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Original Article

Influence of anthropometric characteristics on speed abilities of 14 years old elite male basketball players

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Abstract
The aims of this study were: a) to identify anthropometric characteristics and speed abilities of 14 year old elite male basketball players b) to investigate relations between these two qualities.
At the sample of total of 50 young basketball players, 14 years old, 11 anthropometric (predictors) variables were measured: four longitudinal measures, two transversal measures, body mass, four circumferences, six skinfolds and 2 derived variables: body mass index (BMI), and sum of skinfolds (SUM SKF). Also, they did three speed tests (dependent variables): *run 20m*, *run 30m, and run 50m*. For the assessment of influence of predictor variables on dependent variables regressive analysis, Stepwise method, was applied. Results of three regression analysis talk about a moderate, but significant influence of anthropometric variables on results of 20m (first step - variable *lower limb length*), 30m (first step - variable *sitting height* and second step – variable *sum of skinfolds*) and 50m (first step - variable *sum of skinfolds*) sprint tests of 14 years old basketball players.
Key words: running / young / longitudinal measures / transversal measures / sum of skinfolds

Introduction

Basketball is very worldwide popular dynamic team sport, especially in youth. Basketball games and practices involve a pattern of intermittent, dynamic and skilled movement activities and has complex demands that require a combination of individual skills, team plays, tactics, and motivational aspects (Trninic, & Dizdar, 2000). The actions during basketball game include variety of movements such as running, dribbling, shuffling, and jumping, which are directional, multidirectional, intense and short-lasting (Crisafuli et al., 2002). Generally, there are a large number of sprints and jumps. McInnes et al. (1995) have found 997 ± 183 actions per game, but Ben Abdelkrim et al. (2007) have found 1050 ± 51 actions per game. Speed and acceleration is a key asset of the basketball player and player who is quickest down the court will be in the most commanding tactical position (Harley, 2008). So, in senior basketball we can see very fast, agile, powerful and versatile players.

Naturally, speed and agility are also important in youth basketball. Strength and motor performance generally improve with age during middle childhood and adolescence, but the pattern of improvement is not uniform for all tasks (Malina, 2004). Running speed improves from 5 to 18 years of age in boys, and data suggest an adolescent acceleration after 13 years of age (Malina, Bouchard, & Bar-Or, 2004). There are three good periods for developing speed (Holm, 1987): accelerated run from 12 to 14 years of age, slalom run at 13 years of age and interval training of speed at 15 years of age. Period from 11 to 14 years of age represents second phase in youth sports training (Bompa, 2000). Aims of this phase are: athlete development, talent identification, development of basic technical skills, development of basic tactical skills, and competition. Speed activities take an important part of athlete development in young basketball players.

Besides importance of speed abilities, in team sports (basketball) the importance of tall stature is commonly accepted. Body height influences positively all body segment lengths and, in turn, athletic performance. Successful competition in sports has been associated with specific anthropometric characteristics, body composition and somatotype (Classens et al., 1991; Carter, 1990) For example, often tall stature is the first criteria for selection of youth in basketball, because basketball is activity of more than average tall people. Anthropometric dimensions of basketball players have been linked with playing positions and individual player success (Bale, 1991; Angyan et al., 2003; Coelho et al., 2008; Greene et al., 1998; Hoare, 2000; Jelicic, Sekuliuc & Marinovic 2003) team success (Carter et al, 2005) and skill performances (Kinnunen et al., 2001; Angyan et al., 2003). But, a little information is available on elite basketball players younger then juniors (Coelho et al., 2008; Sickles, & Lombardo, 1993).

Anthropometric characteristics and sped abilities are very important factors of selection in basketball. The aim of this study was primarily to investigate and compare anthropometric variables and speed abilities in children aged 14 years participating in competitive basketball. The second aim was to examine relationship between the anthropometric characteristics and speed abilities.

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Method

Participants

The experts, coaches from Serbian Basketball Federation, have selected the best 14 (±0.5) year old boys from each region of Serbia who were participating in regional and/or national competitions. All participants (N=50) were at the end of the regular season and agreed to participate in the study. The testing was done under supervision of Ethical Board of Faculty of Sport and Physical Education, University of Belgrade.

Variables There were 11 independent variables obtained directly from anthropometric measurements and 2 variables derived from some of that variables. Anthropometric measurements were included 17 anthropometric dimensions which were taken on each participant. *Height* was measured with a stadiometer (Seca 220, UK), to the nearest 0.1 cm. *Sitting height, lower limb length* (from the floor until spinal iliac anterior superior), *upper limb length* (distance from the lateral border of the acromion to the distal end of the dactylian) were measured. *Biacromial breadth* and *bitrochanteric breadth* were measured with pelvimeter (Martin Scientific Pelvimeter, SUI) and reported in centimeters. *Weight* was recorded using portable scale (Tanita BF683W, GER) to the nearest 0.1 kg. The *circumference of mid-upper-arm* (midway between the acromion and olecranon processes with the arm in anatomical position); *forearm* (at maximum forearm girth with the arms hanging down and slightly away from the trunk, palms facing forward); *thigh* (at the maximal girth of the thigh below the gluteal fold with the legs slightly apart); *calf* (at the maximum girth between the knee and ankle joint) were also measured. Six skinfolds were measured using a skinfold caliper (J. Bull, USA) to the nearest 0.1 mm: biceps (vertical fold an the anterior aspect of the arm over the belly of the biceps muscle), forearm (vertical fold at maximum forearm girth with the arms hanging down and slightly away from the trunk, palms facing forward), thigh (vertical fold on the anterior midline of the thigh, midway between the proximal border of the patella and the inguinal fold), medial calf (vertical fold at the maximum girth of the calf on the midline of the medial border), abdominal (horizontal fold 5 cm to the right of the umbilicus), chest (horizontal fold to the right from the left mammilla on the border of sternum). For all bilateral structures measurements were made on the right side. Two variables were derived: body mass index (BMI), weight divided by height squared and sum of skinfolds (SUM SKF) from: biceps, forearm, thigh, medial calf, abdominal and chest.

There were 3 dependent variables: *20-m, 30-m and 50-m sprint.* Variable *20-m sprint* was obtained by using of test 20m sprint. There was a 20 m track with photocells positioned exactly on 20 m from the starting line. Participants started from a standing position placing their forward foot 70 cm before the first photocell and were asked to sprint 20 m. Time in seconds and hundreds of seconds was determined using an electronic timing system (Micro Gate, IT). This test has demonstrate high levels of reliability - correlation coefficients of 0.91 between test and retest (Simonsen, Thomsen, & Klausen, 1985). The same procedure was done for variables *30-m sprint* and *50-m sprint*, normally, using the proper distance.

Statistical analysis The elementary descriptive parameters: means (M), standard deviations (SD), maximum (Max) and minimum (Min) were calculated. For the assessment of influence of predictor variables on dependent variables regressive analysis, Stepwise method, was applied. Statistical analysis was performed with SPSS 16 statistical program.

Results

Table 1 displays basic descriptive parameters of all variables: means (M), standard deviations (SD), minimum (Min) and maximum (Max) values.

Table 1. Means (M), Standard Deviation (SD), minimum values (Min) and maximum values (Max) of all variables

Variable	M	SD	Min.	Max.
20m sprint (sec)	3.54	.258	3.16	4.17
30m sprint (sec)	4.92	.314	4.24	6.20
50m sprint (sec)	7.76	.416	6.57	8.59
Height (cm)	1.86	9.754	163.00	205.00
Sitting height (cm)	91.98	4.847	80.50	102.00
Lower limb length (cm)	99.33	5.907	87.00	112.00
Upper limb length (cm)	81.94	4.361	72.00	90.00
Biacromial breadth (cm)	42.24	4.117	36.00	65.00
Bitrochanteric breadth (cm)	31.24	2.336	26.00	38.00
Arm circumferences (cm)	24.34	1.972	21.00	28.50
Forearm circumferences (cm)	24.58	1.928	21.50	33.00
Thigh circumferences (cm)	51.17	4.045	44.00	61.00
Calf circumferences (cm)	35.21	2.674	30.50	43.00
Weight (kg)	68.72	11.091	47.00	93.00
BMI (kg/m^2)	19.75	2.069	15.53	26.59
SUM SKF (mm)	37.22	9.310	23.30	68.20

Results of regression analysis - Stepwise method, dependent variable - T20m and predictors – anthropometric variables, are shown in table 2. The values of coefficient of regression (R=.572) and coefficient of determination (R^2=.327) talk about influence of anthropometric variables on 20m sprint test's results. In the first and only step variable *lower limb length* was extracted.

Table 2. Results of regression analysis, Stepwise method: dependent variable - T20m, predictors – anthropometric variables (Predictor variable: first and only step - *Lower limb length*)

Model Summary					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	
1	.572	.327	.313	.214	
Coefficients					
Model	B	Std. Error	Beta	t	Sig.
(Constant)	1.053	.516		2.043	.047
Lower limb length	.025	.005	.572	4.833	.000

Influence of anthropometric variables on 30m sprint test's results is shown in table 3. There were two steps: in the first step variable *sum of skinfolds* (SUM SKF) was extracted (R=.383; R^2=.147), and variable *sitting height* was extracted in the second step (R=.465; R^2=.216). Table 4 displays results of regression analysis - Stepwise method, dependent variable – T50m and predictors – anthropometric variables. There was only one step and variable *sum of skinfolds* (SUM SKF) was extracted (R=.363; R^2=.132).

Table 3. Results of regression analysis, Stepwise method: dependent variable – T30m, predictors – anthropometric variables (Predictor variable: first step - *SUM SKF* ; second step - *Sitting height*)

Model Summary					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	
1	.383	.147	.129	.293	
2	.465	.216	.182	.284	
Coefficients					
Model	B	Std. Error	Beta	t	Sig.
(Constant) First step	4.440	.173		25.717	.000
SUM SKF	.013	.005	.383	2.872	.006
(Constant) Sec. step	5.972	.771		7.742	.000
SUM SKF	.015	.004	.439	3.322	.002
Sitting height	-.017	.009	-.269	-2.035	.048

Table 4. Results of regression analysis, Stepwise method: dependent variable – T50m, predictors – anthropometric variables (Predictor variable: first and only step - *SUM SKF*)

Model Summary					
Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	
1	.363	.132	.114	.391	
Coefficients					
Model	B	Std. Error	Beta	t	Sig.
(Constant)	7.163	.230		31.081	.000
SUM SKF	.016	.006	.363	2.703	.009

Discussion

According to anthropometric measurements we can say that our participants belong to elite population of young basketball players. 14 years old players were of the similar body height compared to Australian players of the same age (Pattison, 1989). According to means of body height 14 years old players were in 95 percentile, compared with American population (Malina, Bouchard, & Bar-Or, 2004). Body mass of 14 years old were in 90 percentile compared with American population (Malina, Bouchard, & Bar-Or, 2004). Our results could be incorporated into a database against which talented 14 years old basketball players could be compared.

Results of three regression analysis talk about a moderate, but significant influence of anthropometric variables on results of 20m, 30m and 50m sprint tests of 14 years old basketball players.

Straight sprint running is realized through the four phases: starting, phase of acceleration, phase of maximal speed and phase of speed endurance. Phase of acceleration includes the section of 30 - 50 m, after which it usually enters the phase of maximum velocity. This phase may be shorter, which primarily depends on the age and level of athletes. It can be assumed that players in our sample entered the phase of maximum velocity between 20 and 30m.

The difference between the phases of acceleration and maximal speed was observed with both, the theoretical aspect and in practice (Mero et al., 1992; Young et al., 1995), and is observed primarily in the fact that in these different EMG activity, different running techniques (raising the maximum speed requires lower leg moment of inertia) and the various manifestations of motor skills. Stride length is dependent on explosive power of legs, hip motion in the sagittal plane etc, and the frequency step is totally dependent on the functioning of the CNS and neuromuscular system (Mero, Komi & Gregor, 1992; Locatelli & Arsac 1995; Donatti, 1995). If the running speed approach the value of 7m.s-1, the speed increases due to increased stride length, provided that it does not significantly change the frequency. Further increase in speed is achieved by increasing step frequency, which continues to grow rapidly, because only at the expense of increase reaching its maximum speed of running (Luhtanen & Komi, 1978; Williams, 1985; Mero & Komi, 1985; Majdell & Alexander, 1991; Mero et al., 1992).

So, obtained correlations between morphological variables and the variables of acceleration (20 and 30 m) and maximal running speed (50m) are understandable. In the acceleration phase of the running speed is less, so that longitudinal dimensions, and thus caused stride length, more affects on the speed of running than the steps frequency (Pajić, 2006). Since the leg length and sitting height are measures of longitudinal dimension of the body, and thus the determinants of the variable stride length, their impact on running speed in the acceleration phase is understandable. If speed is the same or is slightly decreasing, any reduction in stride length results in increased frequency. It may be emphasized the importance of frequency of stride length during running at top speed, which agrees with the findings of many authors (Armstrong, & Cooksey, 1983; Čoh, 1985; Mero, Komi, Rusko & Hirvonen, 1987; Mero & Komi, 1994).

The influence of longitudinal dimension of the body is less in the phase of maximum velocity (50m), because of increasing of the steps frequency. The results of this study suggest that, given that the existing correlation of the acceleration phase failed.

The sum of skinfolds was used in this study to assess the influence of body fat mass on running speed of the youth in both stages of running. It is known that body mass is an aggravating factor of speed in both phases of the running. So to say, the thicker athlete has greater inertia due to larger amounts of fat, which requires greater force production per kilogram of lean mass to derive a change in flow velocity (Sheppard, & Young, 2006). Given that this study treated anthropometric characteristics of basketball players which are related on body mass, evaluation of the relationship of body mass and speed of the motor expression is current. There was a statistically significant correlation between the variables sum of skinfolds and running speed of the young basketball players. It is known adverse impact forces of inertia and resistance that the body provides a function of the inactive mass. Subcutaneous fat acts as a ballast weight, because it reduces the relative power. This leads to deficits in the speed (reactive) power, which is very necessary in the performance of running speed in the changed conditions to overcome the gravitational forces, ground reaction forces and limb inertia. Thus, the negative impact of adipose tissue in all regions of the body on the efficiency of locomotion is undeniable, particularly in the phase of maximal running speed, as indicated by the results of this study.

Conclusion

Determination of the relation between morphological characteristics and the running speed of young basketball players was conducted in a relatively small number of studies and extensive researches on the aforementioned relationship have yet to be implemented. Based on the results of previous researches we can be assume that body weight, height, length of individual limbs, the amount of muscle, adipose tissue, fat-free component and their relationships can somewhat affect on kinematics and dynamics of running. Results of this study talk about a moderate, but significant influence of anthropometric variables on results of 20m (*lower limb length*), 30m and 50m (*sum of skinfolds*) sprint tests of 14 years old basketball players.

In such analysis should emphasize the limited use of body mass index, showing the ratio of the weight and body height, so it is necessary to measure body fat component. Generally, it will be very usefully to research other morphologic components which could have influence on straight speed running.

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