International Journal of Physical Education, Sports and Health 2017; 4(4): 221-225

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2017; 4(4): 221-225

www.kheljournal.com
Received: 09-05-2017
Accepted: 10-06-2017

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Study of body composition and somatotyping among the throwers

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Abstract
The purpose of the present study was to compare the body composition and somatotying of the different groups of the throwers. 40 (10 javelin throwers, 10 discus throwers, 10 hammer throwers, 10 shot putters) male university level throwers were assessed during the All India Inter University Athletic Meet. The age of athletes was between 18 to 25 years. All the athletes were measured for height, weight, diameters, circumferences and skinfold thicknesses of the body parts. One-way ANOVA revealed that there were significant differences in skinfold thicknesses ($p<0.05$), body composition ($p<0.05$) and somatotyping components ($p<0.05$) among the different groups of throwers. The shot putters had the highest skinfold thicknesses, percent body fat and total body fat among the throwers. Discus throwers and shot putters were found to have higher lean body mass, endomorphy and mesomorphy than the javelin throwers and hammer throwers. The javelin throwers had the highest ectomorphy component among the groups of throwers.

Keywords: Body composition, Somatotyping, Throwers, Percent Body Fat, Lean Body Mass

Introduction
The sports performance of athletes is greatly influenced by such factors as age, height, weight and body structure. It is also observed that persons of the same age group vary in body size and shape, the individuals of the same height differ greatly in body weight, the persons may weigh the same, but the relative proportion of muscle, fat, and bone will be varied (Johnson and Nelson 1982) [10]. Body composition, somatotyping and morphological characteristics play a vital role in determining the success of sportspersons (Reco-Sanz *et al.*, 1998; Willmore & Costill, 1999; Keogh, 1999) [28, 12]. Performance demands, in present day highly competitive sports have increased continuously and only those individuals, within whom factors influencing performance are on a high level can expect to succeed (Gualdi Russo & Graziani, 1993; Rienzi, 2000) [8, 20]. Kopecky & Pridalova (2001) [13] stated that sports performance is determined in a differentiated way by somatic, functional, physiological and motor characteristics and capabilities. Therefore, the physique becomes a limiting factor of performance i.e. a direct reflection of the level of movement activities. This knowledge is of paramount importance when suitable types for various sports branches or events are sought. It is evident to have differences in body size and proportion, height and weight amongst different sports persons (Kansal *et al.*, 1983) [11] but recent studies have shown that size, weight, height show remarkable differences on the basis of field position also (Gray, 1936; Malhotra *et al.*, 1973; Sidhu *et al.*, 1984) [7, 15, 22]. There are many factors which contribute to the sports performance. Skill, psychological characteristics, powerful and capacious energy-production systems are all important factors in sports performance, but the main success factor in sports is body size, shape and morphology (Claessens *et al.*, 1994) [2]. The study on athletes revealed that usually sprinters are muscular, marathoners are smaller and leaner and throwers are taller and heavier with higher levels of fat. An important concept is morphological optimization most likely to be associated with success in different sports (Norton *et al.*, 1996) [18].
It is a well known fact that a general relationship exists between morphology and performance. While studying an individual's anthropometric characteristics, somatotyping and body composition, the physical merits and demerits of that particular sportsperson in relation to his sport can be known.

Physical characteristics and body composition have been known to be fundamental to excellence in athletic performance (Mathur and Salokun 1985) [16]. Body composition can be a predictor of athletic performance, making it relevant to both athletes and coaches. As the use of skinfolds and body composition techniques help in estimating the amount of fat in athlete, the small quantity of fat in athletes generally helps to attain high sports performance. In most of the sports minimum level of fat is required for better performance, whereas increased levels may obstruct sportsmen from reaching their full potential.

Throwers require greater body weight because when an object is thrown forward and upward an equal and opposite force is exerted on the thrower which disturbs his body balance. So the effect of this reaction will be more if the athlete is not having greater body weight. Further to make the flight of the throwing implement longer in the air the greater height is also advantageous for the athletes (Sodhi, 1991). The purpose of this study is therefore to find out the differences in somatotyping and body composition of university level high and low performer throwers.

Methodology

The present was conducted on 40 university level throwers which were purposively selected from All India Inter University Athletic Meet held at Manonmaniam Sundaranar University Tirunelveli (Tamilnadu) in January 2006. The study was conducted only on male throwers of age between 18 to 25 years. The throwers included discus throwers, javelin throwers, hammer throwers and shot putters.

Data Collection

Body weight was measured with portable weighing machine to the nearest 0.5 kg. Height and length measurements were taken by using the standard anthropometric rod (HG-72, Nexgen ergonomics, Canada) to the nearest 0.5 cm. Widths and diameters of body parts were measured by using sliding caliper. Circumferences of the body parts of the throwers were measured with the help of steel tape to the nearest 0.5 cm. Skinfold thicknesses of the body parts were measured with the Harpenden skinfold caliper.

Body Composition

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 thicknesses 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 & Womersley, 1974)

For 20 to 29 years age group:

Body Density (gm/cc) = 1.1631-0.0632 (X) (Durnin & 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 (LBM) was calculated using the % body fat value estimated from the sum of skinfolds.

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

Somatotyping

Somatotype components (endomorphy, mesomorphy, ectomorphy) were estimated according to protocol of Carter and Heath (1990) using the next equations

Endomorphy = - 0.7182 + 0.1451 (X) - 0.00068 (X^2) + 0.0000014 (X^3)

where X = (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm).

Mesomorphy = 0.858 × humerus breadth + 0.601 × femur breadth + 0.188 × corrected arm girth + 0.161 × corrected calf girth – height 0.131 + 4.5.

Where corrected arm girth =flexed arm girth - triceps skinfold/10

corrected calf girth = maximal calf girth - calf skinfold/10.

Ectomorphy = 0.732 HWR - 28.58

Where HWR = height / cube root of weight

If HWR is less than 40.75 but greater than 38.25 then

Ectomorphy = 0.463 HWR - 17.63

If HWR is equal to or less than 38.25 then

Ectomorphy = 0.1

Statistical Analysis

Statistical analyses were performed using SPSS version 16.0 for windows (SPSS Inc, Chicago, IL, USA). The data was presented as descriptive statistics such as mean, standard deviation. One Way Analysis of Variance (ANOVA) was employed to compare the throwers. Where 'F' values were found significant, Tukey's Post-hoc test was applied to find out the direction and degree of difference. The level of significance was set at 0.05.

Results

Table 1: Comparison of skinfold measurements, body composition and somatotying components among different groups of throwers

Variables	Shot Putters (Mean±SD)	Hammer Throwers (Mean±SD)	Javelin Throwers (Mean±SD)	Discus Throwers (Mean±SD)	F-Value
Biceps Skinfold (mm)	8.12±0.43	7.39±0.29	6.54±0.41	7.55±0.29	31.92*
Triceps Skinfold (mm)	13.68±0.33	14.05±0.38	12.63±1.15	13.90±0.36	9.58*
Subscapular Skinfold (mm)	17.64±1.06	15.43±0.88	13.66±0.84	16.26±0.89	32.25*
Suprailiac Skinfold (mm)	21.00±1.19	18.26±1.47	16.16±1.33	20.18±1.13	27.86*
Calf Skinfold (mm)	16.68±1.04	14.80±0.69	13.10±2.22	15.26±0.80	12.10*
Percentage Body Fat (%)	21.22±0.58	20.09±0.62	18.64±0.75	20.69±0.53	31.16*
Total Body Fat (kg)	21.79±2.33	18.10±1.38	14.94±1.58	20.92±1.63	30.46*
Lean Body Mass (kg)	80.70±6.01	71.89±2.98	65.05±3.98	80.07±4.55	27.05*
Endomorphy	4.84±0.13	4.61±0.18	4.13±0.22	4.65±0.18	26.42*
Mesomorphy	5.10±0.41	5.04±0.26	4.34±0.25	4.98±0.20	14.44*
Ectomorphy	0.66±0.16	0.75±0.14	1.51±0.31	0.86±0.14	34.59*

* Indicates $p<0.05$

Table 2: Tukey's Post-hoc values of skinfold measurements, body composition and somatotyping components of throwers

Variables	Shot Putters Vs Hammer Throwers	Shot Putters Vs Javelin Throwers	Shot Putters Vs Discus Throwers	Hammer Throwers Vs Javelin Throwers	Hammer Throwers Vs Discus Throwers	Javelin Throwers Vs Discus Throwers
Biceps Skinfold (mm)	0.73*	1.58*	0.57*	0.85*	0.16	1.01*
Triceps Skinfold (mm)	0.37	1.05*	0.22	1.42*	0.15	1.27*
Subscapular Skinfold (mm)	2.21*	3.98*	1.38*	1.77*	0.83	2.60*
Suprailiac Skinfold (mm)	2.74*	4.84*	0.82	2.10*	1.92*	4.02*
Calf Skinfold (mm)	1.88*	3.58*	1.42	1.70*	0.46	2.16*
Percentage Body Fat	1.13*	2.58*	0.52	1.44*	0.60	2.05*
Total Body Fat (kg)	3.69*	6.85*	0.87	3.15*	2.81*	5.97*
Lean Body Mass (kg)	8.80*	15.64*	0.62	6.84*	8.18*	15.02*
Endomorphy	0.22*	0.70*	0.19	0.48*	0.03	0.51*
Mesomorphy	0.06	0.76*	0.12	0.69*	0.05	0.64*
Ectomorphy	0.09	0.84*	0.20	0.75*	0.10	0.64*

* Indicates $p<0.05$

Skinfold measurements, different components of body composition and somatotyping components of various groups of throwers are presented in table-1. Tukey's post-hoc values of skinfold measurements, different components of body composition and somatotyping components of various groups of throwers are shown in table-2. Biceps skinfold was significantly different in the individuals among the different groups of throwers ($F=31.92$, $p<0.0001$). The highest value of biceps skinfold was observed in shot putters and it was followed by discus throwers, hammer throwers and javelin throwers respectively. Post-hoc analysis revealed that shot putters had significantly higher biceps skinfold mean values than the hammer throwers, discus throwers and javelin throwers. In the same way, hammer and discus throwers were found to have significantly higher skinfold mean values than the javelin throwers. There were significant differences in triceps skinfold among the different groups of throwers ($F= 9.58$, $p<0.0001$). But hammer throwers had highest triceps skinfold and they were followed by discus throwers, shot putters and javelin throwers respectively. Post-hoc analysis reported that javelin throwers had significantly lower triceps skinfold as compared to shot putters, hammer throwers and discus throwers. In relation to subscapular skinfold, significant difference was observed among the different groups of throwers ($F=32.25$, $p< 0.0001$). The subscapular skinfold was highest in shot putters and this was followed by discus throwers, hammer throwers and javelin throwers. Post-hoc analysis displayed that shot putters had significantly higher subscapular skinfold as compared to hammer throwers, javelin throwers and discus throwers. It was found that discus throwers and hammer throwers have significantly higher subscapular skinfold as compared to javelin throwers. Suprailiac skinfold was significantly different in the individuals among different groups of throwers ($F=27.86$, $p<0.0001$). The highest suprailiac skinfold was observed in shot putters and they were followed by discus throwers, hammer throwers and javelin throwers respectively. Post-hoc analysis revealed that shot putters had significantly higher suprailiac skinfold as compared to hammer throwers and javelin throwers. Similarly, hammer and discus throwers had significantly higher suprailiac skinfold than those of javelin throwers whereas discus throwers had significantly greater suprailiac skinfold than the hammer throwers. Calf skinfold was significantly different in the individuals in the different groups of throwers ($F=12.10$, $p<0.0001$). The shot putters had the highest calf skinfold and they were followed by discus throwers, hammer throwers and javelin throwers respectively. Post-hoc analysis displayed that shot putters had significantly higher calf skinfold values as compared to hammer throwers and javelin throwers. The hammer and discus thrower were found to have significantly higher calf skinfold than those of javelin throwers. Percentage body fat was significantly different in the individuals among the different groups of throwers ($F=31.16$, $p<0.0001$). The percentage body fat was highest in shot putters. This was followed by discus throwers, hammer throwers and javelin throwers respectively. Post-hoc analysis revealed that shot putters had significantly greater percentage body fat as compared to hammer throwers and javelin throwers. In addition, hammer and discus throwers were also found to have significantly greater percentage body fat when compared to javelin throwers. Total body fat was also significantly different in the individuals of different groups of throwers ($F= 30.46$, $p<0.0001$). Shot putters had the highest total body fat and they were followed by discus throwers, hammer throwers and javelin throwers respectively. Post-hoc analysis revealed that javelin throwers showed significantly lower total body fat as compared to shot putters, hammer throwers and discus throwers. It was observed that hammer throwers had significantly lower total body fat when compared to shot putters and discus throwers. In relation to lean body mass significant difference was reported among the different groups of throwers ($F= 27.05$, $p<0.0001$). Shot putters had the highest lean body mass and they were followed by the discus throwers, hammer throwers and javelin throwers respectively. Post-hoc analysis showed that shot putter had significantly greater lean body mass when compared to hammer throwers and javelin throwers. Observations showed that discus throwers had significantly higher lean body mass than the Javelin and hammer throwers. Further, the hammer throwers were also found to have significantly greater lean body mass than those of javelin throwers. Endomorphic component was observed

significantly different in the individuals among the different groups of throwers (F=26.42, p<0.0001). The highest endomorphic component was in shot putters. This was followed by discus throwers, hammer throwers and javelin throwers respectively. The shot putters had significantly higher endomorphic component as compared to hammer throwers and javelin throwers whereas the hammer throwers were found to have significantly higher endomorphic components as compared to javelin throwers. Further, the discus throwers showed significantly higher endomorphic component than those of javelin throwers. In relation to mesomorphy, significant difference was reported among the different groups of throwers (F=14.44 p<0.0001). The shot putters had the highest mesomorphic component, and they were followed by hammer throwers, discus throwers and javelin throwers respectively. Post-hoc analysis showed that javelin throwers had significantly lower mesomorphic component when compared to shot putters, hammers throwers and discus throwers. Ectomorphy was significantly different in the individuals among the different groups of throwers (F=34.59, p<0.0001). The javelin throwers had the highest ectomorphic component and they were followed by discus throwers, hammer throwers and shot putters respectively. Post-hoc analysis revealed that the javelin throwers were found to have significantly higher ectomorphic component when compared to shot putters, hammer throwers and discus throwers.

Discussion

The results of the present study show that the different groups of throwers differed on body composition and somatotyping. Body composition is having a definite relationship with performance in different groups has come to the surface. Low level of fat percentage and greater lean body mass would achieve better performance since more the lean body mass the greater will be the energy output and strength production. Power-to-weight ratio is an important determinant of performance therefore maximizing muscle mass and maintaining low body fat levels is desirable for achieving high performance. The high percentage body fat might be detrimental for performance in sports as the additional body fat adds to the weight of the body without contributing to its force production or energy producing capabilities (Gaurav *et al.*, 2010) [6]. 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) [5]. The body mass is important in throwing events and high endomorphy and mesomorphy are assets to the throwers (Westlake, 1967) [27]. 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) [21, 9]. The hammer throwers have less percentage body fat and greater lean body mass. Hammer throwing is a field event, which requires the production of high muscular power. Human muscular power is determined by muscle fibre type, muscle strength and muscle mass (Morrow *et al.*, 1982; Terzis *et al.*, 2010) [17, 26]. The greater lean body mass among the hammer throwers is advantageous but is still less than those of reported in world class hammer throwers (Terzis *et al.*, 2010) [26]. The somatotype scores of hammer throwers are 4.6-5.0-0.7. The hammer throwers in present study are mesomorph-endomorph. These findings are not supported by other studies (Guimaraes and De Rose, 1980; Sharma and Shukla, 1988; Tanner, 1964) [9, 21, 25] which reported hammer throwers as more mesomorphic. The percentage body fat is greater and lean body mass is lower in javelin throwers as compared to javelin throwers studied by Kruger (2004) [14]. The somatotype scores of javelin throwers are 4.1-4.3-1.5. The javelin throwers in present study are mesomorph-endomorph. These findings are not in line with other studies Guimaraes and De Rose, 1980; Tanner, 1964; de Garry *et al.*, 1974; Sodhi, 1991) [9, 25, 24] which reported javelin throwers as more mesomorphic. The somatotype scores of discus throwers are 4.6-4.9-0.8. The discus throwers in present study are mesomorph-endomorph. The somatotyping scores of discus throwers in present study are in line with previous studies (de Garry *et al.*, 1974; Sharma and Shukla, 1988; Guimaraes and De Rose, 1980) [9, 21]. The javelin throwers had the highest ectomorphy component among the groups of throwers. The variation in the somatotyping components and body composition among different groups of throwers might be attributed to varying demands of different throwing events.

Conclusion

In conclusion, it was found that the significant differences were existed among the different groups of throwers with regard to skinfold thicknesses, body composition and somatotyping. The shot putters had the highest skinfold thicknesses, percent body fat and total body fat among the throwers. Discus throwers and shot putters were found to have higher lean body mass, endomorphy and mesomorphy than the javelin throwers and hammer throwers. The javelin throwers had the highest ectomorphy component among the groups of throwers.

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