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A study of anthropometric measurements, body composition and somatotyping of high jump and shot put athletes

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■ **ABSTRACT**

The purpose of the study was to compare the Anthropometric characteristics, Body composition and Somatotyping in male High jump (N=10) and Shot Put athletes (N=10) of different colleges affiliated to Karnatak University, Dharwad state of: Karnataka, The age of athletes was between 18 to 25 years. All subjects were assessed for height, weight, breadth, girth and skinfold thickness. Percentage of fat was calculated from the sum of 4 measurements of skinfold thickness. The independent samples t-test revealed that, high jump athletes had significantly Higher height ($p<0.01$), Body mass index ($p<0.05$), Total leg length ($p<0.01$) and Total arm length ($p<0.01$) as compared to Shot Put athletes, but their weight ($p>0.01$) was significantly lower as compared to Shot Put athletes. The Shot Put athletes had significantly greater in two girths, Bi-humerus ($p<0.01$) and Bi-femur ($p<0.01$) diameters, as compared to high jump athletes, where as high Jump athletes had lean body mass ($p<0.01$) and mesomorphic score ($p<0.01$) as compared to Shot put athletes. The Shot put athletes found to have significantly higher per cent body fat ($p<0.05$) and Mesomorphic ($p<0.01$) score than the high jump athletes. It is concluded that, in most of the parameters there were significant differences between high jump and shot put athletes. The shot put athletes showed better anthropometric measurements and somatotyping scores.

■ **Key Words :** Anthropometry, Somatotype, Body fat, Body mass, Athletes

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In the endeavor to achieve excellence in sport, all of the possible concomitants of performance have been subject to scientific research. Modern sport science is characterized by the purposefulness of its endeavour to improve elite athletes and to discover talents as precisely as possible. There is evidence to support the concept that an individual's physique greatly limits or enhances successful participation in physical activity (Wilmore and Haskell, 1972; Wilmore and Brown, 1974; Fahey *et al.*, 1975; Wickkiser and Kelly, 1975; Pipes, 1977). Elite and world class athletes have different physiques than individuals in the non athletic population (Tanner, 1964). The body composition and anthropometry of elite athletes has been the subject of much research. The practicing athletes might be expected to exhibited structural and functional characteristics that are specifically favourable for the sport and thus separate him from the general population and athletes involved in other sports. Such differences in body physique might reflect (a) genetic characteristics that have been selective in determining athletic pursuit and (b) changes due to the conditioning effect of high level of training.

Specific physique or morphological features play a major role, arguably critical role in competition success. The size, shape and proportions of athletes are important considerations in player performance and better the performance more critical the relationship (Bell and Rhodes, 1975; Toriola *et al.*, 1987).

In track and field athletics, several papers have investigated anthropometric variables in relation to event participation (De Garay *et al.*, 1974; Thorland *et al.*, 1981; Carter, 1982; Kellet *et al.*, 1983; Housh *et al.*, 1984; Hollings and Robson, 1991; Langer, 2007). However few studies have investigated the track and field athletes in India. The present study, therefore, is an attempt to investigate physical characteristics, body composition and somatotyping of high jump and shot put athletes of different colleges affiliated to Karnataka University, Dharwad, Karanataka (India).

■ METHODOLOGY

The present study was conducted on 20 field athletes (N=10 high jump and N=10 shot put). The age of athletes was between 18 to 25 years. The data of athletes were collected during the various inter-collegiate Athletic meets. The height of the subjects was measured with stadiometer to the nearest 0.5 cm. The weight of subjects was measured by using digital weighing machine to the nearest 0.5 kg. Body mass index (BMI) was calculated by the following formula:

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

Skinfold measurement by means of lange skinfold caliper with proper anatomical mark sites of biceps triceps, subscapular, supraspinale and medial calf. Breadth measurement by means of harpendan caliper at humorous and femur breadth. Girth measurement by means of Gulick Tape Arm Girth and Calf girth.

The somatotype was determined from the following equations (Carter and Heath, 1990) :

Endomorphy = 0.1451 x -0.00068 x ^{2} + 0.0000014 x ^{3} - 0.7182

where, x = The sum of triceps, subscapular and supraspinale skin folds.

Mesomorphy = 0.858(A) + 0.601(B) + 0.188(C) + 0.161(C)-0.131(E)+ 4.5

where,

A = Humerus breadth (cm)

B= Femur breadth (cm)

C = Corrected arm girth [Arm-girth (cm) - (Triceps SF (mm)/10)]

D = Corrected calf girth [Calf girth (cm) - medial calf SF(mm) /10)]

E = height (cm)

Ectomorphy = (Height (cms) x Weight (kgs) - 0.333)

Percentage body fat as estimated from the sum of skin folds was calculated using equations of Siri (1956) and Durnin and Rahaman (1967).

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: Body Density (gm/cc) = 1.1620-0.0630 (X) (Durnin and Womersley,1974)

For 20 to 29 years age group: Body Density (gm/cc) = 1.1631-0.0632 (X) (Durnin and Womersley, 1974)

where,

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

per cent Body Fat = [4.95/ Body density-4.5] x 100 (Siri, 1956)

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

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

Statistical analysis :

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).

■ OBSERVATIONS AND DISCUSSION

The high jump athletes were significantly taller ($p<0.01$) than shot put athletes. Whereas, shot put athletes were heavier ($p<0.01$) as compared to high jump athletes. The shot put athletes had significantly greater value of body mass index ($p<0.05$) as compared to high jump athletes. Leg length ($p<0.01$) and arm length ($p<0.01$) were found significantly higher in high jump athletes when compared to the shot put athletes. Shot put athletes had significantly greater upper arm ($p<0.01$), thigh ($p<0.01$) calf ($p<0.01$) circumferences, Bi-humerus ($p<0.01$) and Bi-femur ($p<0.01$) diameters as compared to high jump athletes (Housh *et al.*, 1984).

Table 2 presents the various components of body composition of the high jump athletes and shot put athletes. The shot put athletes were found to have significantly higher body density ($p<0.05$) and per cent body fat ($p<0.05$) than the high jump athletes, whereas high jump athletes had significantly higher lean body mass ($p<0.01$) as compared to shot put.

Table 3 shows the somatotype scores of the high jump performer and Shot put athletes. The Shot Put athletes had significantly higher mesomorphic score ($p<0.01$) as compared to high jump athletes, whereas the high jump athletes had significantly higher Ectomorphic score ($p<0.01$) than the shot put athletes.

The results of the present study show that the high jump and shot put athletes competing in the inter collegiate Athletic Meet differed in most of the somatometric variables studied with regard to their performance level. The height of the high jump athletes in the present study is greater than the Indian high jumpers reported by Sodhi (1991) and is comparable

Table 1 : Anthropometric measurement of high jump athletes and shot put athletes

Variables	High jump athletes		Shot put athletes		t-value
	Mean	SD	Mean	SD	
Height (cm)	175.60	1.65	171.40	1.30	5.30 **
Weight (Kgs)	66.25	2.79	61.60	4.60	3.69 **
BMI (Kg/M²)	20.80	0.83	19.66	1.49	2.11 *
Leg length (cm)	98.70	1.05	94.40	.86	5.34 **
Arm length (cm)	80.57	.81	78.25	0.59	4.64 **
Upper arm girth	26.50	0.46	24.00	1.72	4.43 **
Thigh girth	45.78	1.28	50.55	1.81	4.90 **
Calf girth	31.00	0.64	34.30	1.80	3.66 **
Bi condylar humerus breadth	6.60	0..75	6.93	0.11	7.68 **
Bi condylar femour breadth	8.86	0.13	9.68	0.35	7.01 **

* and ** indicates of significance of values at P=0.1 and 0.05, respectively

Table 2 : Components of body composition of high jump athletes and shot put athletes

Variables	High jump athletes		Shot put athletes		t-Value
	Mean	SD	Mean	SD	
Body density	1.07	0.002	1.06	0.0017	2.41 *
Per cent body fat	12.56	1.04	13.55	0.77	2.41 *
Total body fat (kg)	8.72	1.00	8.56	0.99	0.37
Lean body mass (kg)	54.60	2.004	59.44	3.71	4.50 **

* and ** indicates of significance of values at P=0.1 and 0.05, respectively

Table 3 : Somatotyping of high jump athletes and shot put athletes

Variables	High jump athletes		Shot put athletes		t-Value
	Mean	SD	Mean	SD	
Endomorphy	2.29	0.19	2.56	0.20	3.02 **
Mesomorphy	2.76	0.19	1.56	0.90	4.09 **
Ectomorphy	3.95	0.46	4.38	0.86	1.39

** indicates of significance of values at P=0.05, respectively

with the jumpers from New Zealand (Hollings and Robson, 1991) and Olympic level jumpers studied by De Garay *et al.* (1974) and Carter *et al.* (1982) whereas the high jumpers in the present study are shorter than Czech, Slovak and Danish high jumpers (Langer, 2007). The high jump athletes have less per cent body fat than shot put performer high jumpers, whereas they have greater lean body mass (muscle mass) as compared to low athletes and therefore achieve better performance since more the lean body mass the greater will be the energy output and higher will be the cardio respiratory fitness (Bandyopadhyay and Chatterjee, 2003; Chatterjee *et al.*, 2005). The somatotype scores of high jump athletes are 2.2-2.7-3.9 which accords with the somatotyping scores of Olympic level jumpers ranging between 2-5-3 and 2-3-5 reported by Tanner (1964). The high jumpers in the present study are ectomorphic mesomorph. The endomorphic, mesomorphic and ectomorphic scores of jumpers are comparable with the high jumpers from Czechoslovakia, Denmark and Czech Republic (Langer, 2007).

Conclusion :

Considering that in most of the parameters there were significant differences between high jump athletes and shot put athletes. The shot put athletes 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 athletes. This investigation indicate the need for further research on the effect of diets and training regime on body composition since it is associated with athletes performance.

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