

Full Length Research Paper

Anthropometric characteristics, somatotyping and body composition of volleyball and basketball players

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The purpose of the study was to compare the anthropometric characteristics and somatotype of the Guru Nanak Dev University, Amritsar's male basketball players and volleyball players. Sixty three sportspersons (volleyball=36 and basketball=27) of age group 18-25 years were selected from different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India. All the participants were assessed for height, weight, breadths, girths and skin fold thickness. An independent samples t-test revealed that basketball players had significantly higher height ($p<0.01$), weight ($p<0.01$) and body surface area ($p<0.01$) as compared to volleyball players. The basketball players were also found to have significantly greater biceps ($p<0.01$) and suprailliac ($p<0.01$) skin fold thicknesses, calf circumference ($p<0.05$), percent body fat ($p<0.01$), total body fat ($p<0.01$), fat free mass ($p<0.05$) and endomorphic component ($p<0.05$) as compared to volleyball players. Volleyball players had significantly greater body density ($p<0.01$) as compared to basketball players. The basketball and volleyball players of this study were found to have higher percentage body fat with lower body height and body weight than their international counterparts. Further investigations are needed on the above studied variables along with fitness and physiological variables to assess relationships among them and with performances in volleyball and basketball.

Key words: Anthropometric characteristics, basketball, body composition, somatotyping, volleyball.

INTRODUCTION

Volleyball and basketball are among the world's popular sports, played practically in every nation at varying levels of competence. Successful participation in these sports requires from each player a high level of technical and tactical skills and suitable anthropometric characteristics. All ball games require comprehensive abilities including physical, technical, mental, and tactical abilities. Among them, physical abilities of the players are more important as these have marked effects on the skill of players and the tactics of the teams because ball games require repeated maximum exertion such as dashing and jumping (Tsunawake, 2003). Such physical abilities are important for both volleyball and basketball players to achieve higher levels of performance.

To evaluate these physical abilities, the anthropometric measurements, parameters of the body composition such as the percent body fat (% FAT), fat-free mass (FFM) and

somatotype components are often used. Studies on the physical characteristics of the human body to-date indicate that the morphological characteristics of athletes successful in a specific sport differ in somatic characteristics from the general population. Basketball and volleyball players are typically taller than the players of other games (Rahmawati et al., 2007). Basketball and volleyball require handling the ball above the head; therefore, having a greater height is an advantage in these sports (Kansal et al., 1986). Higher body mass however, is a hurdle for volleyball players in achieving good jumping height (Bandyopadhyay, 2007). Various researchers suggested that different body size, shape and proportions are beneficial in different physical activities (Malhotra et al., 1972; Kansal et al., 1986; Sidhu et al., 1996).

Several studies on the anthropometric characteristics and somatotype of basketball and volleyball players have been reported in literature (Fleck et al., 1985; Hakkinen, 1993; Hosler et al., 1978; Spence et al., 1980; Sallet et al., 2005; Apostolidis et al., 2003; Gualdi and Zaccagni, 2001; Pelin et al., 2009; Morques and Marinho, 2009;

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Table 1. Physical parameters of the volleyballers and basketballers.

Variables	Basketballers (N=27)		Volleyballers (N=36)		t- Value
	Mean	SD	Mean	SD	
Height (cm)	187.44	5.19	183.25	6.15	2.85**
Weight (kg)	79.40	7.70	73.02	7.58	3.28**
BMI	22.63	2.33	21.78	2.35	1.41
BSA	2.04	0.09	1.94	0.10	3.95**

** indicates $p < 0.01$.

Gabbett, 2008); however, similar studies in the context of India are limited. The present study has been conducted on Indian university volleyball and basketball players to evaluate their selected physical characteristics along with somatotype thus fills up already existing void of literature in Indian concern.

Objectives of the study

- (1) To study the anthropometric characteristics and body composition of basketball and volleyball players.
- (2) To study the body types of the basketball and volleyball players.

MATERIALS AND METHODS

The present study was conducted on 63 young male subjects (volleyball =36 and basketball = 27) of age group 18-25 years. The subjects were randomly selected from the different colleges affiliated to Guru Nanak Dev University, Amritsar, Punjab, India irrespective of their caste, religion, dietary habits and socio-economic status. The age of each subject was calculated from the date of birth as recorded in his institute. The height of the subjects was measured with anthropometric rod to the nearest 0.5 cm (HG-72, Nexgen ergonomics, Canada). The weight of subjects was measured by using portable weighing machine to the nearest 0.5 kg. Body surface area (BSA) and body mass index (BMI) were calculated by the following formulae:

$$BSA (m^2) = (\text{Body mass in kg})^{0.425} \times (\text{Body Height in cm})^{0.725} \times 0.007184 \text{ (DuBois and DuBois, 1916)}$$

$$BMI (Kg/m^2) = (\text{Body mass in kg}) / (\text{Stature in m}^2) \text{ (Meltzer et al., 1988)}$$

Skin fold thickness measurements of the subjects were measured by slim guide skin fold calliper. Girths were taken with the steel tape to the nearest 0.5 cm. Widths of body parts were measured by using sliding calliper with digital readout. Somatotype was determined from the following equations (Heath and Carter, 1990):

$$(i) \text{ Endomorphy} = -0.7182 + 0.1451(X) - 0.00068(X)^2 + 0.0000014(X)^3$$

Where

X = sum of supra-spinale, subscapular and triceps skin fold and corrected for stature by multiplying the sum of skin folds by 170.18/Body Height in cm

$$(ii) \text{ Mesomorphy} = (0.858 \times \text{Humerus width}) + (0.601 \times \text{Femur width}) + (0.188 \times \text{Corrected arm girth}) + (0.161 \times \text{Corrected Calf Girth}) - (\text{Body Height} \times 0.131) + 4.5$$

Where

Corrected Arm Girth = Arm girth-Biceps skin fold, Corrected Calf Girth = Calf Girth-Calf Skin fold.

$$(iii) \text{ Ectomorphy} = (\text{HWR} \times 0.732) - 28.58$$

[Where HWR = (Body Height in cm) / (weight in kg)^{0.33}]

Percentage body fat as estimated from the sum of skin folds was calculated using equations of Siri (1956) and Durnin and Womersley (1974). The regression equations for the prediction of body density from the log of the sum of skin fold thickness at four sites in mm are as follows:

For 17 to 19 years age group:

$$\text{Body Density (gm/cc)} = 1.1620 - 0.0630(X) \text{ (Durnin and Womersley, 1974)}$$

For 20 to 29 years age group:

$$\text{Body Density (gm/cc)} = 1.1631 - 0.0632(X) \text{ (Durnin and Womersley, 1974)}$$

Where

X = log (Biceps + Triceps + Subscapular + Suprailliac).

% Body Fat = [4.95/ Body density - 4.5] × 100 (Siri, 1956)

Total Body Fat (kg) = (% Body fat/100) × Body mass (kg)

Lean Body Mass (kg) = Body mass (kg) – Total body fat (kg)

Statistical analyses

Values are presented as mean values and SD. Independent samples t tests were used to test if population means estimated by two independent samples differed significantly. Data was analyzed using SPSS Version 16.0 (Statistical Package for the Social Sciences, version 16.0, SSPS Inc, Chicago, IL, USA).

RESULTS

Table 1 shows the descriptive statistics for physical parameters of volleyball and basketball players. Mean body height of basketball players was significantly higher than those of volleyball players ($p < 0.01$). Basketball players also had significantly greater weight ($p < 0.01$) as compared to volleyball players. No statistically significant difference was observed between the basketball players and the volleyball players in relation to BMI. BSA was significantly higher in basketball players than those of volleyball players ($p < 0.01$).

In Table 2 descriptive statistics for skin fold measurement values are depicted. Both biceps ($p < 0.01$)

Table 2. Different skin fold measurements of the volleyballers and basketballers.

Variables	Basketballers (N=27)		Volleyballers (N=36)		t-value
	Mean	SD	Mean	SD	
Biceps (mm)	4.88	1.25	4.00	1.17	2.89**
Triceps (mm)	7.48	1.31	8.69	3.43	1.73
Subscapular (mm)	12.55	3.04	11.38	3.66	1.34
Suprailliac (mm)	14.77	2.96	9.03	5.45	4.94**
Calf (mm)	13.07	3.57	11.19	3.97	1.94

** indicates $p < 0.01$.

Table 3. Diameters and circumferences of the volleyballers and basketballers.

Variables	Basketballers (N=27)		Volleyballers (N=36)		t- value
	Mean	SD	Mean	SD	
Bi-humerus diameter	69.77	3.45	70.45	6.49	0.49
Bi-femur diameter	102.66	5.89	100.03	6.99	1.58
Upper arm circumference	27.00	1.33	26.33	1.88	1.56
Calf circumference	36.66	2.28	35.50	2.10	2.09*

* indicates $p < 0.05$.

Table 4. Different components of body composition of the volleyballers and basketballers.

Variables	Basketballers (N=27)		Volleyballers (N=36)		t- value
	Mean	SD	Mean	SD	
Body density	1.062	0.004	1.068	0.009	3.13**
% BF (kg)	15.95	2.12	13.30	4.01	3.10**
TF (kg)	12.67	2.11	9.88	3.75	3.46**
FFM (kg)	66.72	6.59	63.13	5.39	2.37*

* indicates $p < 0.05$. ** indicates $p < 0.01$.

and suprailliac skin folds ($p < 0.01$) measurements were observed to be significantly higher for basketball players than volleyball players. The differences observed between the two groups for triceps, subscapular and calf skin fold measurement were not statistically significant.

Descriptive statistics of diameters and circumferences are shown in Table 3. There was no significant difference between basketball players and volleyball players in bi-humerus and bi-femur diameters. Since arm and calf circumference measurements reflect the bone, muscle and fat mass of the limbs, these two variables have also been evaluating. No significant difference was observed in upper arm circumference between the two groups, but calf circumference ($p < 0.05$) was significantly higher for basketball players when compared to volleyball players.

Descriptive statistics for different components of body composition are presented in Table 4. Volleyball players were found to have significantly greater body density ($p < 0.01$) when compared to basketball players. The basketball players were observed to have significantly

higher percent body fat ($p < 0.01$) and total body fat ($p < 0.01$) when compared to volleyball players. Fat free mass (FFM) was also significantly greater in basketball players ($p < 0.01$) than those of volleyball players. Table 5 summarizes the descriptive statistics of the somatotyping components. Endomorphy values of basketball players were significantly higher ($p < 0.01$) than those of volleyball players. In relation to mesomorphy and ectomorphy, no significant differences were observed between the two groups.

DISCUSSION

In the present study the anthropometric characteristics of the athletes have not been evaluated in relation to their performance, but were instead compared with each other. This study indicates the existence of differences among the players of different games. The overall results show that basketball players were taller and heavier as

Table 5. Somatotyping of the volleyballers and basketballers.

Variables	Basketballers (N=27)		Volleyballers (N=36)		t- value
	Mean	SD	Mean	SD	
Endomorphy	3.21	0.56	2.68	1.05	2.37*
Mesomorphy	2.91	1.14	3.06	1.11	0.51
Ectomorphy	3.40	1.30	3.57	1.41	0.50

* indicates $p < 0.05$.

compared to the volleyball players. Similar findings were found in the studies on Malaysian male athletes (Nudri et al., 1996) and Turkish male athletes (Pelin et al., 2007) which reported that the height of basketball players was greater when compared to other sports groups. The basketball players were also reported to have greater body fat percentage, skin fold measurements, FFM and endomorphic component as compared to volleyball players. These results show that basketball players were taller, heavier and fatter as compared to their counterparts. On average, the basketball players of the present study are considerably taller and heavier than the State level players studied by Sodhi (1976) and top ranking Indian basketball players (Sodhi, 1980). On the other hand, they are considerably shorter and lighter when compared to their international counterparts (Sallet et al., 2005; Apostolidis et al., 2003). Because the basketball and volleyball require handling the ball above the head, having a greater height is an advantage in basketball and volleyball games (Kansal et al., 1986). Lower height of Indian basketball players might be the one of the reason for their dismal performances at the international level.

In volleyball, teams compete by manipulating skills of spiking and blocking high above the head. Therefore, the presence of tall players is an indispensable factor in the success of a team. The volleyball players in the present study have greater height and weight than the volleyball players from West Bengal studied by Bandyopadhyay (2007) whereas they are shorter and lighter than their international counterparts (Gualdi and Zaccagni, 2001; Marques and Marinho, 2009; Gabbett, 2008).

The present data regarding the % fat of the players is approximately accords with the proposal that percentage fat value among basketball and volleyball players should be within the range of 6-15% (Wilmore and Costill, 1999). The basketball players in the present study have higher percentage body fat than the elite level Greek basketball players (Sallet et al., 2005) and French professional basketball players (Apostolidis et al., 2003). The volleyball players have higher body fat percentage than the volleyball players from West Bengal studied by Bandyopadhyay (2007). An increased fat weight will be detrimental in volleyball and basketball because in these sports, the body is moved against the gravity (e.g. volleyball spiking, blocking) or propelled horizontally (as in basketball) as the additional body fat adds to the

weight of the body without contributing to its force production or energy producing capabilities. Higher fat free mass was reported among the overseas players than the Indian volleyball and basketball players who will therefore achieve better performance. Greater fat content and lower FFM among Indian volleyball and basketball players act as a hindrance in their performance. This might be due to lower training levels and thus low level of physical fitness. Constituents of diet may also be one of the reasons for greater fat content and lower FFM among the Indian players.

The somatotyping scores of basketball players in the present study are 3.2-2.9-3.4 and they are reported as endo-ectomorphic. The results in present study are not in line with those of Hebbelinck and Ross (1974) who reported an ecto-mesomorphic somatotype as the prototype for basketball players. The basketball players in the present study have greater endomorphic component and lower mesomorphic component than those of the top ranking Indian basketball players studied by Sodhi (1980) and Turkish basketball players studied by Pelin et al. (2009). The somatotyping scores of volleyball players in the present study are 2.6-3.0-3.5 and they are reported as meso-ectomorphic. The present results are not in agreement with those of Gualdi and Zaccagni (2001) who reported volleyball players as balanced mesomorphs. On the other hand, the somatotyping scores of volleyball players in the present study are in conformity with Indonesian volleyball players showed the mesomorphic-ectomorph somatotype, with a somatotype score of 2.4-3.5-3.7 (Rahmawati et al., 2007).

Conclusion

There were significant differences in most of the anthropometric characteristics between the basketball players and volleyball players. On average, the basketball players were taller and heavier than the volleyball players. The basketball players also had higher body surface area, calf circumference and FFM than the volleyball players. But the biceps and suprailliac skin folds, percentage body fat, total body fat and endomorphy were also higher in basketball players when compared to volleyball players whereas the body density was greater among the volleyball players. More data would be helpful on the above studied variables along

with fitness and physiological variables to assess relationship among them and with performance in volleyball and basketball.

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