



RELATIONSHIP BETWEEN THE ANTHROPOMETRIC VARIABLES AND THROWING SKILL IN MALE SOFTBALL PLAYERS

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Abstract:

The aim of the present study was to assess the relationship between the anthropometric variables and throwing skill in among male softball players. Total 150 male university and national level softball players of different universities and states of India were selected thorough purposive sampling technique. The age of subjects ranged between 18 to 30 years. Body weight of the subjects was measured with a portable weighing machine. Height measurements were taken using the standard anthropometric rod. Body mass index was then calculated using the formula $\text{weight (kg)}/\text{height}^2 \text{ (m)}$. The circumferences of body parts were measured with the help of flexible steel tape. The diameters of the body parts were assessed with sliding caliper. The skinfolds thicknesses of body parts of the subjects were taken with Harpenden skinfold caliper. Percentage body fat as estimated from the sum of skinfolds was calculated using standardized equations. Throwing skill of the players was assessed as given in the AAHPERD softball skill test battery. Karl Pearson's product moment co-efficient of correlation was computed to assess the relationship between anthropometric characteristics and throwing skill test of softball among the softball players. The result of the study shows that height ($p=0.026$), weight ($p=0.008$), total arm length ($p=0.001$), the upper arm length ($p=0.018$) and lower arm length ($p=0.007$) had significant

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relationship with the throwing skill in softball. The throwing skill was significantly associated with the upper arm circumference ($r=0.265$, $p=0.001$), biacromial ($p=0.007$) and bicondylar humerus ($p=0.009$) diameters. Lean body mass ($p=0.000$) was also found to be significantly associated with the throwing skill test in the male softball players.

Keywords: anthropometric variables, throwing skill, softball

1. Introduction

Anthropometry is the branch of the human sciences that deals with body measurements: particularly with measurements of body size, shape, strength and working capacity¹. Anthropometry is the longest-used measure of human variation². Anthropometry plays an important role in athlete selection and performance criteria in sports³ and may indicate whether a player would be suitable to participate at the highest level in a specific sport⁴. Success in sports is directly related to athlete's anthropometric characteristics of the same sport⁵.

Softball is a direct descendant of baseball⁶. Softball is a ball and bat game that has batting, fielding, catching, pitching and throwing as its fundamental skills. In softball, the sport-specific skill of throwing velocity is key component to being successful on the field⁷. Anthropometric variables especially of upper body contributed crucially in the throwing ability of the sportsperson. According to Ferragut et al.⁸ there was a relationship between anthropometric characteristics and throwing velocity. Till et al.⁷ also suggested the association between softball throwing ability and anthropometric variables such as height.

Studies on many other games indicated the relationship between anthropometric variables and throwing ability. Mathavan⁹ indicated that forearm girth influenced the throwing ability of handball players, whereas, arm length was not associated with the throwing skills in handball. According to Skoufas et al.¹⁰ throwing ability in handball was related to the total arm length and hand width of the players. Additionally handball throwing ability was not correlated with the height, arm and forearm length. Zapartidis et al.¹¹ Investigated the relationship between anthropometric and handball throwing ability of adolescent handball players and found that handball throwing velocity was associated with anthropometric variables. Higher correlation was reported between handgrip strength and ball velocity. Throwing ability of the adolescent handball players were moderately correlated with hand length, arm span and body height. Vila et al.¹² founded association of the throwing velocity of water polo

goalkeepers with the anthropometric variables such as arm circumference, biacromial breadth and femur breadth.

Many studies suggested the relationship between the anthropometric variables and throwing skill of the players of different games. But very few studies were conducted on the throwing skill in the softball therefore the present study was undertaken with the aim to assess the relationship between different anthropometric variables and the throwing skill of the softball players.

2. Methodology

The subjects of the present study were purposively selected from the university level and national level male softball players. 150 male softball players, aged 18 to 30 years, of different universities and states of India were selected to participate in the study. Body weight of the subjects was measured with a portable weighing machine to the nearest 0.5 kg. Height measurements were taken using the standard anthropometric rod to the nearest 0.5 cm (HG-72, Nexgen ergonomics, Canada). Body mass index was then calculated using the formula $\text{weight (kg)}/\text{height}^2 \text{ (m)}$. The circumferences of body parts were measured with the help of flexible steel tape. The diameters of the body parts were assessed with sliding caliper. The skinfolds thicknesses of body parts of the subjects were taken with Harpenden skinfold caliper.

2.1 Body Composition

Percentage body fat as estimated from the sum of skinfolds was calculated using equations of Siri¹³ and Durnin and Womersley¹⁴. 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 following:

17 to 19 years age group

$$\text{Body Density (gm/cc)} = 1.1620 - 0.0630 (X)$$

20 to 29 years age group:

$$\text{Body Density (gm/cc)} = 1.1631 - 0.0632 (X)$$

Where

$$X = \log (\text{biceps} + \text{triceps} + \text{subscapular} + \text{suprailliac}).$$

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

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

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

2.2 Throwing Test

Throwing skill of the players was assessed as given in the AAHPERD¹⁵ softball skill test battery edited by Dr. Roberta Rikli. This test assesses the skill in the overhand ball throw by measuring distance and placement of ball. Concurrent validity has been reported by finding the correlation coefficient between the test scores and judges' rating. The validity correlation coefficient ranged from 0.64 to 0.94. The test-retest reliability coefficient from intra-class repeated scores ranged from 0.90 to 0.97. For this test a perpendicular line was marked from a restraining line as shown in fig. 3.4. In this test the subject was required to throw the ball as far and as straight as possible, along the throwing line. The ball was released after taking few steps and released before the restraining line. Each subject was given two trials. The better of two trials was the final score.

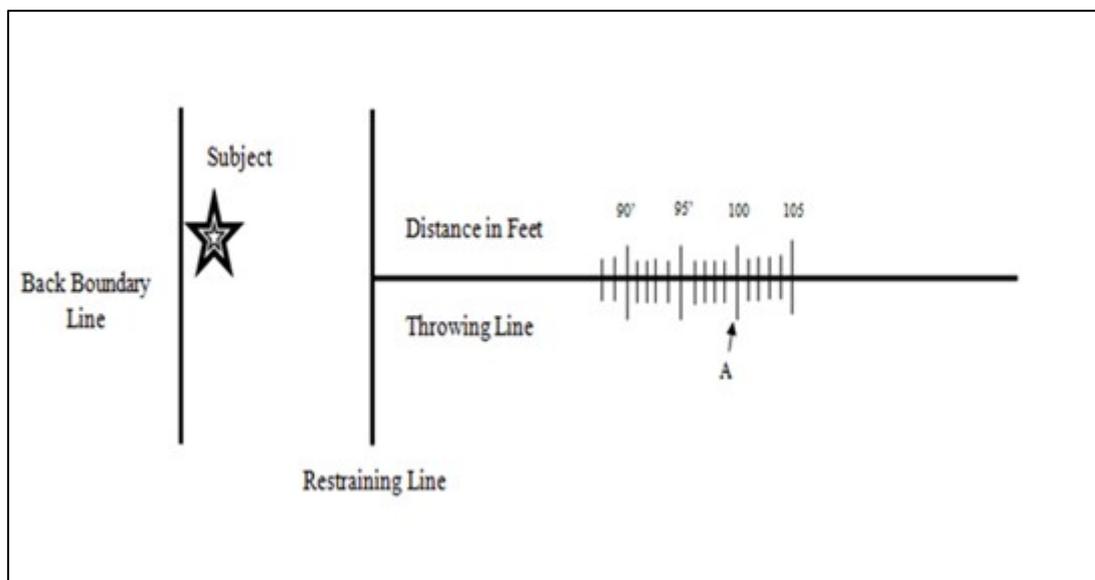


Figure 1: Field marking for overhand throwing test

2.3 Statistical Analysis

Statistical analysis was performed using SPSS version 16.0 for windows (SPSS Inc, Chicago, IL, USA). Karl Pearson's product moment co-efficient of correlation was computed to assess the relationship between anthropometric characteristics and throwing skill test of softball among the softball players. Significance levels were set at $p < 0.05$.

3. Results

Table 1: Relationship of age, height, weight and body mass index with the throwing skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Age (yrs)	150	0.104	0.208
Height (cm)	150	0.182	0.026*
Weight (kg)	150	0.217	0.008*
Body Mass Index (kg/m ²)	150	0.112	0.138

* Indicates $p < 0.05$

The table 1 presents the correlation analyses of age, height, weight and body mass index with throwing skill test in the university and national level male softball players. The results of correlation analyses revealed a significant positive association of height ($r=0.182$, $p=0.026$) with the throwing skill test. The weight of softball players also showed a significant relationship ($r=0.217$, $p=0.008$) with throwing skill test among the male softball players. The age and body mass index of male softball players did not show significant association with the throwing skill test.

Table 2: Relationship of the length measurements of the body parts with the throwing skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Total Arm Length (cm)	150	0.271	0.001*
Upper Arm Length (cm)	150	0.193	0.018*
Lower Arm Length (cm)	150	0.221	0.007*
Total Leg Length (cm)	150	0.061	0.455
Upper Leg Length (cm)	150	0.037	0.654
Lower Leg Length (cm)	150	0.082	0.319

* Indicates $p < 0.05$

The table 2 depicts correlation analyses of various length measurements of body parts with throwing skill test of the male softball players. The results of correlation analyses revealed a significant association of throwing skill test with total arm length ($r=0.271$, $p=0.001$), the upper arm length ($r=0.193$, $p=0.018$) and lower arm length ($r=0.221$, $p=0.007$). On the other hand, total leg, upper leg and lower leg lengths did not demonstrate significant relationship with throwing skill test among male softball players.

Table 3: Relationship of the circumferences of the body parts with the throwing skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Upper Arm Circumference (cm)	150	0.265	0.001*
Forearm Circumference (cm)	150	0.317	0.000
Chest Circumference (cm)	150	0.159	0.052
Thigh Circumference (cm)	150	-0.027	0.728
Calf Circumference (cm)	150	0.096	0.244

* Indicates $p < 0.05$

The correlation analyses of the various circumferences of body parts with the throwing skill test of the male softball players are presented in table 3. The throwing skill was observed to be significantly associated with the upper arm circumference ($r=0.265$, $p=0.001$). On the other hand, forearm, chest, thigh and calf circumferences showed no significant association with the throwing skill test among the male softball players.

Table 4: Relationship of the diameters of the body parts with the throwing skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Biacromial Diameter (cm)	150	0.220	0.007*
Bicondylar Humerus Diameter (cm)	150	0.213	0.009*
Wrist Diameter (cm)	150	-0.034	0.683
Bicondylar Femur Diameter (cm)	150	0.124	0.131

* Indicates $p < 0.05$

The correlation analyses of the diameters of various body parts with throwing skill test of the male softball players are presented in the table 4. The biacromial ($r=0.220$, $p=0.007$) and the bicondylar humerus ($r=0.213$, $p=0.009$) diameters were observed to be significantly associated to the throwing skill test in male softball players. On the other hand, the wrist and bicondylar femur diameters did not demonstrate significant relationship with throwing skill test among the male softball players.

Table 5: Relationship of the skinfold thicknesses of the body parts with the throwing skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Biceps (mm)	150	-0.140	0.088
Triceps (mm)	150	-0.137	0.094
Subscapular (mm)	150	-0.105	0.202
Supra-iliac (mm)	150	-0.114	0.165
Calf (mm)	150	-0.090	0.272

The correlation analyses of skinfold thickness of various parts of body with the throwing skill test of the male softball players are presented in table 5. However, no significant association of the skinfold thicknesses of the body parts viz. biceps, triceps, subscapular, supra-iliac and calf with the throwing skill test was observed among the male softball players.

Table 6: Relationship of the components of body composition with the throwing skill test in male softball players

Variables	N	Pearson Correlation Coefficient (r)	Sig. (2-tailed)
Percent Body Fat (%)	150	-0.137	0.095
Total Body Fat (kg)	150	-0.011	0.892
Lean Body Mass (kg)	150	0.331	0.000*

* Indicates $p < 0.05$

Table 6 presents the correlation analyses between the various components of body composition and the throwing skill of the male softball players. Among the body composition components, only lean body mass ($r=0.331$, $p=0.000$) was observed to be significantly associated with the throwing skill test in the male softball players. The throwing skill test did not demonstrate significant association with percent body fat and total body fat among the male softball players.

4. Discussion

The correlation analyses revealed a significant association of height and weight with the throwing skill test among the male softball players. It was also observed that the upper limb lengths in male players were significantly associated with the throwing skill test. The greater height and longer limbs among softball players provide them mechanical advantage as the distance achieved by the throw is also a function of height of release and due to the longer bones, longer levers are capable of producing more work^{16, 17, 18}. The greater height and limb lengths in their case provide advantage by making the flight of the ball longer before it touches the ground¹⁹. The range of motion is increased due to the longer arm length and it may generate more force during the swinging phase in throwing movement. This might be the reason for a relationship of height and limb lengths with the throwing skill test among the softball players. Till *et al.*⁷ studied the NCAA Division-I female softball players and reported the relationship between height and throwing velocity. The greater amount of strength is required to throw the ball longer distance and the strength is relative to body mass²⁰. This might be the reason that the body weight of softball players showed significant association with the throwing

skill test. Lehman *et al.*²¹ studied the college level baseball players and found the relationship between body weight and baseball throwing velocity.

The upper arm circumference, biacromial and bicondylar humerus diameters of the male softball players showed a significant relationship with throwing skill test. The higher circumferences and diameters of body parts may indicate the better growth and development of the softball players. The higher growth and development of arm and shoulder region is indispensable for greater strength in the upper limbs and it may be an important factor for throwing the ball for longer distance. The greater arm circumferences (forearm and upper arm) may be an advantageous factor in throwing skill in softball as the circumference of a body segment is used as an indication of muscle mass cross sectional area²². Thus it can be considered that the higher arm circumference of the softball players is an indicator of higher muscle mass cross-sectional area and consequently of higher power and force output for these segments.

The skinfold thicknesses and percent body fat did not demonstrate a significant association with throwing skill among softball players. The high amount of fat mass and lack of muscle mass among the players may have a negative effect on the performance as it reduces the force production capacity. The lean body mass demonstrated a significant correlation with throwing skill test among male softball players. Many studies showed that the lean body mass has significant association to success in sport^{23, 24, 25}. In softball, large amount of strength is required to throw the ball for longer distance and strength is produced by the forceful contraction of muscles in the body. Therefore, the greater muscle mass in the body will generate more force and consequently greater amount of strength. The greater muscular make-up of the players would be advantageous in throwing the ball²⁶.

5. Conclusion

On the basis of the results of the study, it was concluded that anthropometric variables such as height, weight, total arm length, upper arm length, lower arm length, upper arm circumference, biacromial and bicondylar humerus diameter, and lean body mass were associated with the throwing skill in the male softball players.

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