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A comparative study of selected anthropometrical variables of male throwers of different throwing events

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Abstract

The purpose of the study was to assess a Comparative Study of selected Anthropometrical Variables Male Throwers of Different Throwing Events. One hundred Eighty (180) male Indian throwers were selected as subjects for the purpose of study. Keeping in view the objectives, the throwers were categorized into four groups' i.e. International (15 male), National (15 male) and All India Intersarsity (15 male) were selected as subjected for the study. The performance of throwers although researcher has selected variable on the bases of their highly importance in throwing competition the research Scholar had gone through discussion, critical as well as allied literature related to the problem. The Following Anthropometric Variables were selected Arm Length, Fore Arm Length, Upper Arm Length, Upper Arm Girth, Hand Length, Leg Length, Thigh Length, Lower Leg Length, Calf Girth, Thigh Girth, and Chest girth, Height, Sitting Height and Weight. The data was analyzed by applying Analysis of Variance (ANOVA) in order to assess and Comparative Study of Anthropometrical Characteristics Male Throwers of Different Throwing Events. The level of significance was set at 0.05. The angle of Knee joint in propulsion phase was significantly influences the performance of low dribble.

Keywords: Anthropometric, athlete and throw

Introduction

The modern world appears to be much more concerned with the world of sports. The hold of sports has grown very strong on the mind of individuals in the society at large. Sportsmen and spectators are very clear about the value and significance of sports. There is hardly any individual who has been deprived of its impact in the developed countries of the world. Now winning the competitions involves the national prestige as each nation strive to win a tournament in which they compete. There are certain nations/states which try to project the superiority of their political ideology and socio-political system through spectacular achievements in the sports world. They show their excellence by winning the maximum number of medals in all the international competitions. The participating competitors in sports, at the international level to win the name, fame and laurels for their countries and also raise their prestige ^[1].

The throwers of Discus, shot put, Javelin and hammer differed greatly in Physique from the other athletes. As a group, they were 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. The discus throwers were the largest of all athletes. Their arms in particular exceptionally big, being not only broader in both muscle and bone, relative to the muscle and bone in the legs but also longer than the legs.

The Shot Putter were also very large and muscular men. None was under 185 cm. and the tallest Shot Putter was 195cm. and weighted 115Kg. They also had long arms, but not so long as those of the discus throwers. Like the discus throwers, they had wide humerous in relation to the widths of the femur and tibia. The large arm bone was not seen in Javelin and hammer throwers nor in the simple of weight lifters. The discus, hammer and Shot Putter are taller and heavier and possess longer extremities and broader knees with a larger amount of leaver body

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¹ Charles A. Bucher, Foundation of Physical Education and Sports (Saint Louis: The C.V. Mosby Company, 1983), p.3.

mass. As already mentioned their greater weight is useful, because when the object is thrown forwards and upwards, an equal and opposite reactive force is exerted on the athlete, pushing him back ward and downwards. The effect of this reaction is however more if he is lighter. The greater height in their case will be of further advantage by making the flight of the implement longer before it touches the ground. Further while throwing the discus, the speed of the discus at the moment of releases of prime importance indenturing how for it will go and for given angular velocity (dependent on how fast the thrower does his turn) the speed is proportional to the length of the lever throwing the discus from the axis of the thrower hence the desirability of long as powerful arms.

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 knees. The better development of the lean body mass will help them to provide the great strength required, in the throwing events.

The purpose of the study was to assess a Comparative Study of selected Anthropometrical Variables Male Throwers of Different Throwing Events.

One hundred Eighty Male Indian throwers were selected as subjects for the purpose of study. Keeping in view the objectives, the throwers were categorized into four groups' i.e. International (15 male), National (15 male) and All India Intersivity (15 male). The International throwers comprised of those who had represented India in Senior and Junior International Athletics competitions held in India or abroad and National throwers were those who had represented in Senior National and Junior National Athletics competitions held in India only were selected as subjects for purpose of the study who were true representative to the population of Indian throwers. All India Interuniversity throwers who represented in AIU competitions.

It was really a very difficult task to select variables for the study because many variables contribute for the performance of throwing event in track and field and every psychological characteristic influence the task and performance of throwers although researcher has selected variable on the bases of their highly importance in throwing competition. Secondly, availability of reliable and valid instruments is also an important consideration in directing one's ingenuity for the choice of variables. Following Anthropometric Variables were selected Arm Length, Fore Arm Length, Upper Arm Length, Upper Arm Girth, Hand Length, Leg Length, Thigh Length, Lower Leg Length, Calf Girth, Thigh Girth, and Chest girth, Height, Sitting Height and Weight.

The tests were administered to the three sample elite throwers group i.e. International, National and Intersivity Players. The researcher personally visited the venues of competition of different championship and request to coach/manager of the team to permit their respective team member to serve as subjects for the study and also contact personally to the throwers when they were not busy and request to them to serve as subjects for the study. The researcher personally visited the venues of International and National tournaments, coaching camps and approached the subjects with the questionnaires.

The data was analyzed by applying Analysis of Variance (ANOVA) in order to assess and Comparative Study of Anthropometrical Characteristics Male Throwers of Different Throwing Events. The level of significance was set at 0.05. The data was analyzed by SPSS version 16.

Results

Table 1: Analysis of variance of standing height among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1125.96	3	375.321	4.148*	.007
Within Groups	15923.99	176	90.477		
Total	17049.95	179			

*Significant at 0.05 level of confidence

F0.05 (3,176) = 2.65

Table 1 reveals that there is significant difference among different male throwers, in relation to Standing Height (Anthropometric) as obtained 'F' ratio of 4.148 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Standing Height (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Standing Height (Anthropometric) has also been presented in table 2.

Table 2: Least significant difference post hoc test of the mean of standing height (anthropometric) among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	4.34222(*)	2.00530	.032
	Javelin	3.46889	2.00530	.085
	Shot Put	-1.78889	2.00530	.374
Hammer	Javelin	-.87333	2.00530	.664
	Shot Put	-6.13111(*)	2.00530	.003
Javelin	Shot Put	-5.25778(*)	2.00530	.010

* The mean difference is significant at the .05 level.

CD 0.05=3.93

It is evident from table 2 that means difference of Discus Thrower & Hammer Thrower (4.34222); Discus Thrower & Shot Put Thrower (1.78889), Hammer Thrower & Shot Put Thrower (6.13111), Javelin Thrower & Shot Put Thrower (5.25778) was found significant in relation to Standing Height (Anthropometric) since mean difference was found greater than critical difference of 3.93 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Javelin Thrower (3.469) and Hammer Thrower & Javelin Thrower (.87333) in relation to Standing Height. The sequence of standing height among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put >Discus Throw > Javelin>Hammer Throw.

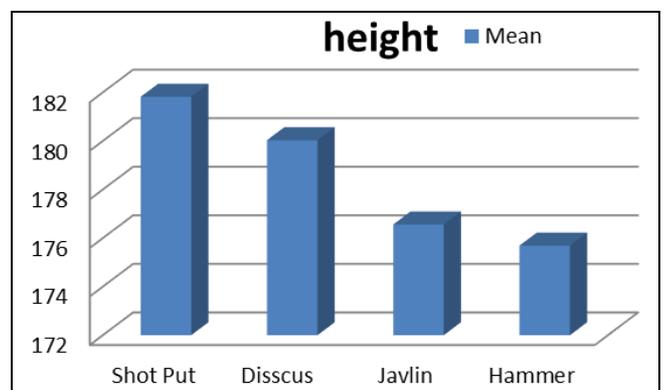


Fig 1: Sequence of posttest means of height in different male throwers

Table 3: Analysis of variance of sitting height (anthropometric) among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	588.34	3	196.114	4.691*	.004
Within Groups	7357.61	176	41.805		
Total	7945.95	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 3 reveals that there is significant difference among different male throwers, in relation to sitting height (Anthropometric) as obtained 'F' ratio of 4.691 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of sitting height (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for sitting height (Anthropometric) has also been presented in table 4.

Table 4: Least significant difference post hoc test of the mean of sitting height among different male throwers (in cm)

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	3.78444(*)	1.36308	.006
	Javelin	3.12444(*)	1.36308	.023
	Shot Put	-.25333	1.36308	.853
Hammer	Javelin	-.66000	1.36308	.629
	Shot Put	-4.03778(*)	1.36308	.003
Javelin	Shot Put	-3.37778(*)	1.36308	.014

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 2.67$

It is evident from table 4 that means difference of Discus Thrower & Hammer Thrower (3.78444); Discus Thrower & Javelin Thrower (3.12444), Hammer Thrower & Shot Put Thrower (4.0377), Javelin Thrower & Shot Put Thrower (3.3777), was found significant in relation to sitting height (Anthropometric) since mean difference was found greater than critical difference of 2.67 at 0.05 level.

On the other hand, insignificant difference was found between Hammer Thrower & Javelin Thrower (.660) and Discus Thrower & Shot Put Thrower (2.5333) in relation to sitting height. The sequence of sitting height among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put >Discus Throw >Javelin> Hammer Throw.

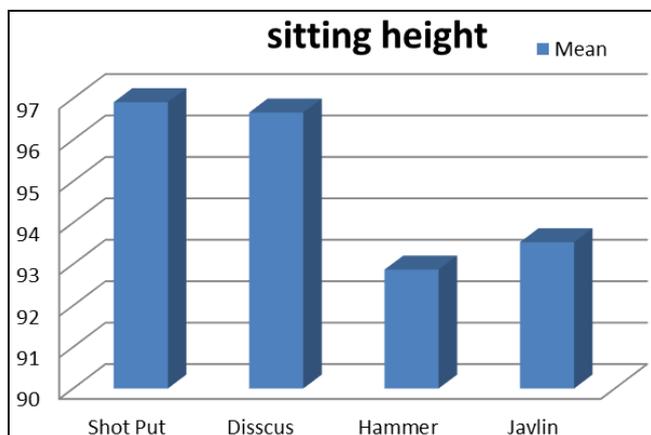


Fig 2: Sequence of posttest means of sitting height in different male throwers

Table 5: Analysis of variance of weight (anthropometric) among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	15806.50	3	5268.835	31.54*	.000
Within Groups	29233.26	175	167.047		
Total	45039.76	178			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 5 reveals that there is significant difference among different male throwers, in relation to Weight (Anthropometric) as obtained 'F' ratio of 31.54 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Weight (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Weight (Anthropometric) has also been presented in table 6.

Table 6: Least significant difference post hoc test of the mean of weight (anthropometric) among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	10.76667(*)	2.72476	.000
	Javelin	18.41111(*)	2.72476	.000
	Shot Put	-5.90384(*)	2.74020	.033
Hammer	Javelin	7.64444(*)	2.72476	.006
	Shot Put	-16.67051(*)	2.74020	.000
Javelin	Shot Put	-24.31495(*)	2.74020	.000

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 5.34$

It is evident from table 6 that means difference of Discus Thrower & Hammer Thrower (10.7667); Discus Thrower & Javelin Thrower (18.4111), Discus Thrower & Shot Put Thrower (5.903), Hammer Thrower & Javelin Thrower (7.644), Hammer Thrower & Shot Put Thrower (16.670), Javelin Thrower & Shot Put Thrower (24.314) was found significant in relation to Weight (Anthropometric) since mean difference was found greater than critical difference of 5.34 at 0.05 level. The sequence of Weight (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put >Discus Throw >Hammer Throw >Javelin.

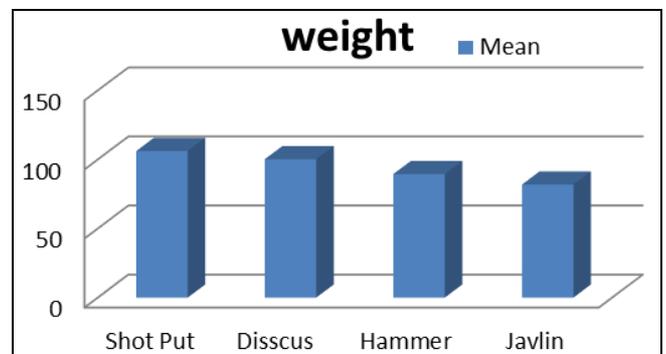


Fig 3: Sequence of posttest means of weight in different male throwers

Table 7: Analysis of variance of chest girth among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6224.43	3	2074.813	3.37*	.020
Within Groups	108327.20	176	615.500		
Total	114552.35	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 7 reveals that there is significant difference among different male throwers, in relation to Chest Girth (Anthropometric) as obtained 'F' ratio of 3.37 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Chest Girth (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Chest Girth (Anthropometric) has also been presented in table 8.

Table 8: Least significant difference post hoc test of the mean of chest girth among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	16.33111(*)	5.23025	.002
	Javelin	10.38222(*)	5.23025	.049
	Shot Put	7.40222	5.23025	.159
Hammer	Javelin	-5.94889	5.23025	.257
	Shot Put	-8.92889	5.23025	.090
Javelin	Shot Put	-2.98000	5.23025	.570

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 10.25$

It is evident from table 8 that means difference of Discus Thrower & Hammer Thrower (16.331); Discus Thrower & Javelin Thrower (10.382), was found significant in relation to Chest Girth (Anthropometric) since mean difference was found greater than critical difference of 10.25 at 0.05 level.

On the other hand insignificant difference was found between Discus Thrower & Shot Put Thrower (7.402), Hammer Thrower & Javelin Thrower (5.948), Hammer Thrower & Shot Put Thrower (8.928), and Javelin Thrower & Shot Put Thrower (2.980) in relation to Chest Girth (Anthropometric). The sequence of Chest Girth (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Discus Throw > Shot Put > Javelin > Hammer Throw.

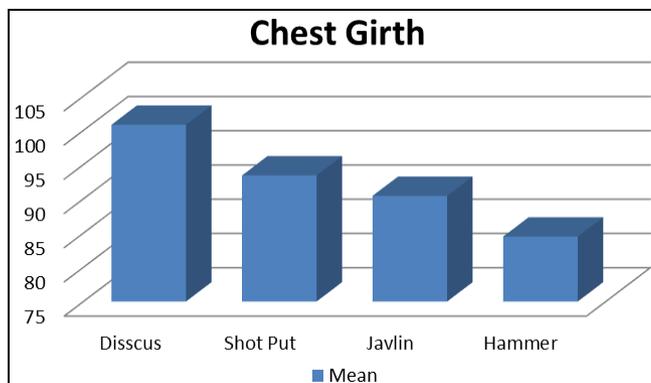


Fig 4: Sequence of posttest means of chest girth in different male throwers

Table 9: Analysis of variance of femur width (anthropometric) among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	74.309	3	24.770	.671	.571
Within Groups	6497.317	176	36.917		
Total	6571.626	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 9 reveals that there no significant difference among different male throwers, in relation to Femur width (Anthropometric) as obtained 'F' ratio of .671 which is lower than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found insignificant in the case of Femur width (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was not applied to test the significant difference between paired means.

Table 10: Analysis of variance of femurs width among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	43.47	3	14.493	2.04	.110
Within Groups	1249.65	176	7.100		
Total	1293.13	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 10 reveals that there no significant difference among different male throwers, in relation to Femurs Width (Anthropometric) as obtained 'F' ratio of 2.04 which is lower than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found insignificant in the case of Femurs width (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was not applied to test the significant difference between paired means.

Table 11: Analysis of variance of hip width among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	548.25	3	182.752	17.93*	.000
Within Groups	1793.65	176	10.191		
Total	2341.91	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 11 reveals that there is significant difference among different male throwers, in relation to Hip Width (Anthropometric) as obtained 'F' ratio of 17.93 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Hip Width (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Hip Width (Anthropometric) has also been presented in table 12.

Table 12: Least significant difference post hoc test of the mean of hip width among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	3.67111(*)	.67301	.000
	Javelin	3.67111(*)	.67301	.000
	Shot Put	.38222	.67301	.571
Hammer	Javelin	.00000	.67301	1.000
	Shot Put	-3.28889(*)	.67301	.000
Javelin	Shot Put	-3.28889(*)	.67301	.000

* The mean difference is significant at the .05 level.
 CD _{0.05}=1.319

It is evident from table 12 that means difference of Discus Thrower & Hammer Thrower (3.671); Discus Thrower & Javelin Thrower (3.671), Hammer Thrower & Shot Put Thrower (3.288), Javelin Thrower & Shot Put Thrower (3.288), was found significant in relation to Hip Width (Anthropometric) since mean difference was found greater than critical difference of 1.39 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Shot Put Thrower (.382), Hammer Thrower & Javelin Thrower (.000) in relation to Hip Width (Anthropometric). The sequence of Hip Width (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Discus Throw > Shot Put > Hammer Throw > Javelin.

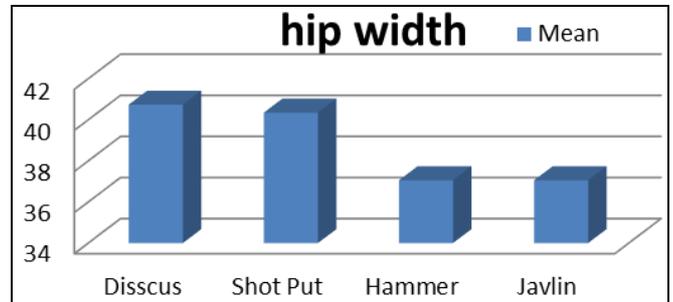


Fig 5: Sequence of posttest means of hip width in different male throwers

Table 13: Analysis of variance of shoulder width among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	427.88	3	142.628	8.22*	.000
Within Groups	3052.70	176	17.345		
Total	3480.58	179			

*Significant at 0.05 level of confidence
 F_{0.05} (3,176) = 2.65

Table 13 reveals that there is significant difference among different male throwers, in relation to Shoulder Width (Anthropometric) as obtained 'F' ratio of 8.22 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Shoulder

Width (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Shoulder Width (Anthropometric) has also been presented in table 14.

Table 14: Least significant difference post hoc test of the mean of shoulder width among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	.88444	.87800	.315
	Javelin	1.72222	.87800	.051
	Shot Put	-2.40222(*)	.87800	.007
Hammer	Javelin	.83778	.87800	.341
	Shot Put	-3.28667(*)	.87800	.000
Javelin	Shot Put	-4.12444(*)	.87800	.000

* The mean difference is significant at the .05 level.
 CD _{0.05}=1.72

It is evident from table 14 that means difference of Discus Thrower & Javelin Thrower (1.722), Discus Thrower & Shot Put Thrower (2.402), Hammer Thrower & Shot Put Thrower (3.286), and Javelin Thrower & Shot Put Thrower (4.124), was found significant in relation to Shoulder Width (Anthropometric) since mean difference was found greater than critical difference of 1.72 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Hammer Thrower (.884) and Hammer Thrower & Javelin Thrower (.837) in relation to Shoulder Width (Anthropometric). The sequence of Shoulder Width (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put > Discus Throw > Hammer Throw > Javelin.

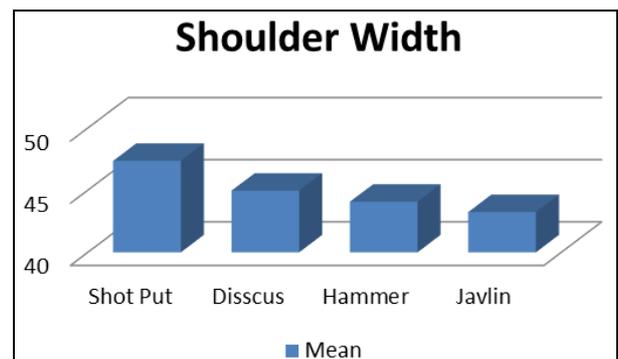


Fig 6: Sequence of posttest means of shoulder width in different male throwers

Table 15: Analysis of variance of upper arm length among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between groups	66.55	3	22.186	2.81*	.041
Within groups	1388.64	176	7.890		
Total	1455.20	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 15 reveals that there is significant difference among different male throwers, in relation to Upper Arm Length (Anthropometric) as obtained 'F' ratio of 2.81 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Upper Arm Length (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Upper Arm Length (Anthropometric) has also been presented in table 16.

Table 16: Least significant difference post hoc test of the mean of upper arm length among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	1.08222	.59217	.069
	Javelin	1.54444(*)	.59217	.010
	Shot Put	.33111	.59217	.577
Hammer	Javelin	.46222	.59217	.436
	Shot Put	-.75111	.59217	.206
Javelin	Shot Put	-1.21333(*)	.59217	.042

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 1.16$

It is evident from table 16 that means difference of Javelin Thrower & Shot Put Thrower (1.213) and Discus Thrower & Javelin Thrower (1.544) was found significant in relation to Upper Arm Length (Anthropometric) since mean difference was found greater than critical difference of 1.16 at 0.05 level. On the other hand, insignificant difference was found between Discus Thrower & Hammer Thrower (1.082), Discus Thrower & Shot Put Thrower (.331), Hammer Thrower & Javelin Thrower (.462) and Hammer Thrower & Shot Put Thrower (.751) in relation to Upper Arm Length (Anthropometric). The sequence of Upper Arm length (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Discus Throw > Shot Put > Hammer Throw > Javelin.

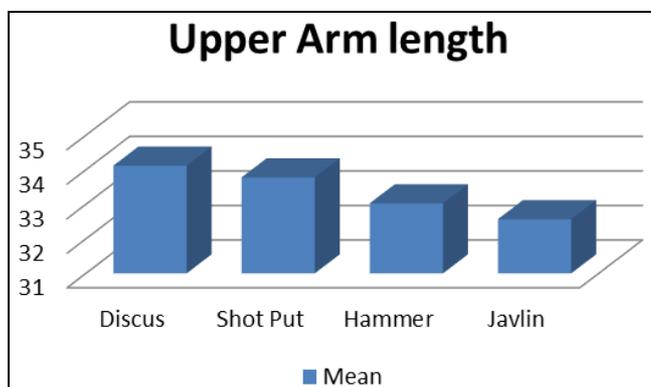


Fig 7: Sequence of posttest means of upper arm length in different male throwers

Table 17: Analysis of variance of forearm length among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	184.09	3	61.365	9.38*	.000
Within Groups	1150.67	176	6.538		
Total	1334.77	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table-17 reveals that there is significant difference among different male throwers, in relation to fore Arm Length (Anthropometric) as obtained 'F' ratio of 9.38 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of fore Arm Length (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for fore Arm Length (Anthropometric) has also been presented in table 18.

Table 18: Least significant difference post hoc test of the mean of fore arm length among different male throwers

(I) Throws	(J) Throws	Mean difference (I-J)	Std. error	Sig.
Discus	Hammer	1.79644(*)	.53905	.001
	Javelin	1.70667(*)	.53905	.002
	Shot Put	-.48222	.53905	.372
Hammer	Javelin	-.08978	.53905	.868
	Shot Put	-2.27867(*)	.53905	.000
Javelin	Shot Put	-2.18889(*)	.53905	.000

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 1.05$

It is evident from table 18 that means difference of Discus Thrower & Hammer Thrower (1.796); Discus Thrower & Javelin Thrower (1.706), Hammer Thrower & Shot Put Thrower (2.278), Javelin Thrower & Shot Put Thrower (2.188), was found significant in relation to Forearm Length (Anthropometric) since mean difference was found greater than critical difference of 1.05 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Shot Put Thrower (.482), Hammer Thrower & Javelin Thrower (.089), in relation to Forearm Length (Anthropometric) since mean difference was found lower than critical difference of 1.05 at 0.05 level. The sequence of forearm length among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put > Discus Throw > Javelin > Hammer Throw.

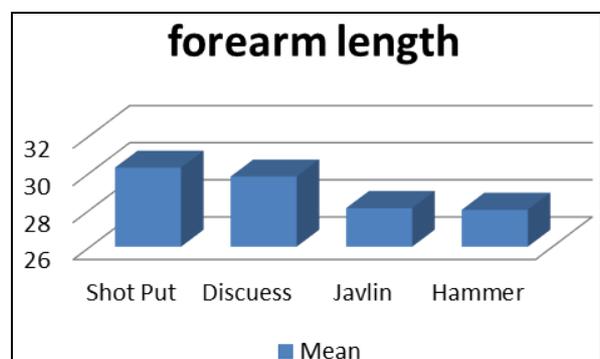


Fig 8: Sequence of posttest means of forearm length in different male throwers

Table 19: Analysis of variance of upper leg length among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1011.63	3	337.21	5.83*	.001
Within Groups	10169.04	176	57.77		
Total	11180.67	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 19 reveals that there is significant difference among different male throwers, in relation to Upper Leg Length (Anthropometric) as obtained 'F' ratio of 5.83 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Upper Leg Length (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Upper Leg Length (Anthropometric) has also been presented in table 20.

Table 20: Least significant difference post hoc test of the mean of upper leg length among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	5.96222(*)	1.60248	.000
	Javelin	5.59333(*)	1.60248	.001
	Shot Put	3.39356(*)	1.60248	.036
Hammer	Javelin	-.36889	1.60248	.818
	Shot Put	-2.56867	1.60248	.111
Javelin	Shot Put	-2.19978	1.60248	.172

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 3.14$

It is evident from table 20 that means difference of Discus Thrower & Hammer Thrower (5.962); Discus Thrower & Javelin Thrower (5.593), Discus Thrower & Shot Put Thrower (3.393) was found significant in relation to Upper Leg Length (Anthropometric) since mean difference was found greater than critical difference of 3.14 at 0.05 level.

On the other hand, insignificant difference was found between Hammer Thrower & Javelin Thrower (.368), Hammer Thrower & Shot Put Thrower (2.568), and Javelin Thrower & Shot Put Thrower (2.199) in Upper Leg Length (Anthropometric). The sequence of Upper Leg Length (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Discus Throw > Shot Put > Javelin > Hammer Throw.

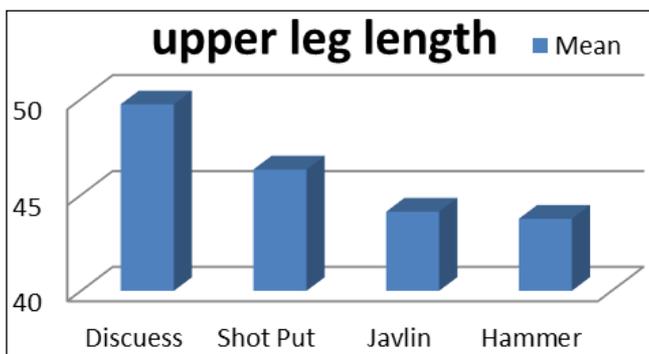


Fig 9: Sequence of posttest means of upper leg length in different male throwers

Table 21: Analysis of variance of lower leg length among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	131.01	3	43.67	5.85*	.001
Within Groups	1313.39	176	7.46		
Total	1444.40	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 21 reveals that there is significant difference among different male throwers, in relation to Lower Leg Length (Anthropometric) as obtained 'F' ratio of 5.85 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Lower Leg Length (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Lower Leg Length (Anthropometric) has also been presented in table 22.

Table 22: Least significant difference post hoc test of the mean of lower leg length among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	2.16889(*)	.57590	.000
	Javelin	1.13778(*)	.57590	.050
	Shot Put	.24000	.57590	.677
Hammer	Javelin	-1.03111	.57590	.075
	Shot Put	-1.92889(*)	.57590	.001
Javelin	Shot Put	-.89778	.57590	.121

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 1.13$

It is evident from table 22 that means difference of Discus Thrower & Hammer Thrower (2.168); Hammer Thrower & Shot Put Thrower (1.928) and Discus Thrower & Javelin Thrower (1.137), was found significant in relation to Lower Leg Length (Anthropometric) since mean difference was found greater than critical difference of 1.13 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Shot Put Thrower (.240), Hammer Thrower & Javelin Thrower (1.031) and Javelin Thrower & Shot Put Thrower (.897), in relation to Lower Leg Length (Anthropometric). The sequence of Lower Leg Length (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Discus Throw > Shot Put > Javelin > Hammer Throw.

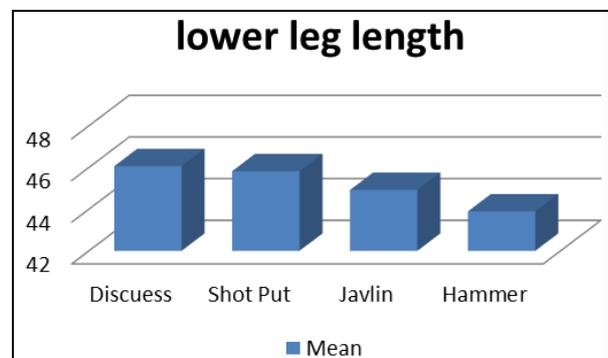


Fig 10: Sequence of posttest means of lower leg length in different male throwers

Table 23: Analysis of variance of upper arm girth among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	366.41	3	122.13	6.37*	.000
Within Groups	3371.98	176	19.15		
Total	3738.39	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 23 reveals that there is significant difference among different male throwers, in relation to upper arm girth (Anthropometric) as obtained 'F' ratio of 6.37 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (2,176) degree of freedom.

As the F-ratio was found significant in the case of upper arm girth (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for upper arm girth (Anthropometric) has also been presented in table 24.

Table 24: Least significant difference post hoc test of the mean upper arm girth among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	-.28667	.92277	.756
	Javelin	2.25333(*)	.92277	.016
	Shot Put	-1.73111	.92277	.062
Hammer	Javelin	2.54000(*)	.92277	.007
	Shot Put	-1.44444	.92277	.119
Javelin	Shot Put	-3.98444(*)	.92277	.000

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 1.81$

It is evident from table 24 that means difference of Hammer Thrower & Javelin Thrower (2.540) Discus Thrower & Javelin Thrower (2.253), and Javelin Thrower & Shot Put Thrower (3.984) was found significant in relation to upper arm girth (Anthropometric) since mean difference was found greater than critical difference of 1.81 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Hammer Thrower (.286); Discus Thrower & Shot Put Thrower (1.731) and Hammer Thrower & Shot Put Thrower (1.444) in relation to upper arm girth (Anthropometric). The sequence of upper arm girth (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put > Hammer Throw > Discus Throw > Javelin.

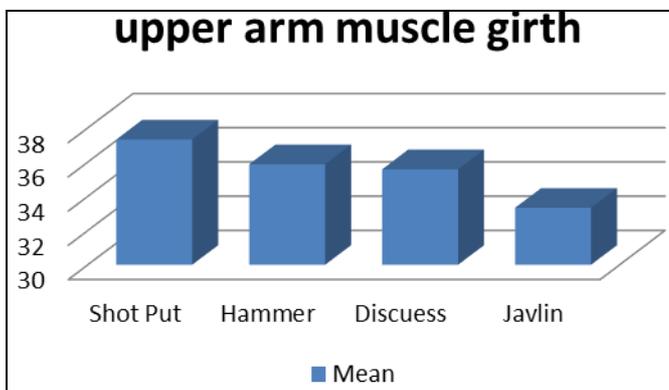


Fig 11: Sequence of posttest means of upper arm muscle girth in different male throwers

Table 25: Analysis of variance of calf muscle girth among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	340.43	3	113.48	12.12*	.000
Within Groups	1628.26	176	9.35		
Total	1968.70	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 25 reveals that there is significant difference among different male throwers, in relation to Calf Muscle Girth (Anthropometric) as obtained 'F' ratio of 12.12 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Calf Muscle Girth (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Calf Muscle Girth (Anthropometric) has also been presented in table 26.

Table 26: Least significant difference post hoc test of the mean of calf muscle girth among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	1.22222	.64491	.060
	Javelin	2.66889(*)	.64491	.000
	Shot Put	-1.05096	.65236	.109
Hammer	Discus	-1.22222	.64491	.060
	Shot Put	-2.27318(*)	.65236	.001
Javelin	Shot Put	-3.71984(*)	.65236	.000

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 1.26$

It is evident from table 26 that means difference of Discus Thrower & Javelin Thrower (2.668), Hammer Thrower & Javelin Thrower (1.446), Hammer Thrower & Shot Put Thrower (2.273), and Javelin Thrower & Shot Put Thrower (3.719), was found significant in relation to Calf Muscle Girth (Anthropometric) since mean difference was found greater than critical difference of 1.26 at 0.05 level.

On the other hand, insignificant difference was found between Discus Thrower & Hammer Thrower (1.222) and Discus Thrower & Shot Put Thrower (1.050), in relation to Calf Muscle Girth (Anthropometric). The sequence of Calf Muscle Girth (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put > Discus Throw > Hammer Throw > Javelin.

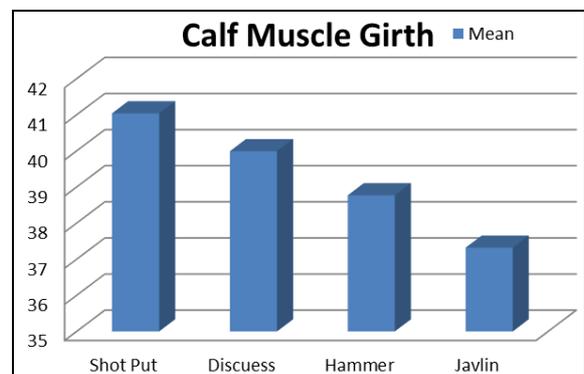


Fig 12: Sequence of posttest means of calf muscle girth in different male throwers

Table 27: Analysis of variance of thigh muscle girth among different male throwers

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	728.18	3	242.72	4.52*	.004
Within Groups	9436.35	176	53.61		
Total	10164.53	179			

*Significant at 0.05 level of confidence
 $F_{0.05}(3,176) = 2.65$

Table 27 reveals that there is significant difference among different male throwers, in relation to Thigh Muscle Girth (Anthropometric) as obtained 'F' ratio of 4.52 which is higher than the tabulated value of 2.65 required for significance at 0.05 level with (3,176) degree of freedom.

As the F-ratio was found significant in the case of Thigh Muscle Girth (Anthropometric) the least significant difference (L.S.D.) test of post-hoc test was applied to test the significant difference between paired means. Further, the L.S.D. analysis for paired means for Thigh Muscle Girth (Anthropometric) has also been presented in table 28.

Table 28: Least significant difference post hoc test of the mean of thigh muscle girth (anthropometric) among different male throwers

(I) Throws	(J) Throws	Mean Difference (I-J)	Std. Error	Sig.
Discus	Hammer	-.62889	1.54367	.684
	Javelin	2.97111	1.54367	.056
	Shot Put	-2.64222	1.54367	.089
Hammer	Javelin	3.60000(*)	1.54367	.021
	Shot Put	-2.01333	1.54367	.194
Javelin	Shot Put	-5.61333(*)	1.54367	.000

* The mean difference is significant at the .05 level.
 $CD_{0.05} = 3.02$

It is evident from table 28 that means difference of Hammer Thrower & Javelin Thrower (3.600) and Javelin Thrower & Shot Put Thrower (5.613) was found significant in relation to Thigh Muscle Girth (Anthropometric) since mean difference was found greater than critical difference of 3.02 at 0.05 level. On the other hand, insignificant difference was found between Discus Thrower & Hammer Thrower (.628); Discus Thrower & Javelin Thrower (2.971), Discus Thrower & Shot Put Thrower (2.642), Hammer Thrower & Shot Put Thrower (2.013) in relation to Thigh Muscle Girth (Anthropometric). The sequence of Thigh Muscle Girth (Anthropometric) among Discus Throw, Hammer Throw, Javelin Throw and Shot Put Throw in different male throwers was Shot Put > Hammer Throw > Discus Throw > Javelin.

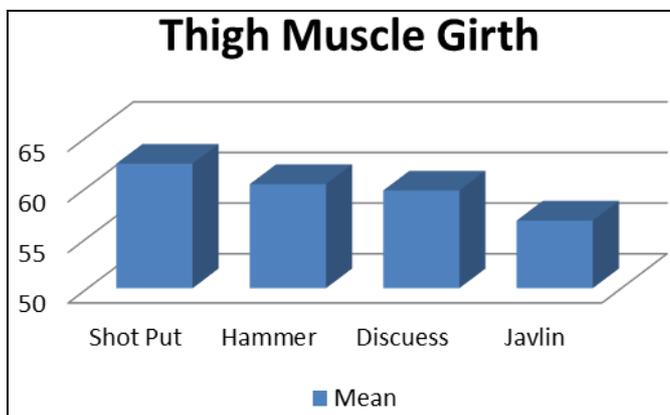


Fig 30: Sequence of posttest means of thigh muscle girth in different male throwers

Discussion of Findings

The raw data was computed and analysis of variance was applied which showed that the elite throwers differ significantly with each other in the most of the anthropometric variable such as standing height, sitting height, weight, shoulder width, hip width, upper arm length, fore arm length, upper leg length, lower leg length, chest girth, bicep girth, calf muscle girth, thigh muscle girth, except femur width, humerus width, competitive anxiety and body composition.

In the case of standing height and sitting height table no 1 or 2 reveals that there is a significant difference exists. This might be due to the individual difference or any other factor such as heredity. Every individual has different type of body structure and height is the most important part of human body. As we clearly known that the height plays a very important role in most of the sportive event which is really very helpful for giving good performance to achieve top position in many competitions. Especially thrower height highly matters for full exposure to the skill performing goodly because the height of the player directly contributes significantly to the height of release in throwing events, especially in discus and javelin throw it has positive impact. The findings of the L. S. D. reveals that the mean difference of the groups of discus and hammer, hammer and shot put, javelin and shot put is more significant than to the groups of discus and javelin, hammer and javelin as compare with the critical difference in standing height. Apart from all discus throwers are best from the other groups in standing height. On the other hand, in sitting height the mean value of discuss and hammer, discus and javelin, hammer and shot put, javelin and shot put found significant than the group of hammer and javelin, hammer and shot put as compare with the critical difference. Apart from others shot put throwers in sitting height are the best group. However, the mean difference of the other groups was near to the range of the critical difference in both the variables.

In the case of weight (anthropometric) the findings of the study revealed that there exists a higher significant difference amongst all the group of the throwers because the tabulated value is lower than the calculated value. No doubt in this that weight has an equal importance and contribution to the player's performance as height. As we had seen so many times the throwers who carry good or more weight have good power and throwing capacities. Discus, shot put and hammer throw, in such event the thrower need more shoulder strength to cover maximum distance by applying maximum force through the body as more body weight have more power to expel for good performance. The finding of the LSD shown all the groups means difference were found higher than the critical difference and shot put throwers are the best group in weight category according to the table 2.

Another finding which also shown significant difference is, hip width, and shoulder width, as it is already evident in the finding of the height and weight have equal importance same as width also plays a very important role in throwing events specially in hammer and shot put throw. It is helpful in force generation and movement through joints especially these two anthropometric width have major effect upon the throwing event and player's performance. The role of body in player's performance is being also evident by the Sheldon body types, the three different body types suitable to different game and event according to body structure. On the other hand, femur width and humerus width has shown insignificant difference this might be due to the involvement of another two widths was more rather than femur width and humerus width for the throwing event. Especially in hammer, shot put, and discus the

maximum use of shoulder width, and hip width is involved rather than femur width and humerus width. However, in LSD the table no 1 and 2 shows that in hip width discus throwers and in shoulder width shot put throwers are the best group.

Through the anthropometric analysis the research shows that there is a significant difference in the other four regions i.e. chest girth, bicep girth, thigh muscle girth, and calf muscle girth within the subjects of different groups. It may be due to the reason that players have already gone through some sorts of exercise and specific training which has made their body more muscular, as the player of shot put or hammer perform weight training exercise to develop power in their upper extremity and the lower extremity of the body in order to obtain their best output because of the maximum use of upper and lower extremities. Another reason for such anthropometric difference could be diet, supplements and heredity of the individual which differ with each other according to their socio economic status.

In the case of upper arm length, fore arm length, upper leg length, lower leg length, the data reveals that there is a significant difference in these four region of the lengths in different throwers. This might be due to the individual difference or any other factor such as heredity. As it earlier stated that every individual has different type of body structure and length of the body played an important role in achieving good performance in throwing events. As we clearly know that the length of the upper and lower extremity of the player's played a vital role in the sportive event such as javelin and discus throw because, it is helpful in giving height to the angle of release which is quite significant for giving good performance to achieve top position in many competitions. Especially in discus and javelin throw it has positive impact.

The findings of the LSD reveals that the mean difference of the groups of discus and javelin, javelin and shot put is more significant than to the groups of discus & hammer and discus and shot put as compare with the critical difference in upper arm length. Apart from all discus and shot put throwers are best from the groups in upper arm length. On the other hand, in fore arm length the mean value of discus and hammer, discus and javelin, hammer and shot put, javelin and shot put found significant than the group of hammer and javelin, discus and shot put as compare with the critical difference. Apart from others shot put and hammer throwers in fore arm length are the best group.

In the case of upper leg length, the LSD reveals that the mean difference of the groups of discus and hammer, discus and javelin, discus and shot put is more significant than to the groups of hammer & javelin, hammer & shot put, javelin & shot put as compare with the critical difference in upper leg length. Apart from all discus and shot put throwers are best from the groups. On the other hand, in lower leg length the mean value of discus and hammer, discus and javelin, hammer and shot put, found significant than the group of hammer and javelin, discus and shot put, javelin and shot put, as compare with the critical difference. Apart from the others discus and hammer throwers are the best from the other groups.

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