Frane Erčulj*
Mitja Bračič

DIFFERENCES BETWEEN VARIOUS TYPES OF ELITE YOUNG FEMALE BASKETBALL PLAYERS IN TERMS OF THEIR MORPHOLOGICAL CHARACTERISTICS

RAZLIKE V MORFOLOŠKIH ZNAČILNOSTIH MED RAZLIČNIMI TIPI ELITNIH MLADIH EVROPSKIH KOŠARKARIC

ABSTRACT

Morphological characteristics are an important factor of efficiency in basketball. This study aimed to establish and analyse the morphological characteristics of elite young European female basketball players. We were also interested in the development level of the morphological characteristics of various types of players and the differences amongst them. The study sample consisted of 68 basketball players with an average age of 14.58 years. They were divided into three groups according to their playing position: guards (n = 31), forwards (n = 20) and centres (n = 17). In the study, a battery of 23 morphological measures served as a basis for calculating somatotypes, percentages of fat, muscle and bone mass, and some other morphological indexes.

The study established significant differences between individual types of young female players in terms of their body height, body weight, all three somatotypes (ectomorphic, endomorphic and mesomorphic) and the percentage of muscle tissue. After eliminating the effect of body height, statistically significant differences were observed in the percentage of bone tissue, whereas the differences in the percentage of muscle tissue were no longer statistically significant. It is also interesting that no differences were established between the individual types of players in terms of the percentage of fat tissue.

Key words: basketball, women, anthropometry, playing positions

Faculty of Sport, University of Ljubljana, Slovenia

Corresponding author:
Faculty of Sport, University of Ljubljana
Gortanova 22,
SI-1000 Ljubljana, Slovenia
Tel.: +386 1 5207766, fax: +386 1 5207750
E-mail: frane.erculj@fsp.uni-lj.si

IZVLEČEK

Morfološke značilnosti predstavljajo pomemben dejavnik uspešnosti v košarki. V pričujoči raziskavi smo se zato odločili analizirati morfološke značilnosti vrhunskih mladih evropskih košarkaric. Zanimala nas je raven razvitosti morfoloških značilnosti različnih tipov mladih košarkaric in morebitne razlike med njimi. Vzorec merjenk je zajel 68 košarkaric starih 14.58 let. Glede na njihovo igralno mesto smo jih razdelili v tri skupine: branilke (n = 31), krila (n = 20) in centre (n = 17). Vzorec spremenljivk je zajel 23 morfoloških mer na osnovi katerih smo izračunali komponente somatotipa odstotek kostnega, mišičnega in maščobnega tkiva ter še nekatere druge morfološke indekse.

Ugotovili smo statistično značilne razlike med posameznimi tipi igralk v njihovi telesni višini, telesni teži, vseh treh komponentah somatotipa ter v odstotku mišičnega tkiva. Po izločitvi vpliva telesne višine se pojavijo statistično značilne razlike v odstotku kostnega tkiva, razlike v odstotku mišičnega tkiva pa niso več statistično značilne. Zanimivo je tudi, da v odstotku maščobnega tkiva ne zasledimo razlik med posameznimi tipi igralk.

Ključne besede: košarka, ženske, morfologija, igralna mesta

INTRODUCTION

The study of basketball players' morphological characteristics contributes significantly to understanding the concept of performance in basketball. The influence of morphological characteristics on basketball performance has been confirmed by a number of studies delving into the morphological characteristics of male and female basketball players of different age groups (Carter, Ackland, Kerr, & Stapff, 2005; Dežman, 1988; Dežman, Trninić, & Dizdar, 2001; Erčulj, 1996, 1998; Erčulj & Dežman, 1995; Karpowicz, 2006; Ostojić, Mazić, & Dikić, 2006; Piechaczek, 1990; Trninić, Dizdar, & Fressl, 1999).

Basketball requires an extremely pronounced body height and some other longitudinal measures. They chiefly influence the performance of certain specific basketball movements with a pronounced vertical component (rebounds, different shots, blocking of shots, jumping at the jump ball etc.). In addition to longitudinal dimensions, the efficiency of playing performance is affected to a smaller extent by transversal dimensions, volumes of body segments and fat tissue (Dežman 1988; Erčulj, 1996).

There are different types of players in basketball. They are divided into guards, forwards and centres in terms of the roles they play in the game and their position in offence. Due to the specifics of each position, differences can be found amongst players in terms of their psychosomatic status dimensions. The above is also true for the morphological characteristics of both male (Dežman, Trninić, & Dizdar, 2001; Erčulj, 1998; Jeličić, Sekulić, & Marinović, 2002; Trninić, Dizdar, & Fressl, 1999) and female basketball players (Ackland, Schreiner, & Kerr, 1997; Bale, 1986; Carter et al., 2005). The most apparent differences are found in the longitudinal dimensions; however, to some extent the basketball player types have a specific structure of transversal dimensions, circumferences and fat tissue. Subcutaneous fat negatively affects the playing efficiency of female and male players mainly playing in perimeter positions, i.e. guards and forwards (Dežman 1988; Erčulj, 1996), whereas centres of the highest quality across different age categories often have a slightly higher percentage of fat tissue compared to the perimeter players (Bale, 1986; LaMonte et al., 1999; Spurgeon, Spurgeon, & Giese, 1981).

In 2008 and 2009, an international basketball camp for select under-15-year-old European female basketball players took place in Postojna, Slovenia. With the prior agreement of FIBA Europe and the Basketball Federation of Slovenia, we took this opportunity to measure the players' morphological characteristics and establish a morphological profile of the best European female basketball players of this age. A database was created to set up quality international standards for different types of such female basketball players. Even if this subject has already been dealt with by many researchers, the literature lacks studies that use a sample of female basketball players of such high quality and of such a young age. The purpose was to enable the coaches of clubs and national teams to assess the morphological characteristics of their female basketball players and compare them against their elite European counterparts. Data on the structure of the morphological characteristics of female basketball players of such high quality are clearly very valuable for both basketball theory and practice. They enable model values to be generated that can greatly assist both basketball coaches and basketball researchers.

The study chiefly aimed to establish and analyse the morphological characteristics and/or morphological potential of the best European young female basketball players. Another area of interest was the development level of the morphological characteristics of various player types and any differences amongst them.

METHODS

Participants

The study sample consisted of 68 basketball players aged 14 and 15. Their average age was 14.58 years (SD = 0.52 years) and their training experience 5.34 years (SD = 1.99 years). The participants were divided into three groups according to their playing position: guards (n = 31), forwards (n = 20) and centres (n = 17). The classification by playing position was made by the coaches and was officially published by the camp organisers. The participants came from 26 European countries competing in division A, division B and division C of the European Championship for this age group. Each country was represented by at least one player and a maximum of three players. As a rule, these were the top players in their countries and had been chosen by their national team selectors. They were all tested during two international basketball camps held in Postojna, Slovenia. The camps took place from 6 to 11 July, 2008 and from 5 to 10 July, 2009 and were organised by the international basketball organisation FIBA Europe and the Basketball Federation of Slovenia. For all participants, formal consent was given by their parents/guardians prior to the investigation. All players were healthy and had no injuries.

Table 1: Age and training experience of the participants

	Playing position	Mean	Std. Dev.	Std. Error	Min.	Max.
age (years)	G	14.55	.506	.091	14	15
	F	14.70	.470	.105	14	15
	C	14.59	.507	.123	14	15
	Total	14.58	.526	.060	14	15
training experience (years)	G	5.71	1.716	.308	3	9
	F	5.25	2.124	.475	1	9
	C	4.76	2.278	.553	1	9
	Total	5.34	1.997	.242	1	9

Legend: G – guards; F – forwards, C – centres

Instruments and procedure

In the study, a battery of 23 standard morphological measures was applied, i.e. indicators of longitudinal and transversal dimensions, circumferences and fat tissue. These were applied in the calculation of seven morphological indexes: the three somatotypes, percentages of bone, fat and muscle tissue (according to Matiegka) and body mass index.

Table 2: Description of the sample of variables of morphological measures and indexes*

Anthropometric measure/dimension
skin fold of upper arm (biceps) (mm)
skin fold of back (mm)
skin fold of calf (mm)
skin fold of upper arm (mm)
skin fold of forearm (mm)
chest skin fold (mm)
skin fold of thigh (mm)
suprailiac skin fold (mm)
skin fold of stomach (mm)
circumference of calf – left (cm)
circumference of upper arm – left (cm)
circumference of upper arm – left – max (cm)
circumference of forearm – left (cm)
circumference of thigh – left (cm)
circumference of thigh – left – medium (cm)
diameter of left knee (cm)
diameter of left elbow (cm)
diameter of left ankle joint (cm)
diameter of wrist (cm)
pelvis width (cm)
shoulder width (cm)
BH - body height (cm)
BW - body weight (kg)
ECTO - ectomorphic component of somatotype
ENDO - endomorphic component of somatotype
MESO - mesomorphic component of somatotype
BTP - percentage of bone tissue (Matiegka) (%)
FTP - percentage of fat tissue (Matiegka) (%)
MTP - percentage of muscle tissue (Matiegka) (%)
BMI - body mass index (kg/m^2)

* skin folds, circumferences and diameters of arms and legs were measured on the left-side extremity

The data were processed using the SPSS 18.0 statistical software for Microsoft Windows. The following statistical data were calculated for all groups of subjects: mean value, standard deviation, standard error and minimal and maximal results. The differences between the groups (types of players) were established using a one-way ANOVA. In addition, a multivariate analysis of covariance (MANCOVA) with body height as a confounding variable was conducted for the variables BTP, FTP and MTP. P-values less than 0.05 were considered statistically significant.

RESULTS

First, the basic morphological characteristics of participants from all three groups were established, followed by an investigation of the differences between them. The results are shown in Table 3 and Figure 1.

Table 3: Descriptive statistics and differences between the player types

	Position	Mean	Std. Dev.	Std. Error	Min.	Max.	F*	Sig*.
BW	G	58.261	5.713	1.026	46.0	68.9		
	F	66.450	5.562	1.243	57.3	76.9		
	C	70.406	8.329	2.020	57.3	87.5		
	Total	63.706	8.204	.995	46.0	87.5	22.246	.000
BH	G	168.097	5.599	1.005	158.0	187.0		
	F	176.000	4.565	1.020	165.0	184.0		
	C	183.588	3.447	.836	179.0	191.0		
	Total	174.294	7.959	.965	158.0	191.0	57.840	.000
BMI	G	20.584	1.540	.276	17.9	23.4		
	F	21.430	1.610	.360	18.7	24.1		
	C	20.871	2.359	.572	17.4	26.5		
	Total	20.904	1.804	.218	17.4	26.5	1.354	.265
ECTO	G	3.216	.871	.156	1.8	5.4		
	F	3.290	.905	.202	1.5	4.7		
	C	4.071	1.209	.293	1.4	5.9		
	Total	3.451	1.025	.124	1.4	5.9	4.607	.013
ENDO	G	3.265	.492	.088	2.5	4.2		
	F	3.825	.826	.184	2.8	5.4		
	C	3.435	1.036	.251	2.1	6.0		
	Total	3.472	.785	.095	2.1	6.0	3.341	.042
MESO	G	3.403	.872	.156	1.5	5.7		
	F	3.200	.781	.174	1.9	4.8		
	C	2.312	.693	.168	1.1	3.7		
	Total	3.071	.911	.110	1.1	5.7	10.451	.000
BTP	G	16.152	1.201	.215	13.8	19.0		
	F F	15.955	1.335	.298	13.5	18.5		
	C	16.618	2.037	.494	13.0	20.5		
	Total	16.210	1.485	.180	13.0	20.5	.957	.389
FTP	G	21.171	2.503	.449	16.3	26.1		
	F	22.940	4.191	.937	14.5	30.0		
	C	22.612	6.250	1.515	13.0	38.1		
	Total	22.051	4.218	.511	13.0	38.1	1.280	.285
MTP	G	40.565	1.710	.307	37.2	44.0		
	F	42.075	2.421	.541	38.3	47.0		
	C	40.088	2.090	.507	36.8	44.1		
	Total	40.890	2.155	.261	36.8	47.0	5.108	.009

* by ANOVA

Legend: G – guards; F – forwards; C – centres

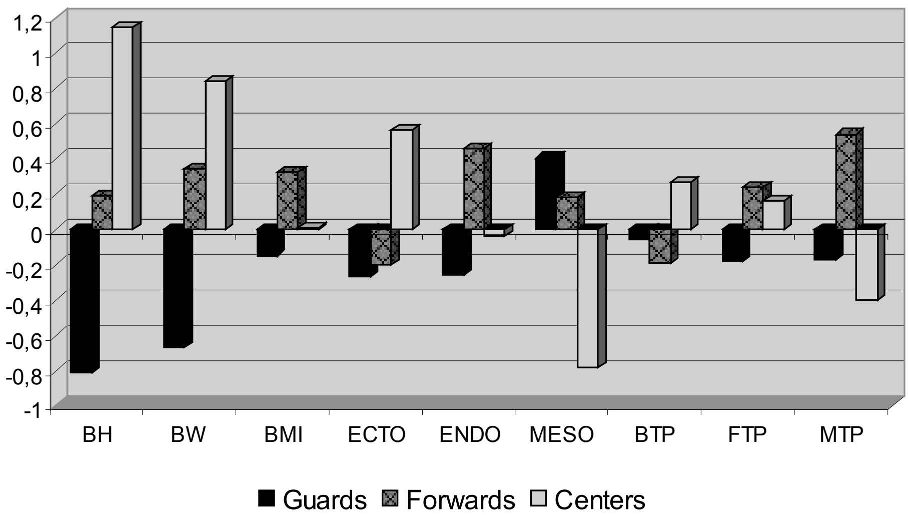

Figure 1: Comparison between the guards, forwards and centres in terms of standardised Z-scores.

We were also interested in changes in the bone, fat and muscle mass shares the elimination of the effect of body height which statistically significantly differentiates between individual player types (Table 4).

Table 4: Adjusted means after MANCOVA

	Guards	Forwards	Centres	F	Sig.
BTP	16.666	15.813	15.847	**5.051**	**0.028**
FTP	22.363	22.612	20.825	3.313	0.073
MTP	40.619	42.060	40.007	0.028	0.868

DISCUSSION

The results in Table 3 lead us to conclude that the centres in the elite European national teams, aged slightly less than 15 years, are nearly 184 cm tall on average and thus 8 cm taller than forwards and twice that much taller than guards. Similar results were reported by Blašković and Matković (1993) when investigating the morphological characteristics of the best Croatian female basketball players, who were one year older on average. Elite Slovenian female basketball players of this age are much shorter on average, in all three categories: guards, forwards and centres (Erčulj, 1996; Erčulj & Bračič, 2007, 2009a). The differences between the individual types of young female basketball players were statistically significant in terms of their body height and weight (see Table 3). Some other authors established the same (Bale, 1991; Erčulj, 1996; LaMonte et al., 1999); however, their samples consisted of slightly older female basketball players. In body mass index (BMI) terms, there were no statistically significant differences between the individual player types.

Regarding somatotype, the guards had all three components (ectomorphic, endomorphic and mesomorphic) in relative balance, whereas the forwards revealed a slightly more pronounced endomorphic component and the centres a more pronounced ectomorphic and a less pronounced mesomorphic component. Statistically significant differences were established between the player types in terms of all three somatotypes. The most obvious differences between them (F = 10.45) were established in terms of the mesomorphic component, which was less pronounced with the centres. In terms of the ectomorphic and endomorphic components, the centres and forwards dominated, respectively. Using a sample of the world's elite female basketball players in the senior women's category, Carter et al. (2005) established that the mesomorphic component was more pronounced with guards and/or perimeter players. Similar to our findings, these authors also reported lower values of the ectomorphic component with guards compared to forwards and centres. Obviously, already in this age category, the somatotype trends are similar to those of elite female basketball players in the senior women's category. The data on young female basketball players' somatotype can thus be helpful in selecting players and directing them towards certain positions.

In all three player types, very similar and fairly high values of fat tissue (about 22%) and skin folds can be seen. These values correspond to the general population of girls of this age (Heyward & Wagner, 2004; Malina, Bouchard, & Bar-Or, 2004; Starc, Strel, & Kovač, 2010; Tomazo-Ravnik, 1994). It is interesting that some other authors (LaMonte et al., 1999; Erčulj & Bračič, 2009b) have established that centres are highly predominant in terms of percentage of fat tissue, while also reporting that a slightly higher percentage of fat tissue in young female basketball players does not hinder their performance in the position of centre. It can be established that the percentage of fat tissue in the selected sample of female players was relatively high in comparison to the elite female basketball players of the senior women category, in which the values of fat tissue slightly exceeded 15% (Carter et al., 2005; Spurgeon, Spurgeon, & Giese, 1981). The reasons may be found in nutrition habits, training experience, age of the subjects and the fact that they are in puberty, as well as in their physical development. In this age period, it is often established that the biology of physical development prevails over the effects of training (Bravničar, 1988). A higher share of fat tissue is one of the physical changes that are characteristic of the fast body development of girls in puberty (Cumming, Standage, Gillison, & Malina, 2008). At this age, girls show less interest in very intensive motor activities, such as strength training with weightlifting or endurance training, and at the same time achieve worse results in those sports in which muscle force and strength as well as velocity play an important role (Malina, Bouchard, & Bar-Or, 2004). As regards the percentage of bone tissue, the three player types are relatively equal, whereas in terms of muscle tissue statistically significant differences were established between the player groups. Somewhat surprisingly, a higher percentage of muscle tissue was established with the forwards, even though this playing position does not require as high a level of motor abilities as that of the guards (Erčulj, 1996). According to expectations, the lowest percentage of muscle tissue was established in the centres and it is their development of motor abilities that researchers have often found to be at the lowest level (Abdelkrim, El Fazaa, & El Ati, 2007; Erčulj, 1996; Stone, 2007). In our opinion, the smaller share of muscle mass with the centres is also due to the accelerated growth of the body, which is characteristic of this age group (Bravničar, 1988; Malina, Bouchard, & Bar-Or, 2004; Tomazo-Ravnik, 1994); of course, this is even more prominent with centres. At the age of 14 and 15, the fast physical development of girls slowly ends (Kuczmarski et al., 2000; Malina, Bouchard, & Bar-Or, 2004). When speaking about bone and muscle tissue of athletes in adolescence, it is quite difficult to separate the effects of biological growth from those of training (Bravničar, 1988). Researchers in this field of study have established that rapid physical development (skeletal and sexual) is characteristic of young female and male athletes aged between 11 and 16 (Malina, Bouchard, & Bar-Or, 2004) and that systematic training causes specific changes and differences between different groups of athletes only after this period, i.e. after the period of growth and development has been completed (Bravničar, 1988).

Table 4 shows that the effect of the BTP covariate (% of bone tissue), after eliminating the effect of body height, increased substantially and became statistically significant. The highest percentage of bone tissue was observed in the guards, whereas the forwards and the centres were relatively equal. The effect of the FTP covariate (% of fat tissue) increased slightly but was still above the limit of statistical significance. After eliminating the effect of body height, the adjusted means after MANCOVA was higher with the guards and lower with the centres. This data is of particular interest and importance; researchers have repeatedly established that centres have the highest percentage of fat tissue among all basketball player types (Bale, 1986; Erčulj, & Bračič, 2009b; LaMonte et al., 1999; Spurgeon, Spurgeon, & Giese, 1981). In our study, after the effect of body height had been eliminated, the opposite was observed. The effect of muscle tissue (MTP) decreased considerably and, following the multifactor analysis of covariance, it became statistically insignificant; however, the relations between individual player types remained roughly the same as before the effect of body height had been eliminated.

CONCLUSION

The findings of this study as well as some other studies using a sample of quality young female basketball players (Bale, 1991; Erčulj, 1996; Erčulj, & Bračič, 2009b; LaMonte, et al., 1999; Matković & Blašković, 1993) lead to the following conclusions: the guards have the least pronounced longitudinal dimensions, their mesomorphic somatotype is the most pronounced of all the player types and the values of their ectomorphic component are lower than those of the centres; the forwards are taller than the guards and smaller than the centres, they dominate in terms of their endomorphic component and lag behind the centres in terms of their ectomorphic component, and their muscle tissue percentage is the highest; the centres are the tallest group of players due to their position and/or their longitudinal dimensions are the most pronounced, they dominate in the ectomorphic component and achieve the lowest values in their mesomorphic somatotype, and they have less pronounced muscle tissue than the forwards. Contrary to some other studies (Bale, 1986; Erčulj, & Bračič, 2009b; LaMonte et al., 1999; Spurgeon, Spurgeon, & Giese, 1981), we cannot confirm a higher percentage of fat tissue with the centres compared to the guards and forwards. After the effect of body height had been eliminated using MANCOVA, the abovementioned percentage was even the lowest.

When speaking about morphological characteristics in adolescence, it is sometimes difficult to separate the effects of biological growth from those of training. Nevertheless, these findings on the structure and level of the morphological characteristics of different types of female basketball players of such high quality are clearly very important for both basketball theory and practice. They enable the generation of model values that can greatly assist basketball coaches when selecting different types of young female basketball players and directing them towards certain playing positions.

ACKNOWLEDGMENTS

This study was conducted in the framework of the research programme 'Kinesiology of Monostructural, Polystructural and Conventional Sports' under the leadership of Milan Čoh. The authors would like to thank FIBA Europe and the Basketball Federation of Slovenia for their co-operation, as well as all the basketball players and their coaches for participating in the study.

REFERENCES

Abdelkrim, N. B., El Fazaa S., & El Ati, J. (2007). Time motion analysis and physiological data of elite under 19 year old basketball players during competition. *British Journal of Sports Medicine, 41,* 69–75.

Ackland, R., Schreiner, A. B., & Kerr, D. A. (1997). Absolute size and proportionality characteristics of world championship female basketball players. *Journal of Sports Sciences, 15* (5), 485-490.

Bale, P. (1986). A review of the physique and performance qualities characteristic of games players in specific positions on the field play. *The Journal of Sports Medicine and Physical Fitness, 26* (2), 109–122.

Bale, P. (1991). Anthropometric, body composition and performance variables of young elite female basketball players. *Journal of Sports Medicine and Physical Fitness, 31* (2), 173–177.

Bravničar, M. (1988). *Nekatere skupne in posebne lastnosti športnikov v izbranih športnih igrah [Some common and individual characteristics of athletes in selected sports].* Doctoral dissertation, Ljubljana: University of Edvard Kardelj, Faculty of Physical Culture.

Carter, J.E.L., Ackland, T.R., Kerr, D.A., & Stapff, A.B. (2005). Somatotype and size of elite female basketball players. *Journal of Sports Sciences, 23* (10), 1057–1063.

Cumming, S.P., Standage, M., Gillison, F., & Malina R.M. (2008). Sex Differences in Exercise Behavior During Adolescence: Is Biological Maturation a Confounding Factor? *Journal of Adolescent Health, 42* (5), 480–485.

Dežman, B. (1988). *Določanje homogenih skupin na osnovi nekaterih antropometričnih in motoričnih razsežnosti pri mladih košarkarjih [The establishment of homogeneous groups based on certain anthropometric and motor dimensions in young basketball players].* Doctoral dissertation, Ljubljana: Faculty of Physical Culture.

Dežman, B., Trninić, S., & Dizdar, D. (2001). Expert model of decision-making system for efficient orientation of basketball players to positions and roles in the game - empirical verification. *Collegium antropologicum, 25* (1), 141–152.

Erčulj, F., & Dežman, B. (1995). Unterschiedliche anthropometrische und motorische Dimensionen bei 13- und 14- jährigen Basketballspielerinnen, die auf verschiedenen Spielpositionen spielen. In Proceedings of an international conference on science in sports team games (pp. 216–223). Biala Podlaska: Instytut Wychowania Fizycznego i Sportu.

Erčulj, F. (1996). *Ovrednotenje modela ekspertnega sistema potencialne in tekmovalne uspešnosti mladih košarkaric [Evaluation of a model of an expert system of the potential and competitive performance of young basketball players].* Master's thesis, Ljubljana: University of Ljubljana, Faculty of Sport.

Erčulj, F. (1998). *Morfološko-motorični potencial in igralna učinkovitost mladih košarkarskih reprezentanc Slovenije [Morphological-motor potential and playing efficiency of young basketball national teams of Slovenia].* Doctoral dissertation, Ljubljana: University of Ljubljana, Faculty of Sport.

Erčulj, F., & Bračič, M. (2007). Differences in the level of development of basic motor abilities between young foreign and Slovenian female basketball players. *Kalokagathia, 47* (3-4), 77–89.

Erčulj, F., & Bračič, M. (2009a). Differences in the development of the motor abilities of young elite European and Slovenian female basketball players. *Kinesiologia Slovenica, 15* (1), 24–32.

Erčulj, F., & Bračič, M. (2009b). Anthropometric characteristics of elite young European female basketball players. In V. Koprivica, & I. Juhas (Eds.), International Scientific Conference Theoretical, Methodological and Methodical Aspects of Competitions and Athletes' Preparation (pp. 228–233). Belgrade: University of Belgrade, Faculty of Sport and Physical Education.

Heyward, V.H., & Wagner, D.R. (2004). Applied body composition assessment. Champaign: Human Kinetics.

Jeličić, M., Sekulić, D., & Marinović, M. (2002). Anthroptimetric characteristics of high level European junior basketball players. *Collegium antropologicum, 26,* 69–76.

Karpowicz, K. (2006). Interrelation of selected factors determining the effectiveness of training in young basketball players. *Human Movement, 7*(2), 130–146.

Kuczmarski, R.J., Ogden, C.L., Grummer-Strawn, L.M., Flegal, K.M., Guo, S.S., Wei, R., Mei, Z., Curtin. L.R., Roche, A.F., & Johnson, C.L. (2000). CDC growth charts: United States. Advanced Data from Vital and Health Statistics, no. 314. Hyattsville: National Center for Health Statistics.

LaMonte, M.J., McKinnex, J.T., Quinn, S.M., Bainbridge, C.N., & Eisenman, P.A. (1999). Comparison of physical and physiological variables for female college basketball players. *Journal of Strength and Conditioning Research, 13* (3), 264–270.

Malina, R.M., Bouchard, C., & Bar-Or, O. (2004). *Growth, maturation, and physical activity,* Champaign: Human Kinetics.

Matković, B., & Blašković, M. (1993). *Sastav tijela košarkašica – kadetkinja [Morphology of female cadet basketball players].* In International Conference on Sport Alpe - Jadran (pp. 369–371). Rovinj: University of Zagreb, Faculty of Physical Culture.

Ostojić, S.M., Mazić, S., & Dikić, N. (2006). Profiling in basketball: physical and physiological characteristics of elite players. *Journal of Strength and Conditioning Research. 20*(4), 740–44.

Piechaczek, H. (1990). Body structure of male and female basketball players. *Biology of Sport, 7,* 273–285.

Spurgeon, J. H., Spurgeon, N.L., & Giese, W.K. (1981). Measures of body size and form of elite female basketball players. *Medicine and Sport, 15,* 192–200.

Starc, G., Strel, J., & Kovač, M. (2010). *Telesni in gibalni razvoj slovenskih otrok in mladine v številkah [Physical and motor development of Slovenian children and youth in figures].* Ljubljana: University of Ljubljana, Faculty of Sport.

Stone, N. (2007). Physiological response to sport-specific aerobic interval training in high school male basketball players. Auckland: Auckland University of Technology, School of Sport and Recreation.

Tomazo-Ravnik, T. (1994). *Sestava telesa in človekov somatotip v juvenilnem obdobju [Morphology and human somatotype in juvenile age].* Doctoral dissertation, Ljubljana: Biotechnical Faculty, Biology Department.

Trninić, S., Dizdar, D., & Fressl, Ž.J. (1999). Analysis of differences between guards, forwards and centres based on some anthropometric characteristics and indicators of playing performance in basketball. *Kinesiology, 31* (1), 29–36.