enables the players to perform a large number of fast and intensive movements, both in defence and in offence, as it has been demonstrated in numerous previously conducted research that excessive fat tissue can have a negative effect on speed, agility and endurance (Apostolidis et al., 2004; Osváth et al., 2009). In a study conducted by Gerodimus et al. (2005), the percentage of body fat was analysed for members of the Greece U16 national basketball team, and the measured results were on average 11.12±2.35 % of body fat, which is somewhat lower than the results measured among examinees in this research.

Table 2. – Descriptive statistical parameters of results obtained from tests for assessing motor skills – guards

Var.	AM	SD	MIN	MAX
20Y	4.93	0.06	4.85	5.04
4x5M	4.74	0.07	4.64	4.86
SSTEP	7.34	0.20	6.98	7.55
20m	3.30	0.04	3.27	3.36
CMJ	46.72	6.72	39.63	58.60

Table 3. – Descriptive statistical parameters of results obtained from tests for assessing motor skills – forwards

Var.	AM	SD	MIN	MAX
20Y	4.92	0.18	4.65	5.13
4x5M	4.75	0.08	4.68	4.88
SSTEP	7.28	0.36	6.70	7.61
20m	3.45	0.15	3.26	3.67
CMJ	44.39	6.71	36.93	53.00

Table 4. – Descriptive statistical parameters of results obtained from tests for assessing motor skills – centres

Var.	AM	SD	MIN	MAX
20Y	5.17	0.00	5.17	5.18
4x5M	4.92	0.12	4.80	5.04
SSTEP	7.88	0.40	7.48	8.28
20m	3.54	0.04	3.50	3.57
CMJ	43.62	3.78	39.83	47.40

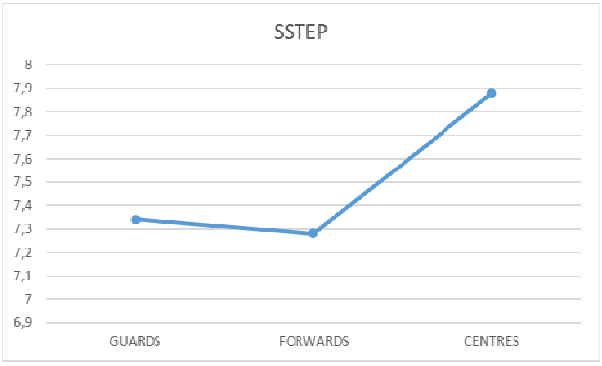
AM – arithmetic mean; SD – standard deviation; MIN – minimum value; MAX – maximum value; 20Y – 20-yard test; 4x5M – 4x5 meter test without the ball; SSTEP – Side-Step test; 20m – 20-meter running test; CMJ – countermovement jump test

Observing basketball from the aspect of complexity of performance of specific motor skills, which are quite often during high intensity periods in the game, the assumption can be made that players must possess a high level of development of the overall motor area. During the test for assessing the frontal-nimble agility (20Y), U16 basketball players achieved the following results: guards 4.93±0.06 sec, forwards 4.92±0.18 sec and centres 5.17± 0.00 sec.

In a study which was conducted by Sporiš et al. (2010), on a sample of players who were part of the Croatia U16 national team (born in 1993 or younger), players reached better results comparing to this research.

The average results in the 4x5 meter test (4x5M) were 4.74±0.07 sec. (guards), 4.75±0.08 sec. (forwards) and 4.92±0.12 (centres). In the Side-step test (SSTEP) that was applied for evaluating the players lateral agility, forwards demonstrated to be the most agile (7.28±0.36 sec) then followed the guards (7.34±0.20 sec), and centres (7.88±0.40 sec).

The mentioned results indicate that forwards and guards have similar results and they are more agile and nimble than centres.



Figures 5-7. – Relation between obtained test results for assessing movement agility of guard, forward and centre players

For the purpose of evaluating explosive strength during sprint performance, the 20-meter running test (20M) was applied. Guards took on average 3.30±0.04 sec in order to run the 20 meters, forward players took 3.45±0.15 sec, while centre players took 3.54±0.04 sec, which clearly demonstrates that guards and forwards are faster than centre players.

It was precisely the explosive strength during sprint performance in U18 national team players that was analysed by Gardasević et al., (2011), also by using the 20-meter running test; the average result was 3.31±1.43 sec, which is a faster result than the one measured among forwards and centres, and similar with guards in this research.

It should be taken into account that these were U18 players, which means that they are up to two years older, and research indicate that sprint speed increases in basketball players over the years (Kamandulis et al., 2013).

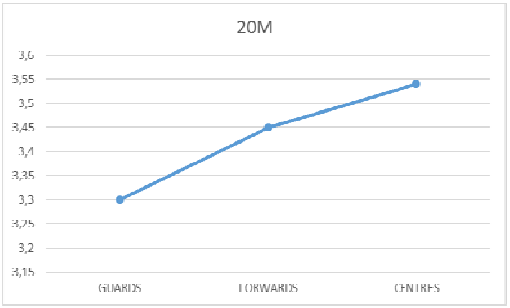


Figure 8. – Relation between obtained test results for assessing explosive strength during sprint performance of guard, forward and centre players

The success rate during the realisation of high jumps both in defence and in offence, sudden movements with or without the ball, fast passes and short sprints greatly depends on a player's explosive strength. In the countermovement jump test (CMJ) for evaluating explosive strength during vertical jumps, results for guard players were on average 46.72±6.72 cm, forwards 44.39±6.71 cm and centre players 43.62±3.78 cm.

Upon comparing the obtained results with the ones achieved in other research, it can be noticed that the examinees in this study demonstrated better results with respect to basketball players and athletes from other sports (football, handball) with the identical chronological age (Singh, B., Kumar, A. and Ranga, M. D., 2014; Gerodimos, V. Manou, V., Ioakimidis, P., Perkos, S. and Kellis, S., 2006).

Table 5. – Descriptive statistical parameters of aerobic functional abilities – beep test

GUARDS	AM	SD	MIN	MAX
HRmax	184.20	4.43	179.00	190.00
Distance	12.05	0.87	11.03	13.03
VO_2max rel	55.52	3.13	51.10	59.90
FORWARDS	AM	SD	MIN	MAX
HRmax	192.50	4.82	185.00	198.00
Distance	11.36	0.44	11.01	11.36
VO_2max rel	53.05	0.53	11.03	12.11
CENTRES	AM	SD	MIN	MAX
HRmax	187.5	2.12	186.00	189.00
Distance	11.03	0.01	11.03	11.04
VO_2max rel	51.25	0.15	51.10	51.40

AM – arithmetic mean; SD – standard deviation; MIN – minimum value; MAX – maximum value; HRmax – maximum heart rate; VO_2max rel – estimated relative maximum of oxygen consumption

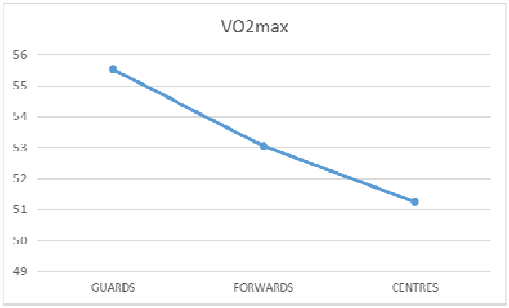


Figure 9. – Relation between obtained test results for assessing aerobic endurance (VO2max) of guard, forward and centre players

Table 6. – Descriptive statistical parameters of anaerobic functional abilities – 300-meter sprint test

GUARDS	AM	SD	MIN	MAX
HRmax	181.20	3.34	179.00	187.00
Time	65.88	2.98	62.71	70.55
FORWARDS	AM	SD	MIN	MAX
HRmax	179.50	3.69	175	183
Time	69.43	2.43	66.95	72.73
CENTRES	AM	SD	MIN	MAX
HRmax	181.50	7.77	176	187
Time	70.73	4.68	67.42	74.04

AM – arithmetic mean; SD – standard deviation; MIN – minimum value; MAX – maximum value; HRmax – maximum heart rate

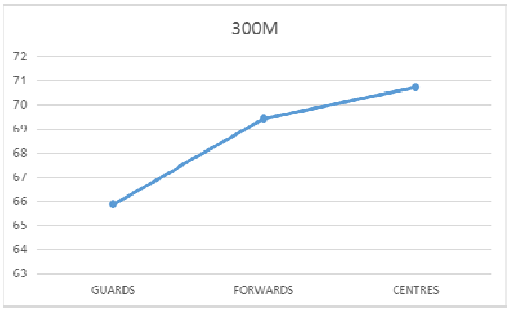


Figure 10. – Relation between obtained test results for assessing anaerobic endurance of guard, forward and centre players

"Basketball is a sport composed of high intensity activities, such as sprints or rebounds, and they are interrupted by low intensity activities, which makes basketball a so-called intermittent activity, or in other words, during a basketball game both anaerobic and aerobic energy sources are used" (Matković et al., 2010). In relation to different playing positions, roles and assignments, players can also differ in terms of their physiological aspects so that their aerobic capacity demonstrates

a wide range of variations. In sports games, the expected relative maximum oxygen consumption is somewhere between 55-65 ml/kg/min (Matković and Ružić, 2009). The assessment of aerobic abilities in U16 basketball players was conducted solely on the basis of their results in the beep test (FTBEEP). Table 5. demonstrates descriptive statistical parameters of aerobic functional abilities of players according to their playing position. The highest results of the estimated maximum relative oxygen consumption can be noted in guards (55.52±3.13 ml/kg/min), then forward players (53.05±0.53 ml/kg/min) and centres (51.25±0.15 ml/kg/min). The obtained results clearly reflect the assignments of each particular playing position during a basketball game. Guards are players who move the most, whereas centre players are the most static, despite the tendency of modern basketball in which some players can play in several positions. This is a good comparison with the results obtained in a research by Sporiš et al., (2010) in which the same test was applied in order to evaluate the aerobic capacity on a sample of a U16 national basketball team, however, during which the changes were monitored during a preparation period for the U16 European Championship. During the initial measurement, the average VO_2max was 54.00±3.94 ml/kg/min, while the final result was 59.79±6.98 ml/kg/min. Therefore, despite the fact that the initial results are almost identical, a significant improvement of the results was achieved during the preparation period, which was most likely the goal of the preparation period. The increase of aerobic capacity is beneficial for players, not only from the aspect of fast recovery during short break intervals in the game (time out, intervals of play, half-time), but also due to the fact that physical fatigue can considerably disturb a player's efficiency while performing elements of technique related to his defensive and offensive assignments (Rupčić et al., 2015). In the course of a basketball game, a player's anaerobic capacity is manifested during activities of high intensity, such as frequent sprints, defensive and offensive rebounds, consecutive changes of direction, etc. Unlike the aerobic capacity which is clearly defined by the maximum oxygen consumption, there is no such clearly defined parameter when it comes to the anaerobic capacity. For the purpose of this study, the results of the 300-meter sprint test (15x20m) were applied for assessing the anaerobic capacity of basketball players. Upon comparing the results of each individual playing position, it can be noticed that guards demonstrate the highest level of development in anaerobic capacity (65.88±2.98), and then next come forwards (69.43±2.43) and centres (70.73±4.68). The results obtained in this study suit to the requirements of each playing positions in modern basketball.

Conclusion

Based on the obtained results of the observed morphological characteristics, the conclusion can be made that, already in the U16 age category, there are noticeable differences in the longitudinal and transverse dimensionality of the skeleton between the guard – forward – centre player positions, even though their final process of specialisation for one particular playing position is often not yet complete in the mentioned age. The data which was collected on the percentage of body fat indicate that all players in this specific sample of examinees have an optimal body composition with regard to the demands of the game. In all motor tests the best results were achieved by guards and forwards. The biggest differences between players in terms of the position that they play were noticed in tests for assessing speed, agility and explosive strength. The aerobic capacity is well developed in all players, and guards demonstrate the highest results. Basketball players in the U16 category achieved lower results in motor and functional tests when compared to senior and U18 players, which can be accounted for by the fact that these players are still in the process of intensive functional and motor development. With regard to the selected sample of examinees and their results in tests for assessing and evaluating their anthropological profile, the conclusion was made that the obtained results can be utilised as model values that can in the future serve as a means of directing and developing basketball players in all age categories. However, differences in the biological development which are surely still present must not be forgotten.

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ANTROPOLOŠKI PROFIL KOŠARKAŠA OD 16 GODINA

Sažetak

Cilj ovog istraživanja bio je analizirati antropološki profil vrhunskih mladih košarkaša, kadetskih (U16) reprezentativaca Hrvatske radi definiranja modelnih vrijednosti koje će u budućnosti poslužiti u svrhu usmjeravanja i razvoja košarkaša odabranog uzrasta. U ovom istraživanju sudjelovalo je jedanaest (11) potencijalnih kadetskih reprezentativaca, prosječne dobi 15.72±0.44 godina. Uzorak varijabli bio je sastavljen od morfoloških karakteristika te testova za procjenu motoričkih i funkcionalnih sposobnosti. Obrada podataka izvršena je primjenom programskog paketa Statistica for Windows, ver. 12. Za svaku varijablu izračunati su i prikazani osnovni deskriptivni statistički parametri. Na temelju dobivenih rezultata u mjerenim morfološkim karakteristikama može se zaključiti da je već u kadetskom uzrastu uočljiva razlika u longitudinalnoj i transverzalnoj dimenzionalnosti skeleta između igračkih pozicija bek – krilo – centar, iako potpuna specijalizacija za pojedinu igračku poziciju vrlo često u toj dobi nije konačna. Također, dobivene vrijednosti postotka tjelesne masti pokazuju da svi igrači u ovom uzorku ispitanika imaju optimalan sastav tijela. U većini motoričkih testova najbolje rezultate pokazuju bekovi, a najveće razlike između igrača na različitim igračkim pozicijama vidljive su u testovima brzine, agilnosti i eksplozivne snage. Aerobni i anaerobni kapacitet dobro su razvijeni kod svih igrača i zadovoljavaju visoke zahtjeve moderne, košarkaške igre.

Ključne riječi: *košarka, morfološke karakteristike, motoričke i funkcionalne sposobnosti, U16*

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