

# Anthropometric Characteristics, Body Composition and Somatotyping of High and Low Performer Shot Putters

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**Abstract.** The purpose of this study was to find out anthropometric measurements, body composition and somatotyping differences in high performer and low performer shot putters. 20 male shot putters of age 18 to 25 years were assessed for the present study. Out of which 10 were high performers and 10 were low performers. All subjects were assessed for height, weight, widths, girths and skinfold thickness. The independent samples t-test revealed that high performer shot putters were significantly taller ( $p<0.01$ ) and had significantly greater all the length measurements when compared to low performer shot putters. The high performer shot putters also possessed significantly greater upper arm ( $p<0.05$ ), forearm ( $p<0.01$ ), chest ( $p<0.05$ ), thigh ( $p<0.05$ ) circumferences and bi-humerus ( $p<0.01$ ), wrist ( $p<0.05$ ), bi-acromial ( $p<0.01$ ), hip ( $p<0.05$ ) diameters as compared to low performer shot putters. Endomorphy ( $p<0.05$ ) was significantly higher in low performers while the lean body mass ( $p<0.05$ ) was significantly greater in high performer shot putters. It is concluded that in most of the parameters there were significant differences between high performer shot putters and low performer shot putters, and the high performer athletes showed better anthropometric measurements and somatotyping scores.

**Key words :** Anthropometry, % body fat, shot put, somatotyping, lean body mass.

## 1. Introduction

Development in a sport at elite level can be improved by knowing the morphological, physical, physiological, and psychological characteristics of current top athletes and to isolate those factors that contribute to high levels of performance. Morphological characteristics are most important factor because to a great extent these are genetically determined (Sodhi, 1980; Norton and Olds, 2001). The anthropometric measurements are used to determine the morphological status, that is, body constitution and body structure of an athlete. It is well known fact that a general relationship exists between morphology and performance. Several studies on various body characteristics of different sports activities have been carried out by many researchers and they concluded that strong relationship exist between structure and performance (Gualdi-Russo & Graziani, 1993; Rienzi, 2000; Tanner 1964, Carter 1984; Morrow et al., 1982; Singh et al, 1987; Guennadi, 1990; Bell & Rhodes, 1975; Torilola, 1987). Physical performance declines when body weight and percentage of body fat is at extreme level (Gomez, 2004), but depending on the sport, a higher or lower body fat level may be beneficial. Because of this, body composition trends in different sports can help identify potential participants. The top athletes in a particular sport or event show similarities in body dimension and body constitution (Carter, 1984). Thus the model body type for a specific sport or event is most easily determined by studying the top level athletes. The knowledge of these characteristics assists the coaches in planning better training programs while preparing their athletes for competition.

The shot put is a track and field event involving "Putting" (throwing in a pushing motion) a heavy metal ball (called the shot) as far as possible. Performance in this event is mainly determined by the height of releasing angle, release velocity of the shot (Zatsiorsky et al, 1981). To put the shot further and to achieve high release velocity the high power production is required. Power production in an athlete is mainly determined by his muscle fibre type and muscle mass (Aagaard and Anderson, 1998). Height and the other segmental lengths of the body of the athlete also play significant role as it increases the height of the

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releasing angle. Therefore, the aim of the present study is to investigate the anthropometric characteristics, body composition and somatotyping of the university level shot putters.

## 2. Methodology

The present study was conducted on 20 shot putters (10 high performers and 10 low performers). The age of athletes was between 18 to 25 years. The data of athletes were collected during the All India Inter University Athletic Meet held at Manonmaniam Sundaranar University, Trinelveli, Tamilnadu, in January 2006. The high performer athletes were selected among the first 12 positions and low performers were selected from those who could not qualify in first 12 positions. Body weight was measured with portable weighing machine to the nearest 0.5 kg. Height measurements were taken by using the standard anthropometric set to the nearest 0.5 cm. Widths and diameters of body parts were measured by using caliper. Girths and lengths were taken with the steel tape to the nearest 0.5 cm. Skinfold thickness measurements were taken with Harpenden Skinfold Caliper to the nearest 0.1 mm. Percentage body fat as estimated from the sum of skinfolds 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 skinfold thickness at four sites in mm are as follows:

For 17 to 19 years age group:

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

For 20 to 29 years age group:

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

Where  $X = \log(\text{biceps} + \text{triceps} + \text{Subscapular} + \text{suprailiac})$ .

$$\% \text{ Body Fat} = [4.95 / \text{body density} - 4.5] \times 100 \quad (\text{Siri, 1956})$$

$$\text{Total Body Fat (kg)} = (\% \text{body fat} / 100) \times \text{body mass (kg)}$$

$$\text{Lean Body Mass (kg)} = \text{body mass (kg)} - \text{total body fat (kg)}$$

Somatotyping components (endomorph- mesomorph-ectomorph) were calculated according to Carter and Heath method (1990).

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

(Where  $X = \text{sum of supra-spinal, subscapular and triceps skinfold and corrected for stature by multiplying the sum of skinfolds by } 170.18 / \text{Body Height in cm})$

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

(Where Corrected Arm Girth = Arm girth-Biceps skinfold, Corrected Calf Girth = Calf Girth-Calf Skinfold)

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

$$[\text{Where HWR} = (\text{Body Height in cm}) / (\text{weight in kg})^{1/3}]$$

**Statistical analysis:** Values are presented as mean values and SD. Independent samples t test was 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).

## 3. Results

Table 1 shows the mean physical characteristics of high performer and low performer shot putters. Mean body height of high performer shot putters was significantly higher than the low performer shot putters ( $p < 0.01$ ). In table 2 length measurements of body parts of the subjects are depicted. The high performer shot

putters were found to have significantly greater mean values for all the length measurements than the low performer shot putters. Circumferences of the body parts of the subjects are given in table 3. The high performer shot putters showed significantly greater upper arm circumference ( $p<0.05$ ), forearm circumference ( $p<0.01$ ), chest circumference ( $p<0.05$ ) and thigh circumference ( $p<0.05$ ) as compared to low performer shot putters. Table 4 presents the diameters of body parts of the subjects. Mean values of bi-humerus diameter ( $p<0.01$ ), wrist diameter ( $p<0.05$ ), bi-acromial diameter ( $p<0.01$ ) and hip diameter were reported significantly greater for high performer shot putters when compared to low performer shot putters. Different components of body composition of the subjects are shown in the table 5. The high performer shot putters had significantly greater lean body mass ( $p<0.05$ ) as compared to low performer shot putters. Table 6 summarizes the somatotyping components of the subjects. The low performer shot putters possessed significantly higher mean value for endomorphic component than the high performer shot putters. No statistically significant differences were observed for other somatotyping components.

Table 1 Mean physical characteristics of high performer and low performer shot putters

Variables	High performers (N=10)		Low performers (N=10)		t- Value
	Mean	SD	Mean	SD	
Height (cm)	184.74	3.45	180.00	2.35	3.58**
Body Weight (kg)	102.50	8.33	96.00	7.83	1.79
BMI ( $\text{kg/m}^2$ )	29.98	1.34	29.59	1.80	0.54

\*\* indicates  $p<0.01$

Table 2 Length measurements of high performer and low performer shot putters

Variables	High performers (N=10)		Low performers (N=10)		t- Value
	Mean	SD	Mean	SD	
Sitting Height (cm)	94.97	1.18	92.48	0.87	5.35**
Leg Length (cm)	103.37	2.47	101.05	2.17	2.22*
Upper Leg Length(cm)	54.28	1.42	51.93	0.97	4.29**
Lower Leg Length (cm)	40.54	0.90	39.67	0.70	2.40*
Arm Length (cm)	84.16	2.16	81.90	1.72	2.57*
Upper Arm Length (cm)	36.13	0.99	35.11	0.79	2.53*
Lower arm length (cm)	27.19	0.66	26.49	0.50	2.63*

\* indicates  $p<0.05$ , \*\* indicates  $p<0.01$

Table 3 Circumferences of high performer and low performer shot putters

Variables	High performers (N=10)		Low performers (N=10)		t- Value
	Mean	SD	Mean	SD	
Upper Arm Circumference(cm)	33.21	1.45	31.80	1.16	2.39*
Forearm Circumference (cm)	27.85	0.83	26.59	0.70	3.63**
Chest Circumference (cm)	109.61	4.56	105.15	3.62	2.42*
Waist Circumference (cm)	95.88	4.97	92.23	4.83	1.66
Thigh Circumference (cm)	58.70	1.75	57.07	1.51	2.22*
Calf Circumference (cm)	39.46	1.90	38.23	0.95	1.82

indicates  $p<0.05$ , \*\* indicates  $p<0.01$

Table 4 Diameters of high performer and low performer shot putters

Variables	High performers (N=10)		Low performers (N=10)		t- Value
	Mean	SD	Mean	SD	
Elbow Diameter (cm)	7.40	0.18	7.20	0.11	2.92**
Wrist Diameter (cm)	6.00	0.14	5.84	9.66	2.84*
Shoulder Diameter (cm)	43.15	0.97	41.30	0.34	5.66**
Hip Diameter (cm)	30.29	0.67	29.52	0.59	2.70*
Knee diameter (cm)	10.30	0.21	10.19	0.21	1.13
Ankle Diameter (cm)	7.50	0.23	7.43	0.14	0.80

indicates  $p < 0.05$ , \*\* indicates  $p < 0.01$

Table 5 Different components of body composition of high performer and low performer shot putters

Variables	High performers (N=10)		Low performers(N=10)		t- Value
	Mean	SD	Mean	SD	
% Body Fat	21.22	0.58	21.70	1.18	1.13
Total Body Fat (kg)	21.79	2.33	20.90	2.76	0.77
Lean Body Mass (kg)	80.70	6.01	75.09	5.12	2.24*

\* indicates  $p < 0.05$

Table 6 Somatotyping components of high performer and low performer shot putters

Variables	High performers (N=10)		Low performers(N=10)		t- Value
	Mean	SD	Mean	SD	
Endomorphy	4.84	0.13	5.13	0.39	2.22*
Mesomorphy	5.10	0.41	5.00	0.29	0.67
Ectomorphy	0.66	0.16	0.59	0.32	0.63

\* indicates  $p < 0.05$

## 4. Discussion

The results of the present study show that the shot putters differed in most of the kinanthropometric measurements, body composition and somatotyping with regard to their performance level. The high performer shot putters showed significantly better almost all kinanthropometric measurements, body composition and somatotyping components than the low performer shot putters. Similar results were found in the studies on other games (Guladi-Russo and Zaccangi, 2001; Jaskaran and Rajinder, 2006; Demuth et al., 2007). The high performer shot putters were taller and heavier than low performer shot putters. The greater height in their case provides advantage by making the flight of the implement longer before it touches the ground (Sodhi, 1991). The height of the high performer shot putters in present study is lower than the Olympic level shot putters and world class shot putters (Tanner, 1964; de Garry et al., 1974; Fahey et al., 1975) but the shot putters in present study are taller than the Brazilian young shot putters, previously studied Indian shot putters and university level shot putters (Guimaraes and De Rose, 1980; De et al., 1991; Sodhi, 1991; Sumanta et al., 2008; Pritam et al., 2009). The higher body weight is advantageous in shot put event as the shot putters require greater strength to put the shot for greater distance and the strength is relative to body mass (Bush, 1978). The weight of shot putters in the present study is lower than the world class shot putters studied by Fahey et al. (1975) and Olympic level shot putters (Tanner, 1964) while it is comparable with the weight of shot putters studied by de Garry et al. (1974) but shot putters in present study have greater weight compared to Brazilian young shot putters, previously studied Indian shot putters and university level shot putters (Guimaraes and De Rose, 1980; Sodhi, 1991; Sumanta et al., 2008; Pritam et al., 2009). The high

performer shot putters in the present study have longer upper extremities as compared to low performer shot putters. The greater length of upper extremities plays an important and crucial part in shot put event as it increases the height of release. The high performer shot putters also possess higher circumferences and diameters which show better growth and development as compared to low performer shot putters. Shot put event requires the production of high muscular power for better performance and it is determined by muscle strength and muscle mass. Therefore, the greater lean body mass is advantageous in shot put (Fahey et al., 1975). The body mass is important in throwing events and high endomorphy and mesomorphy are assets to the throwers (Westlake, 1967). The somatotype scores of high performer shot putters are 4.8-5.1-0.6. The shot putters in present study are mesomorph-endomorph. The somatotyping scores of shot putters in present study are supported by other studies (de Garry et al., 1974; Sharma and Shukla, 1988; Guimaraes and De Rose, 1980). The shot putters in the present study show low level of ectomorphy, a characteristic seen in throwers in the studies of de Garry et al. (1974) and Thorland et al. (1981).

## 5. Conclusion

Considering that in most of the parameters there were significant differences between high performer shot putters and low performer shot putters, and the high performer shot putters showed better anthropometric measurements and somatotyping scores, it is concluded that various anthropometric characteristics, components of body composition and somatotyping scores has clear impact on the performance of the shot putters. This investigation indicates the need for further research on the effect of diets and training regime on body composition since it is associated with throwers performance.

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