

Research Paper :

## Study on differences in ponderal index, hip widths-stature index and shoulder widths-stature index of elite male Indian throwers of different throwing events

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### ABSTRACT

The purpose of the study was to compare the body proportionality of Indian elite male throwers. The data from 25 subjects each of shot put, discus, javelin and hammer throws was collected from national and international tournaments, India Camp, SAI and State hostels. The variables of the study were Ponderal index, hip breadth- stature index and shoulder breadth- stature index. Analysis of variance (ANOVA) was used to find out the significant difference in the said variables of the study among four types of throwers. Where significant differences were observed, the L.S.D. test was used to compare mean difference. The results of the analysis had shown that javelin throwers were having greater mean Ponderal index than other three groups. Hammer throwers were having greater shoulder breadth- stature index than other three groups and shot putters having greater mean hip width- stature index of all.

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**Key words :** Ponderal index, Hip breadth, Stature index and shoulder breadth, Stature index

In ancient time throws were used in hunting and warfare. In modern time throws are used for achieving awards or medals in national and international level competitions. The "throws" (shot put, discus, javelin, and hammer) are field events in athletics. They are measures for explosive strength (power) in a human being from ancient time to modern time (Behke and Royce, 1996). The throwers of shot put, discus, javelin and hammer differ greatly in physique from the other athletes (Carter, 1970, 1986). As a group, they are taller and heavier, with longer arms in relation to their legs. They had broader shoulders and broader hips even for their trunk size, and are somewhat fatter than the track athletes. Their proportions of leg to the trunk is similar to those of middle distance runners.

The relationship of length to breadth, height to thickness, length-to-length etc. of various parts of body represents proportions (Johnston, 1982). This importance of proportion becomes evident, when we want to compare particular body parts of two persons who are otherwise different in over all size. The proportions or ratio keeps one measurement constant in all subjects compared and evaluate the differences in the other measurements. The body proportion can be studied in various ways, but indices method is best for determining body proportions (McLean and Parker, 1989).

The purpose of this research work was to assess the differences existing in various segmental proportions of Indian elite male shot put, discus, javelin and hammer throwers.

### METHODOLOGY

For the purpose of this study, 25 elite male throwers for each javelin, shot put, discus and hammer throws were selected from various national and international tournaments, State and SAI hostels and India camp.

#### Anthropometrical measurement from 25 elite male shot putters were collected from:

- Eight shot putters from All India Police Athletic Championship, Kolkata date. 20-11-2004
- Two shot putters from SAI Hostel Kolkata, dated- 23-11-2004.
- Five shot putters from Delhi SAI Hostel, dated 11-03-2005.
- Two shot putters from SAI Hostel Patiala, dated 27-01-2005.
- Three shot putters from India Camp, dated- 05-02-2005.
- Two shot putters from State Hostel Allahabad, dated-27-12-2004.
- One shot putter from Indo-Pak Punjab Competition, dated -18-02-2005.
- Two shot putters from State Hostel Lucknow, dated- 30-12-2004.

#### Anthropometrical measurement from 25 elite male discus thrower were collected from:

- Seven discus throwers from All India Police Athletic Championship, Kolkata, dated- 20-11-2004

- Two discus throwers from SAI Hostel Kolkata, dated -23-11-2004.
- Five discus throwers from Delhi SAI Hostel, dated 11-03-2005.
- Three discus throwers from SAI Hostel Patiala, dated 27-01-2005.
- Four discus throwers from India Camp, dated-05-02-2005.
- Two discus throwers from State Hostel Allahabad, dated-27-12-2004.
- One discus thrower from State Hostel Lucknow, dated- 30-12-2004.
- One discus thrower from Indo-Pak Punjab Competition, dated-18-02-2005.

**Anthropometrical measurement from 25 elite male javelin thrower were collected from:**

- Eight javelin throwers from All India Police Athletic Championship, Kolkata, dated- 20-11-2004
- Three javelin throwers from SAI Hostel Kolkata, dated -23-11-2004.
- Three javelin throwers from Delhi SAI Hostel, dated 11-03-2005
- Four javelin throwers from SAI Hostel Patiala, dated 27-01-2005.
- Three javelin throwers from India Camp, dated-05-02-2005.
- Two javelin throwers from State Hostel Allahabad, dated-27-12-2004.
- Two javelin throwers from State Hostel Lucknow, dated- 30-12-2004.

**Anthropometrical measurement from 25 elite male hammer thrower were collected from:**

- Seven hammer throwers from All India Police Athletic Championship, Kolkata, dated- 20-11-2004
- One hammer thrower from SAI Hostel Kolkata, dated -23-11-2004.
- Three hammer throwers from Delhi SAI Hostel, dated 11-03-2005.
- Three hammer throwers from SAI Hostel Patiala, dated 27-01-2005.
- Three hammer throwers from India camp, dated-05-02-2005.
- Six hammer throwers from State Hostel Allahabad, dated-27-12-2004.
- One hammer thrower from State Hostel Lucknow, dated- 30-12-2004.
- One hammer thrower from Indo-Pak Punjab Competition, dated -18-02-2005.

The selected subjects belonged to the 16 states of

India, namely, U.P, Punjab, Haryana, Delhi, Bihar, Chhatisgarh, Jharkhand, Karnataka, Kerala, M.P, Maharashtra Uttarakhand, J&K, West Bengal, Andhra Pradesh and Tamil Nadu.

**Collection of data :**

The data in the form of ratios were the criterion measure of the study, it was derived through the following methods-

**Proportionalities:**

The following indices were used to determine various body segmental proportionality

$$\text{Ponderal index} = \frac{\text{Stature}}{3\sqrt{\text{Weight}}}$$

$$\text{Hip width - Stature index} = \frac{\text{Hip width}}{\text{Stature}} \times 100$$

$$\text{Shoulder width - Stature index} = \frac{\text{Shoulder width}}{\text{Stature}} \times 100$$

**Statistical procedure :**

Reiterating the objective of the study, it was intend to investigate the body proportionality differences among four types of throwers. Thus, analysis of variance was used to find out the significant differences among the four types of throwers. Where the difference was significant L.S.D. was used test to analyse, which groups mean was greater than other. The significance of difference among four groups of throwers was tested at 0.05 level of significance.

**OBSERVATIONS AND DISCUSSION**

Since calculated F value was greater than tabulated F value, it was conclude that significant difference was existing in the mean ponderal index of shot put, discus, javelin and hammer throwers (Table 1). To further find out which group was having greater mean, Ponderal index, pair wise mean analysis were done through LSD test.

| Table 1 : Ponderal index  |        |                     |          |         |
|---------------------------|--------|---------------------|----------|---------|
| Source of variation       | d.f.   | SS                  | Mss      | F-value |
| Treatment                 | r-1=3  | 94.69117            | 31.56372 |         |
| Error                     | N-r=96 | 178.3104            | 1.8574   | 16.9935 |
| Significance 0.05 level , |        | Tab F (3, 96) =2.70 |          |         |

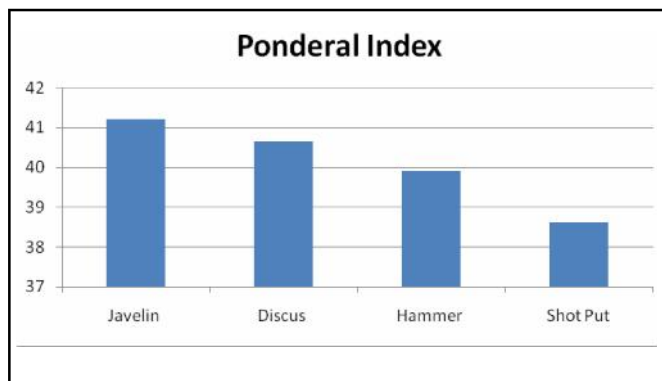
Comparing the pair wise mean difference with critical difference (Table 2) it was concluded that mean ponderal index of javelin throwers was significantly greater than

**Table 2 : Treatment means arranged in order of magnitude**

| Throwing groups |        |        |          | Mean difference | C.D. (P=0.05) |
|-----------------|--------|--------|----------|-----------------|---------------|
| Javelin         | Discus | Hammer | Shot put |                 |               |
| 41.22           | 40.65  |        |          | 0.57            |               |
| 41.22           |        | 39.91  |          | 1.31            | 0.15          |
| 41.22           |        |        | 38.62    | 2.6             |               |
|                 | 40.65  | 39.91  |          | 0.74            |               |
|                 |        | 39.91  | 38.62    | 1.29            |               |
|                 | 40.65  |        | 38.62    | 2.03            |               |

\* indicates significance of value at P=0.05

mean ponderal index of discus thrower, hammer thrower and shot putter. Further mean ponderal index of discus thrower was also significantly greater than mean ponderal index of hammer thrower and shot putter and mean ponderal index of Shot putter was significantly the least from all the three groups (Fig.1 ).



**Fig. 1 :** The mean ponderal index (in cm.) of throwers (shot putter, discus thrower, javelin thrower and hammer thrower)

Since calculated F value was greater than tabulated F value, the hypothesis was accepted and was conclude that significant difference was existing in the mean hip breadth-stature index of shot put, discus, javelin and hammer throwers. To further, find out which group was having greater mean hip breadth-stature index, pair wise mean analysis was done through LSD test.

**Table 3 : Hip breadth-stature index**

| Source of variation | d.f.   | SS       | Mss      | F-value  |
|---------------------|--------|----------|----------|----------|
| Treatment           | r-1=3  | 130.4026 | 43.46753 |          |
| Error               | N-r=96 | 240.2188 | 2.502279 | 17.37118 |

Significance 0.05 level Tab F (3, 96) =2.70

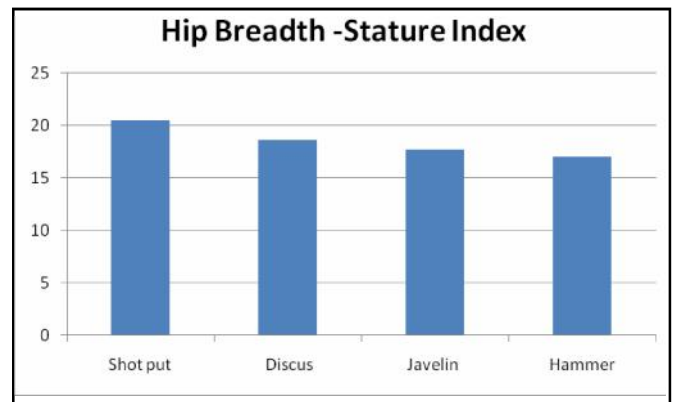
Comparing the pair wise mean difference with critical difference it was concluded that mean hip breadth-Stature index of shot putter was significantly greater than mean

hip breadth-Stature index of discus, javelin and hammer throwers (Table 4). Further, mean hip breadth-Stature index of discus was also significantly greater than mean hip breadth-Stature index of javelin and hammer throwers, and mean hip breadth-Stature index of hammer thrower was significantly the least from all the three groups (Fig. 2).

**Table 4 : Treatment means arranged in order of magnitude**

| Throwing groups |        |         |        | Mean difference | C.D. (P=0.05) |
|-----------------|--------|---------|--------|-----------------|---------------|
| Shot put        | Discus | Javelin | Hammer |                 |               |
| 20.5            | 18.68  |         |        | 1.82            |               |
| 20.5            |        |         | 17.7   | 2.8             | 0.18          |
| 20.5            |        | 17.72   |        | 2.78            |               |
|                 | 18.68  |         | 17.7   | 0.98            |               |
|                 | 18.68  | 17.72   |        | 0.96            |               |
|                 |        | 17.72   | 17.7   | 0.02            |               |

\* indicates significance of value at P=0.05



**Fig. 2 :** The mean hip breadth-stature index (in cm.) of throwers (shot putter, discus thrower, javelin thrower and hammer throwers)

Since calculated F value was greater than tabulated F value, it was concluded that significant difference was existing in the mean shoulder breadth-stature index of shot put, discus, javelin and hammer throwers (Table 5). To further find out which group was having greater mean shoulder breadth-stature index, pair wise means analysis was done through LSD test.

**Table 5 : Shoulder breadth-stature index**

| Source of variation | d.f.   | SS       | Mss      | F-value  |
|---------------------|--------|----------|----------|----------|
| Treatment           | r-1=3  | 34.64613 | 11.54871 |          |
| Error               | N-r=96 | 202.8982 | 2.113523 | 5.464199 |

Significance 0.05 level Tab F (3, 96) =2.70

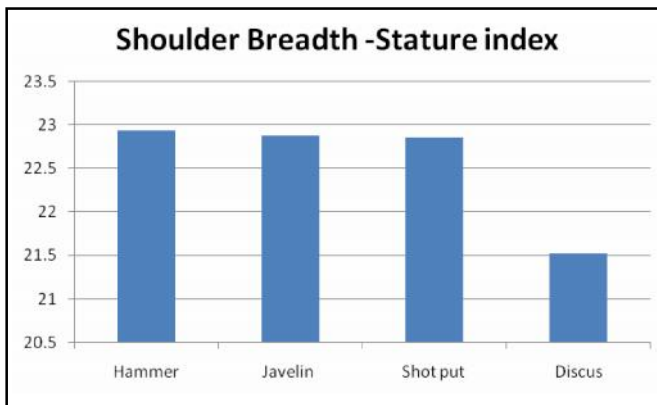
Comparing the pair wise mean difference with critical difference (Table 6), it was concluded that mean shoulder

**Table 6 : Treatment means arranged in order of magnitude**

| Throwing groups |         |          |        | Mean difference | C.D. (P=0.05) |
|-----------------|---------|----------|--------|-----------------|---------------|
| Hammer          | Javelin | Shot put | Discus |                 |               |
| 22.94           | 22.89   |          |        | 0.05            |               |
|                 |         | 22.86    | 21.53  | 1.33            | 0.163         |
| 22.94           |         | 22.86    |        | 0.08            |               |
| 22.94           |         |          | 21.53  | 1.41            |               |
|                 | 22.89   | 22.86    |        | 0.03            |               |
|                 | 22.89   |          | 21.53  | 1.36            |               |

\*indicates significance of value at P=0.05

breadth-stature index of hammer thrower was significantly greater than mean shoulder breadth-stature index of javelin, shot put and discus throwers. Further, mean shoulder breadth-stature index of javelin thrower was also significantly greater than mean shoulder breadth-stature index of shot put and discus throwers and mean shoulder breadth-stature index of discus thrower was significantly the least from all the three groups (Fig. 3).



**Fig. 3 :** The mean shoulder breadth –stature index (in cm.) throwers (shot putter, discus thrower, javelin thrower, and hammer throwers)

**Ponderal index:**

Comparing the pair wise mean difference with critical difference, it was concluded that mean ponderal index of javelin throwers was significantly greater than mean ponderal index of discus, hammer and shot putter. Further mean ponderal index of discus thrower was significantly greater than mean ponderal index of hammer throwers and shot putter and mean ponderal index of shot putter was significantly the least from all the three groups.

Shot putters use linear application of force where as hammer and discus throwers use centrifugal force to propel their respective implements. Getting more stability compensate lesser height/weight of hammer and discus thrower. Greater stability helps in speedy turning movement resulting in the development of greater

centrifugal force. Javelin is the lighter of all the four implements, it moves under the principles of aerodynamics, a powerful natural jerk of shoulder is necessary to execute the throw to maximum distance. Therefore, effective technique and powerful natural shoulder jerk compensate requirement of height/weight.

**Hip width –Stature index:**

Comparing the pair wise mean difference with critical difference it was concluded that mean hip breadth-stature index of shot putter was significantly greater than mean hip breadth-stature index of discus, javelin and hammer throwers. Further mean hip breadth-stature index of discus was also significantly greater than mean hip breadth-stature index of javelin and hammer throwers, and mean hip breadth-stature index of hammer thrower was significantly the least from all the three groups.

Shot putter needs greater hip breadth-stature index for putting the shot to maximum distance. Greater hip and shoulder breadth signifies greater bone surface and muscular mass, which gives greater stability and power, greater stability gives more resistance to counteract opposite reactionary force of shot.

Hammer throwers also need greater weight for counteracting centrifugal force while taking turn. Shot putters use linear application of force to propel the shot where as hammer thrower use centrifugal force. Therefore, the requirement of hip breadth-stature index for shot putter is greater than hammer thrower.

In discus throw, principles of aerodynamics are used. Discus throwers have lesser hip breadth-stature index in comparison to shot putters and hammer throwers. Discus thrower requires greater speed during turning movement to create greater centrifugal force. Therefore, the requirement of hip breadth-stature index for discus thrower was lesser than shot putter and hammer thrower.

Javelin also moves under the principles of aerodynamics. Javelin throwers need greater power to execute the throw to maximum distance. They need a

natural shoulder jerk. Therefore their hip breadth and stature index was the lesser of all the throwers.

#### **Shoulder breadth-Stature index:**

Comparing the pair wise mean difference with critical difference it was concluded that mean shoulder breadth-stature index of hammer thrower was significantly greater than mean shoulder breadth-stature index of javelin thrower, shot putter and discus thrower. Further, mean shoulder breadth-stature index of javelin throwers was also significantly greater than mean shoulder breadth-stature index of shot putter and discus thrower and mean shoulder breadth-stature index of discus thrower was significantly the least from all the three groups.

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