Chapter -v

Summary, Conclusion
and
Recommendation
SUMMARY, CONCLUSION AND RECOMMENDATION

The human physique differs in a thousand ways. It can be analyzed by studying the size, shape and proportion form of an individual. For this purpose, a set of selected anthropometrics measurements are taken on an individual. The inter group comparisons are made to understand the physical peculiarities of a population. From such body measurements, it is also possible to estimate the distribution of fat and development of bone and muscle in one’s body. This is known to be more important in the case of athletes and sportsmen where the physical fitness plays a vital role in the competitive performance.

Mc Ardle et al. pointed out that athlete generally have physique characteristics unique to their specific sports. For example field events athletes have relatively large quantities of lean tissues and a high percentage of body fat where as long distance runners have the least amount of lean tissue and fat mass.

Sports sciences have a long history of studying physique. Sheldon et at. Used photoscopic and anthropometric methods to describe individual physique as three different Somatotype viz; (i) Endomorphy (fatty: predominance of digestive organs, softness and roundness of contour throughout the body), (ii) Mesomorphy (muscular: predominance of muscles, bones and connective tissues) and (iii) Ectomorphy (predominance of surface area over body mass linearity). This method has basic shortcoming i.e., it does not quantify the various body dimensions, indices and ratios. The body profile
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technique of Mc Ardle et al. Describes physique in terms of muscular and non muscular components. The diversity in overall body dimensions can be compared among individuals or groups from that of reference man and reference woman.

Track and field consists of running, hurdling, jumping, and throwing events held between individuals and teams at indoor and outdoor meets. The running and hurdling competitions make up the track events, while the jumping and throwing contests comprise the field events. In many countries the sport as a whole is called Athletics. The throws (Shot put, Discus, Javelin, and Hammer) are field events in athletics. They are measure for explosive strength (power) in a human being from ancient time to modern time. The throwers of Shot put, Discus, Javelin and Hammer differed greatly in physique from the other athletes. 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 were somewhat fatter than the track athletes. Their proportions of legs to the trunk were similar to those of middle distance runners. 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 greater size of the throwers in all dimensions contributes to increase the proportionally body weight of these athletes. The stresses of weight bearing in the case of throwers may be responsible for broadening their knee. The better development of the lean body mass will help them to provide the great strength required in the throwing events.
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For the purpose of this study 25 elite male throwers of each Javelin, Shot put, Discus and Hammer throw were selected from various National and Inter-National tournaments, State and SAI hostels and India camp.

The selected subjects belonged to the 15 states of India. Namely - U.P, Punjab, Haryana, Delhi, Bihar, Chhattisgarh, Jharkhand, Karnataka, Kerala, M.P, Maharashtra, Uttarakhand, J & K, West Bengal, Andhra Pradesh, Tamil Nadu.

The criterion measures for this study were-

Weight – Kilogram, Anthropometrical parameters - Centimeter and mm., Proportionality (indices) – Ratios, Somatotype - Grading., Body compassion- (%).

The study was delimited to the following anthropometrical parameters

Weight, Height, Sitting Height, Femur Biepicondylar diameter, Humerus Biepicondylar Diameter, Hip Breadth, Shoulder Breadth, Total age, Total Arm Length, Wrist Breadth, Training age, Biceps Muscle Girth, Calf Muscle Girth, Thigh Length, Forearm muscles girth, Chest girth, Chest depth, Total leg length, Lower leg length, Upper leg length, Lower arm length, Upper leg length, Triceps skin fold, Suprailiac skin fold, Sub-scapular skin fold, Thigh skin fold, Body composition, Foot length.

Somatotype: Heath and Carter Method, 1984

Body proportionality: 1) Sitting height - stature index, 2) ponderal index, 3) Thigh length - lower leg length index, 4) Upper arm length - lower arm length index, 5) Hip breadth - stature index, 6) Shoulder breadth - stature index.
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Product moment correlation technique, analysis of variance and LSD test were used to find out the significant differences and relationship among above mentioned delimited variable of different groups of throwers, and their performances.

The statistical analysis revealed significant differences among the following variable of different throwers, the results of LSD test in descending order are presented below:

1) **Weight** - shot put < discus < hammer < javelin,
2) **Height** - discus < shot put < javelin < hammer,
3) **Femur Biepicondylar diameter** - shot put < discus < hammer < Javelin,
4) **Humerus Biepicondylar Diameter** – shot put < discus < javelin < hammer,
5) **Hip Breadth** - shot put < discus < javelin < hammer,
6) **Shoulder Breadth** - shot put < javelin < hammer < discus,
7) **Total Arm Length** - javelin < discus < shot put < hammer,
8) **Wrist Breadth** - shot put < javelin < discus < hammer,
9) **Skin Fold** - shot put < hammer < discus < javelin,
10) **Biceps Muscle Girth** - shot put < discus < hammer < javelin,
11) **Calf Muscle Girth** - shot put < discus < hammer < javelin
12) **Thigh Length** - shot put < discus < javelin < hammer,
13) **Forearm muscles girth** - discus < shot put < hammer < javelin,
14) **Chest girth** - shot put < hammer < discus < javelin,
15) **Chest depth** - shot put < discus < hammer < javelin,
16) **Total leg length** - discus < hammer < javelin < shot put,
17) **Endomorphy** - Shot put < Hammer < Discus < Javelin,
18) **Mesomorphy** - shot put < discus < javelin < hammer,
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19) **Ectomorphy** - javelin < discus < hammer < shot put,

20) **Ponderal Index** - javelin < discus < hammer < shot put,

21) **Upper arm length -lower arm length** - shot put < javelin < hammer < discus,

22) **Hip breadth-Statute index** - shot put < discus < javelin < hammer,

23) **Shoulder breadth-Statute index** - hammer < javelin < shot put < discus.

24) **FAT %** - Shot put < discus < javelin < Hammer

The statistical analysis revealed insignificant differences among the following variable of Shot put, Discus, Javelin and Hammer throwers:

1) **Total age**

2) **Sitting height**

3) **Foot length**

4) **Sitting height –statue index**

5) **Thigh length –lower leg length index**

Further correlation ship between variables of different groups of throwers and their performance was find out through product moment correlation technique. The inter group comparison of correlation between selected variables of different groups and their performances is given in table -168.
### TABLE -168

**INTER GROUP COMPARISONS OF CORRELATION**

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>SP</th>
<th>DT</th>
<th>JT</th>
<th>HT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total age &amp; total training</td>
<td>0.38</td>
<td>0.19</td>
<td>0.07</td>
<td>0.55</td>
</tr>
<tr>
<td>Height-</td>
<td>0.31</td>
<td>-0.13</td>
<td>0.15</td>
<td>0.26</td>
</tr>
<tr>
<td>Weight</td>
<td>0.72</td>
<td>0.51</td>
<td>-0.33</td>
<td>0.23</td>
</tr>
<tr>
<td>Sitting height</td>
<td>0.09</td>
<td>0.45</td>
<td>-0.08</td>
<td>0.6</td>
</tr>
<tr>
<td>Chest girth &amp; depth</td>
<td>0.45</td>
<td>-0.33</td>
<td>0.4</td>
<td>0.19</td>
</tr>
<tr>
<td>Humerus &amp; femur-biepicondylar</td>
<td>0.75</td>
<td>0.74</td>
<td>-0.19</td>
<td>0.28</td>
</tr>
<tr>
<td>Wrist &amp; Ankle breadth</td>
<td>0.66</td>
<td>-0.29</td>
<td>-0.15</td>
<td>0.17</td>
</tr>
<tr>
<td>Hip &amp; Shoulder breadth</td>
<td>0.12</td>
<td>-0.14</td>
<td>0.05</td>
<td>0.17</td>
</tr>
<tr>
<td>Upper arm length</td>
<td>0.57</td>
<td>-0.22</td>
<td>-0.29</td>
<td>0.23</td>
</tr>
<tr>
<td>Lower arm length</td>
<td>0.26</td>
<td>0.04</td>
<td>-0.39</td>
<td>0.06</td>
</tr>
<tr>
<td>Total arm length</td>
<td>0.76</td>
<td>0.1</td>
<td>-0.03</td>
<td>0.83</td>
</tr>
<tr>
<td>Upper leg length</td>
<td>0.49</td>
<td>-0.38</td>
<td>0.23</td>
<td>0.12</td>
</tr>
<tr>
<td>Lower leg length</td>
<td>0.37</td>
<td>-0.32</td>
<td>0.46</td>
<td>0.02</td>
</tr>
<tr>
<td>Total leg length</td>
<td>0.08</td>
<td>0.05</td>
<td>0.26</td>
<td>0.31</td>
</tr>
<tr>
<td>Muscles girths</td>
<td>0.87</td>
<td>-0.33</td>
<td>0.32</td>
<td>0.09</td>
</tr>
<tr>
<td>Skin folds</td>
<td>0.55</td>
<td>0.08</td>
<td>0.06</td>
<td>0.22</td>
</tr>
<tr>
<td>Endomorphy</td>
<td>0.43</td>
<td>0.11</td>
<td>0.06</td>
<td>0.15</td>
</tr>
<tr>
<td>Mesomorphy</td>
<td>-0.22</td>
<td>-0.33</td>
<td>0.12</td>
<td>-0.04</td>
</tr>
<tr>
<td>Ectomorphy</td>
<td>-0.48</td>
<td>0.37</td>
<td>0.25</td>
<td>-0.3</td>
</tr>
<tr>
<td>Sitting height-stature Index</td>
<td>0.19</td>
<td>0.22</td>
<td>-0.18</td>
<td>0.24</td>
</tr>
<tr>
<td>Ponderal Index</td>
<td>-0.48</td>
<td>0.37</td>
<td>0.23</td>
<td>-0.3</td>
</tr>
<tr>
<td>Thigh Length –Lower Leg length Index</td>
<td>0.04</td>
<td>0.02</td>
<td>-0.18</td>
<td>0.07</td>
</tr>
<tr>
<td>Upper arm length-Lower arm length</td>
<td>0.38</td>
<td>-0.3</td>
<td>0.23</td>
<td>0.24</td>
</tr>
<tr>
<td>Hip breadth-Stature Index</td>
<td>-0.06</td>
<td>-0.46</td>
<td>0.14</td>
<td>-0.11</td>
</tr>
<tr>
<td>Shoulder breadth-Stature Index</td>
<td>0.04</td>
<td>-0.34</td>
<td>-0.34</td>
<td>0.02</td>
</tr>
<tr>
<td>Fat Percentage</td>
<td>0.54</td>
<td>0.09</td>
<td>0.16</td>
<td>0.03</td>
</tr>
<tr>
<td>Foot length</td>
<td>-0.018</td>
<td>-0.002</td>
<td>-0.36</td>
<td>0.207</td>
</tr>
</tbody>
</table>
SUMMARY, CONCLUSION AND RECOMMENDATIONS

The review of various research studies in light of our finding is leading us to conclude that the observed significant differences in the various anthropometrical variables of different throwers are decisive determinants of the performance limits binding these throwers. Which is confirming the fact that competitive sport, demands events specific physical structure.

A top-level performance demands a particular type of body size shape and proportion. Numerous researchers had observed high co-relation between the body profile of athletes and performance in specific tasks. Hirata had suggested that nation with people whose general physique is limited to the characteristics of champions in certain events must concentrate their training program on those events only.

Carter had also suggested that the athletes who wish to achieve success in sports at high level must compare their physique with Olympic athletes.

Thus our findings are setting guideline for coaches and up­coming athletes for comparing their physical structure with the different group of throwers of our country. If their structure is inline with the high performers then they may also achieve their status, subject to the optimization of other factors.
CONCLUSIONS

After going through the analysis of results in light of literature available, we are able to draw following conclusions:

1. The Shot putters are having greater weight and chest depth than Discus throwers followed by Hammer and Javelin throwers.
2. The Discus throwers are having greater height than Shot putters followed by Javelin and Hammer throwers.
3. The Discus throwers are having greater sitting height than Javelin throwers followed by Shot put and Hammer throwers.
4. The Shot putters are having greater femur Biepicondylar diameter than Discus throwers followed by Hammer and Javelin throwers.
5. The Shot putters are having greater humerus biepicondylar diameter than Discus throwers followed by Javelin and Hammer throwers.
6. Shot putters are having greater hip widths and thigh lengths than Discus throwers followed by Javelin and Hammer throwers.
7. Shot putters are having greater shoulder breadth than Javelin followed by Hammer and Discus throwers.
8. Discus throwers are having greater total age than Javelin followed by Hammer and Shot put throwers.
9. Javelin throwers are having greater total arm length than Discus throwers followed by Shot put and Hammer throwers.
10. Shot putters are having greater wrist breadths than Javelin throwers followed by Discus and Hammer throwers.
11. Shot putters are having greater skin folds than Hammer throwers followed by Discus and Javelin throwers.
12. Shot putters are having greater biceps and calf muscle girths than Discus throwers followed by Hammer and Javelin throwers.
13. Discus throwers are having greater forearm muscle girths than Shot putter followed by Hammer and Javelin throwers.
14. Shot putters are having greater chest girth than Hammer throwers followed by Discus and Javelin throwers.
15. Discus throwers are having greater total leg length than Hammer throwers followed by Javelin and Shot put throwers.
16. Shot putters are having greater endomorphy than Hammer throwers followed by Discus and Javelin throwers.
17. Shot putter are having greater mesomorphy than Discus throwers followed by Javelin and Hammer throwers.
18. Javelin throwers are having greater ectomorphy and ponderal index than Discus throwers followed by Hammer and Shot putter.
19. Javelin throwers are having greater sitting height – stature index than Discus throwers followed by Shot put and Hammer throwers.
20. Javelin throwers are having greater thigh – lower leg length index than Shot putter followed by Hammer and Discus throwers.
21. Shot putters are having greater upper arm length – lower arm length than Javelin throwers followed by Hammer and Discus throwers.
22. Shot putters are having greater hip breadth-statute index than Discus throwers followed by Javelin and Hammer throwers.

23. Hammer throwers are having greater shoulder breadth- stature index than Javelin throwers followed by Shot put and Discus throwers.

24. Shot putters are having greater fat % than Discus throwers followed by Javelin and Hammer throwers.

25. Javelin throwers are having greater foot length than Shot putters followed by Discus throwers and Hammer throwers.

26. Positive correlations were observed between the following variables of Shot putters and their performances

- Total age & training age (0.38)
- Height (0.31), Sitting height (0.09)
- Weight (0.72)
- Chest girth & depth (0.45)
- Humerus & femur- biepicondylar (0.75)
- Wrist & ankle breadth (0.66)
- Hip & shoulder breadth (0.12)
- Upper arm length (0.57), lower arm length (0.26) and total arm length (0.76)
- Upper leg length (0.49), lower leg length (0.37), and total leg length (0.08)
- Muscle girths (0.87)
- Skin folds (0.55)
- Endomorphy (0.43)
- Sitting height – stature index (0.19)
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- Thigh length –lower leg length index (0.04)
- Upper arm length –lower arm length index (0.38)
- Shoulder breadths-stature index (0.04)
- Fat % (0.54)

27. Negative correlations were observed between the following variables of Shot putters and their performances.
   - Mesomorphy (-0.22)
   - Ectomorphy (-0.48)
   - Ponderal index (-0.48)
   - Hip breadth –stature index (-0.06)
   - Foot length (-0.018)

28. Positive correlations were observed between the following variables of Discus throwers and their performances.
   - Total age & total training age (0.19)
   - Weight (0.51)
   - Sitting height (0.45)
   - Humerus &femur-biepicondylar (0.74)
   - Lower arm length (0.04)
   - Total arm length (0.1)
   - Total leg length (0.05)
   - Skin folds (0.08)
   - Endomorphy (0.11)
   - Ectomorphy (0.37)
   - Sitting height-stature index (0.22)
   - Ponderal index (0.37)
   - Thigh length –lower leg length index (0.02)
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- Fat % (0.09)

29. Negative correlations were observed between the following variables of Discus throwers and their performances.

- Height (-0.13)
- Chest girth & depth (-0.33)
- Wrist & ankle breadth (-0.29)
- Hip & shoulder breadth (-0.14)
- Upper arm length (-0.22)
- Upper leg length (-0.38)
- Lower leg length (-0.32)
- Muscles girths (-0.33)
- Mesomorphy (-0.22)
- Upper arm length – lower arm length index (-0.3)
- Hip breadth – stature index (-0.46)
- Shoulder breadth – stature index (-0.34)
- Foot length (-0.002)

30. Positive correlations were observed between the following variables of Javelin throwers and their performances.

- Total age & total training age (0.07)
- Height (0.15)
- Chest girth & depth (0.4)
- Hip & shoulder breadth (0.05)
- Upper leg length (0.23)
- Lower leg length (0.46)
- Total leg length (0.26)
- Muscles girths (0.32)
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- Skin folds (0.06)
- Endomorphy (0.06)
- Mesomorphy (0.12)
- Ectomorphy (0.25)
- Ponderal index (0.23)
- Upper arm length –lower leg length index (0.23)
- Hip breadth –stature index (0.14)
- Body composition (0.16)

31. Negative correlations were observed between the following variables of Javelin throwers and their performances.

- Weight (-0.33)
- Sitting height (-0.08)
- Humerus & femur biepicondylar (-0.19)
- Wrist & ankle breadth (-0.15)
- Upper arm length (-0.29)
- Lower arm length (-0.39)
- Total arm length (-0.03)
- Sitting height –stature index (-0.18)
- Thigh length –lower length index (-0.18)
- Shoulder breadth –stature index (-0.34)
- Foot length (-0.36)

31. Positive correlations were observed between the following variables of Hammer throwers and their performances.

- Total age & training age (0.55)
- Height (0.26)
- Weight (0.23)
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- Sitting height (0.6)
- Chest girth & depth (0.19)
- Humerus & femur biepicondylar (0.28)
- Wrist and ankle breadth (0.17)
- Hip and shoulder breadth (0.17)
- Upper arm length (0.23)
- Lower arm length (0.06)
- Total arm length (0.83)
- Upper leg length (0.12)
- Lower leg length (0.02)
- Total leg length (0.31)
- Muscles girths (0.09)
- Skin folds (0.22)
- Endomorphy (0.15)
- Sitting height–stature index (0.24)
- Thigh length–lower leg length index (0.07)
- Upper arm–lower arm length index (0.24)
- Shoulder breadths–stature index (0.02)
- Body composition (0.03)
- Foot length (0.207)

32. Negative correlations were observed between the following variables of Hammer throwers and their performances.

- Mesomorphy (-0.04)
- Ectomorphy (-0.3)
- Ponderal index (-0.3)
- Hip breadth–stature index (-0.11)
RECOMMENDATIONS

In light of the findings of our study following recommendation are made-

(1) The findings of the study should be taken into consideration while going for talent hunts for probable high potential throwers of different throwing events.

(2) Along with physical and physiological parameters, psychological and mechanical parameters of different throwers should also be studied.

(3) Further, a study should be conducted to compare elite male Indian throwers with the rest of world selected throwers in relation to physical, physiological and mechanical parameters.