

A Comparative Study of Anthropometric Measurements, Physique and Body Composition of Intersersity level Jumper Girls

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Abstract- In the present cross sectional study of anthropometric measurements, physique and body composition of all Intersersity level Jumper girls, specialising in high jump, long jump and triple jump have been reported. The data were collected from Dec.1997to Jan2000.The mean, standard deviation, analysis of variance and post-hoc test were applied for evaluation.

The result of the study shows that the high jumpers were found to be higher in mean of height and lower in mean value of weight as compare to long and triple jumpers but the test ANOVA shows non -significant differences in all anthropometric measurements except calf skin fold. In case of derived measurements the long jumper, high jumper and triple jumper are significantly different in height/weight ratio, Ponderal index and ectomorphy component.

Index Terms- Anthropometry, % body fat, physique, lean body mass, jumpers.

I. INTRODUCTION

High Jump is an event where the competitors must jump over a bar at measured heights. Women's high jump event was a part of the track and field athletics programme at the 1928 Summer Olympics. It was the first appearance of the event marked the debut of women's Olympic athletics. The competition was held on Sunday, August 5, 1928. Twenty high jumpers from nine nations competed. Ethel Cather Wood of Canada won Gold medal and her winning record was 1.59 mts and at present high jump world record is 2.09 mts set by Stefka Kostadinova in 1987, and also the longest held record in the event. The long jump is a field event in which athletes combine speed, strength, and agility in an attempt to leap as far as possible from a takeoff point. The first world record in the women's long jump was recognized by the Federation Sportive Feminine International (FSFI) in 1922. The FSFI was absorbed by the International Association of Athletics Federations in 1936. The long jump was entered in Olympics in 1948 in London summer Olympics. Olga Gyarmati was a retired Hungarian athlete who competed at three Olympic Games in four different events. Her greatest success was winning the inaugural Olympic Women's Long Jump competition in London in 1948. Triple Jump incorporates a 'hop', 'step' and 'jump' where the distance is measured from the board where the athlete takes off from in the hop. The women's triple jump was introduced into the Atlanta Olympics in 1996. Inessa Mykolajivna Kravets Shulyak, was won the first gold Medal. She jumped the world record at the 1995 World

Championships in Gothenburg with 15.50m after studying a picture of Jonathan Edwards.

Anthropometry is a scientific specialized closely allied to physical education, sports science, sports Medicine, human biology, physical anthropology and several medicine disciplines. The knowledge of anthropometry is increasingly being appreciated by the sports administrators. Assessment of human physical performance through anthropometry helps to evaluate the physical structure and the performance of individual. So anthropometry is a science which deals with human body measurements and sports person are selected on the basis of bodily characteristics for a particular sport or event. Every game requires a particular type of a body and unspecific body types in relation to the sports events may be hindrance in the improvement and achievement of an athlete's performance. According to Sodhi and Sidhu (1984), "physique refers to the shape, the size and the form of an individual. All the three factors are intimately linked with each other and are manifestation of the internal structure and the tissue components which in turn, are influenced by environmental and genetic factors. The athletes in a particular sport must possess such typical characteristics which are of advantage to them during the game. The attainment of these characteristics will help an athlete to perform better during the competition". Therefore, it has been observed that apart from other factors the performance of sportsman, and sports women in any sport and game is influenced by various specific characteristics of physique, body composition, psychological traits and physiological functions which help him to attain better performance. (Cureton, 1951; Tanner, 1964; Hirata, 1966 and 1979; de Garay e et al., 1974; Wolanski, 1979; Carter, 1982; Singh et al., 1987; Mokha and Sidhu, 1988; Sandhu, 1993) The present study is likely to impart new knowledge with regard to the anthropometric measurements, physique and body composition of all India interuniversity female jumpers.

II. MATERIAL AND METHODS

In the present investigation the All India Inter University jumpers have been studied for anthropometric measurements, physique and body composition .70 jumpers were studied which included 25 high jumpers, 20 long jumpers and 25 triple jumpers. Only those subjects were studied who had participated or held some positions in All India Interuniversity competition. The anthropometric measurements i.e. Height, Weight, Sitting Height, Upper arm circumference, fore arm circumference, Thigh circumference, calf circumference, waist circumference, Biceps

skin fold, Triceps skin fold, Fore arm skin fold, Subscapular skin fold, Superficial skin fold and Calf skin fold, Humerus bicondylar diameter, Femur diameter, Wrist and Ankle diameter were taken by using the standard techniques. Harpenden skinfold caliper was used for measuring skinfold. From the anthropometric measurements so taken, body mass index, Ponderal index, percent body fat, height/weight ratio, humerus dia/femur dia, wrist dia/ankle dia. and sitting height/height ratio and Somatotype components (endomorph-mesomorph-ectomorph) has been calculated.

III. RESULT AND DISCUSSION

In the present study the anthropometric measurements have been taken on the categories of jumper's viz. high, long and triple jumpers. Out of the three categories of jumpers; on an average, the high jumpers are the tallest with longest trunks and largest arm spans and lightest with less muscle at thigh, calf and the fore arm. They also possess medium bony diameters of femur, wrist and ankle. The body mass index (18.39) and ponderal index (22.38) is the least above said jumpers of this series. The long jumpers on the other side are heaviest with most massive musculature at fore arm. They also possess maximum body mass index (19.96) and ponderal index (23.15). The long jumpers among three categories have the shortest stature, hand span and bony diameters at humerus, wrist, femur and ankle. Body fat at upper and lower extremities is the least. Among all the jumpers the triple jumpers possess highest hand span with massive bony upper and lower extremities and muscular thigh and calf. Their trunk and arm span and shortest with less muscular upper arms and waists of the whole series of jumpers. (Table 1 & 2)

When all the jumpers are compared for anthropometric measurements with each other, the values of ANOVA indicate significant F ratio in calf skin fold and ponderal index. Post-hoc test shows significant differences between long and triple jumpers.

Body Proportions:-

Table 2 indicates that height/weight ratio of the high jumpers is large (44.73), relations to weights. However, long jumpers are on the lowest (43.31) side and triple jumpers (43.87) fall in between in this regard. The value of ANOVAs indicates significant 'F' ratio at 0.05 levels (Table 4). The Post-hoc test shows significant differences between long jumpers and high jumpers.

A resume of the study of height /weight ratio clearly indicates that high jumpers have less weight in relation to height. With this, they definitely have an advantage over the others because they have to lift their body against the gravitational pull. The lighter the weight the better are the chance of performance. Moreover, if the body height is large they will try to lift the body of higher levels.

In case of long jumpers the proportion of height/weight ratio indicates, inverse trend. They have more body weight in relation to height. Perhaps the reason is that when athlete is participating in a long jump he is allowed to run some distance to gain momentum. The larger the body weight the larger is the momentum which helps the individual to take his body to large distance.

The height /weight of triple jumpers fall in between the two, because the triple jump is a special event in which both momentum and lifting of the body up ward is required. Their other body proportions do not indicate and any difference wrist/humerus diameters ankle /femur diameter and sitting height /height.

Body Composition

When the body composition of the jumpers of the present series is studied, it is found that high jumpers are the boniest with mean Ossa being 8.10 kg. The triple jumpers and long jumpers follow them with 8.03 and 7.64 values. In derma component in the jumpers, the triple jumpers are leading with the value 7.79 kg and the high jumpers and long jumpers follow them with 7.30 kg and 7.04 kg values. The body density, on an average in the jumpers is almost equally distributed. In case of % body fat again triple jumpers are most fatty value being 15.32% followed by high jumpers and long jumpers with 14.55% and 13.69 %.(Table 2)

This shows that the high jumpers are most bony with medium derma and percentage of body fat but almost equal body density among the jumper's series. This type of body composition of high jumpers with massive bony and medium musculature and fat might be helpful for getting the peak performance. The strong bones and medium fat component is useful in giving good performance in high jump. On the other hand, the triple jumpers have largest derma and % body fat with medium bony weight, because such types of bodies may be able to generate more momentum which is useful in performing better triple jumps.

Long jumpers have almost equal units of Ossa and derma components but less percentage of body fat among the jumper series. In other words, the main body weight of jumpers is constituted by bones with moderate percentage of body fat. This type of body composition might be helpful for increasing the momentum and maintaining a co-ordination in long jump execution for getting peak performance in long jump

Somatotypes

While studying the somatotypes of the present series, it is found that High Jumpers are the most ectomorphic, with mean ectomorphic component being 4.17. Triple jumpers and long jumpers follow them with 3.53 and 3.20 values (Table 2). The endomorphic and mesomorphic components of the jumpers are almost equally distributed. On an average the high jumpers are endomorphic ectomorph. This shows that the high jumpers have thin and lean body types which help them to jump to a higher level of the bar which require lifting of relatively less body weight, whereas the long jumper have almost same endomorphic and mesomorphic components. Both the endomorphic and mesomorphic components seem to help increase the momentum which results in the better performance in long jump. On the other hand the triple jumpers have endomorphic-ectomorph somatotypes. The ectomorphic component is helpful for lifting the body during the process of triple jumpers.

IV. COMPARISON WITH OLYMPIANS AND OTHER JUMPERS

We have compared the stature and body weight between and jumpers of presents series with Olympians of Mexico city 1968(de Garay et al., 1974) ⁴, Olympians of Montreal 1976 (Carter J.E.L.,1982) ⁵, Olympians of Tokyo 1964 (Hirata K.I.,1979) ⁶ Olympians of Munich 1972 (Novak et al., 1972)⁷, Brazilian jumpers (Guimaraes et al., 1978 , 1980) ⁸, state jumpers

of San Deigo (Westlake , 1967)⁹. Similarly, the pond real index and height/weight ratio of present series of jumper has been compared with Olympians of Montreal, Tokyo and Munich studied by Hirata in 1979.While comparing our data with Olympians, it has been found that the Olympians posses larger height, weight and pondreal Index. Table 7 \$ 8 depicts the picture more vividly.

MEAN, STANDARD DEVIATION AND STANDARD ERROR OF MEAN OF ANTHROPOMETRIC MEASUREMENTS (Table-1)

	Long Jump			High Jump			Triple Jump		
No. of Jumpers	20			25			25		
Measurements	Mean	SD	SE (M)	Mean	SD	SE (M)	Mean	SD	SE (M)
Height	160.09	5.92	1.32	163.68	6.99	1.40	161.79	5.89	1.18
Sitting Height(cm)	79.65	3.01	0.67	80.92	4.03	0.81	79.43	3.54	0.71
Weight (kg)	51.08	7.78	1.74	49.43	7.08	1.42	50.40	5.22	1.04
Arm Span	163.63	7.62	1.70	166.72	6.91	1.38	163.02	6.90	1.38
Hand Span (cm)	19.30	1.09	0.24	19.82	1.34	0.27	20.12	1.55	0.31
Humerus Diameter (cm)	5.79	0.37	0.08	5.90	0.35	0.07	5.87	0.35	0.07
Wrist Diameter (cm)	4.68	0.24	0.05	4.82	0.29	0.06	4.87	0.39	0.08
Femur Diameter (cm)	8.52	0.69	0.15	8.67	0.51	0.10	8.68	0.38	0.08
Ankle Diameter (cm)	6.18	0.37	0.08	6.23	0.33	0.07	6.28	0.30	0.06
Upper Arm Cir. (cm)	22.77	2.19	0.49	22.90	3.55	0.71	22.54	1.67	0.33
Fore Arm Cir. (cm)	21.25	1.31	0.29	21.18	1.26	0.25	21.23	1.16	0.23
Thigh Cir. (cm)	49.44	4.14	0.93	48.92	3.84	0.77	51.22	3.17	0.63
Calf Circumference (cm)	31.23	1.79	0.40	31.02	2.08	0.42	31.95	1.97	0.39
Waist Cir. (cm)	68.84	6.04	1.35	67.55	6.42	1.28	67.34	4.68	0.94
Biceps Skinfold (mm)	5.32	1.53	0.34	5.54	1.77	0.35	6.12	1.99	0.40
Triceps Skinfold (mm)	10.55	3.77	0.84	11.47	3.42	0.68	11.14	3.75	0.75
Fore Arm Skinfold(mm)	6.92	3.32	0.74	6.95	2.19	0.44	7.48	1.88	0.38
Superilliac Skinfold(mm)	7.08	1.89	0.42	7.86	2.80	0.56	8.80	2.90	0.58
Subscapular Skinf. (mm)	8.85	2.18	0.49	9.84	3.05	0.61	10.92	3.52	0.70
Calf Skinfold (mm)	11.06	5.14	1.15	14.41	6.18	1.24	17.69	3.78	0.76

MEAN, STANDARD DEVIATION AND STANDARD ERROR OF MEAN OF DERIVED MEASUREMENTS (Table-2)

	Long Jump			High Jump			Triple Jump		
No. of Jumpers	20			25			25		
Derived Measurements	Mean	SD	SE (M)	Mean	SD	SE (M)	Mean	SD	SE (M)
Endomorphy	2.65	0.77	0.17	2.94	0.87	0.17	3.12	0.81	0.16
Mesomorphy	2.55	0.97	0.22	2.19	1.02	0.20	2.44	0.80	0.16
Ectomorphy	3.20	1.39	0.31	4.17	1.11	0.22	3.53	1.04	0.21
Ossa	7.64	0.88	0.20	8.10	1.02	0.20	8.03	0.75	0.15
Derma	10.30	2.41	0.41	10.46	2.81	0.45	10.96	2.37	0.39
Body density	1.05	0.01	0.00	1.05	0.01	0.00	1.05	0.01	0.00
Percent body fat	20.05	3.02	0.57	20.93	3.52	0.62	21.59	3.13	0.55
Body Mass Index	19.96	3.10	0.69	18.39	1.92	0.38	19.25	1.67	0.33
Pondereal Index	23.15	1.23	0.27	22.38	0.78	0.15	22.82	0.75	0.15
Height/weight Ratio	43.31	2.16	0.48	44.73	1.52	0.30	43.87	1.42	0.28
Wrist/Humerus Dia.	81.18	5.84	1.31	81.79	5.04	1.01	83.19	7.75	1.55
Ankle/Femur Diameter	7308	7.71	1.73	71.94	3.85	0.77	72.42	4.15	0.83
Sitting Height/Height	49.77	1.37	0.31	49.44	1.39	0.28	49.10	1.61	0.32

ANALYSIS OF VARIANCE OF ANTHROPOMETRIC MEASUREMENTS (Table 3)

Measurements	Source of Variation	Sum of Squares	d. f.	Mean sum of Squares	F-Ratio
Height	Between Samples	144.95	2	72.48	1.818
	Within Samples	2671.00	67	39.87	
Sitting Height	Between Samples	31.639	2	15.81	1.226
	Within Samples	864.22	67	12.90	
Weight	Between Samples	31.06	2	15.53	.346
	Within Samples	3005.66	67	44.86	
Humerus Bic. Dia.	Between Samples	.148	2	7.393E-02	.580
	Within Samples	8.542	67	.127	
Femur Bic. Diameter	Between Samples	.358	2	.179	.637
	Within Samples	18.83	67	.281	
Wrist Diameter	Between samples	.390	2	.195	1.933
	Within Samples	6.760	67	.101	
Ankle Diameter	Between Samples	.102	2	5.091E-02	.465
	Within Samples	7.336	67	.109	
Hand Span	Between Samples	7.557	2	3.779	2.044
	Within Samples	123.837	67	1.848	
Arm Span	Between Samples	192.792	2	96.396	1.905
	Within Samples	3391.068	67	50.613	
Upper Arm Cir. (cms)	Between Samples	1.662	2	.831	.121
	Within Samples	459.689	67	6.861	
Fore Arm Cir. (cms)	Between Samples	4.593E-02	2	2.296E-02	.015
	Within Samples	102.834	67	1.535	
Thigh Cir. (cms)	Between Samples	71.989	2	35.995	2.621
	Within Samples	920.182	67	13.734	
Calf Cir.	Between Samples	11.572	2	5.786	1.503
	Within Samples	257.854	67	3.849	
Waist Cir.	Between Samples	28.381	2	14.191	.430
	Within Samples	2209.390	67	32.876	
Bicipes Skinfold	Between Samples	7.966	2	3.983	1.242
	Within Samples	214.907	67	3.208	
Triceps Skinfold	Between Samples	9.466	2	4.733	.357
	Within Samples	888.464	67	13.261	
Fore Arm Skin fold	Between Samples	4.703	2	2.351	.682
	Within Samples	408.560	67	6.098	
Superilliac Skinfold	Between Samples	33.711	2	16.856	2.467
	Within Samples	457.747	67	6.832	
Subscapular Skinfold	Between Samples	48.416	2	24.208	2.656
	Within Samples	610.657	67	9.114	
Calf Sinfold	Between Samples	489.911	2	244.955	9.320**
	Within Samples	1760.933	67	26.283	

ANALYSIS OF VARIANCE OF DERIVED MEASUREMENTS (Table 4)

Derived Measurements	Source of Variation	Sum of Squares	d.f.	Mean sum of Squares	F-Ratio
Endomorphy	Between Simple	2.530	2	1.265	1.878
	With Samples	45.125	67	.674	
Mesomorphy	Between Samples	1.617	2	.809	.928
	With Samples	58.377	67	.871	
Ectomorphy	Between Samples	11.010	2	5.505	3.995*
	With Samples	92.331	67	1.378	
OSSA	Between Samples	2.640	2	1.320	1.673
	With Samples	52.881	67	.789	
DERMA	Between Samples	5.445	2	3.322	.420
	With Samples	434.707	67	4.996	
Body Density	Between Samples	1.401E-04	2	9.31E-05	1.165
	With Samples	4.028E-03	67	4.967E-05	
Percent Body Fat	Between Samples	26.286	2	14.707	1.245
	With Samples	707.319	67	7.898	
Body Mass Index	Between Samples	27.757	2	13.878	2.755
	With Samples	337.518	67	5.038	
Pondreal Index	Between Samples	6.688	2	3.344	3.973*
	With Samples	56.393	67	.842	
Height / Weight Ration	Between Samples	23.344	2	11.672	4.076*
	With Samples	191.865	67	2.864	
Wrist/Humerus Diameter	Between Samples	48.872	2	24.436	.606
	With Samples	2701.703	67	40.324	
Ankle/Femur Diameter	Between Samples	14.310	2	7.155	.252
	With Samples	1899.927	67	28.357	
Sitting HeightHeight	Between Samples	4.951	2	2.476	1.152
	With Samples	143.994	67	2.149	

- Significant at 0.05% level

Results of Post-Hoc Test in Anthropometric Measurements between different Events (Table 5)

Measurements	Long/High	Long/ Triple	High/ Triple	Measurements	Long/High	Long/ Triple	High/ Triple
Height	3.595	1.707	1.888	Calf Circumference	211	.713	.208
Sitting Height	1.270	.218	1.488	Waist Cir.	1.292	1.500	.208
Weight	1.648	.680	.968	Biceps Skinfold	.229	.805	.576
Humerus Bic. Dia.	.114	7.800	3.600	Triceps Skinfold	.918	.590	.2387
Wrist Dia.	.135	.183	4.800	Fore Arms Skinfold	2.800	.556	.528
Femur Dia.	.152	.164	1.200	Superiliac Skinfold	.785	1.729	.944
Ankle Diameter	4.300	9.500	5.200	Subscapular Skinfold	.999	2.079	1.080
Upper Arm Cir.	.126	.234	.360	Calf Skinfold	3.348	6.628*	3.280
Fore arm Cir.	6.100	1.700	4.400	Arm Span	3.090	.606	3.696
Thigh Cir.	.524	1.780	2.304	Hand Span	.521	.821	.300

Results of Post-Hoc Test In Derived Measurements (Table 6)

Variable	Long/High Jumpers	Long/Triple Jumpers	High/Triple Jumpers
Endomorphy	.290	.476	.185
Mesomorphy	.363	.105	.258
Ectomorphy	.946*	.331	.632
OSSA	.458	.393	6.504
DERMA	.171	.659	.487
Body Density	2.030	3.550	1.520
Percent Body Fat	.878	1.537	.650
Body Mass Index	1.569	.713	.855
Pondreal Index	.766*	.328	.438
Height/Weight Ratio	1.422*	.557	.864
Wrist/Humerus Diameter	.608	2.006	1.398
Ankle/Femur Diameter	1.134	.658	.475
Sitting Height/ Height	.360	.665	.335

Comparison of Stature, Body Weight, Pondreal Index and Height/Weight Ratio of Present Study (High Jumpers) Table 7

Countries	No.	Height	Weight	Height/Weight Ratio	Pondreal Index
Present Study	25	163.7	50.4	44.7	22.1
Brazil (Guimaraes et al. 1978,80)	11	174.4	56.0	45.7	
Maxico City 1968(de aray et al., 1974)	4	175.5	58.9	45.11*	
Montreal 1976(Carter,J.E.L.,1982)	40	177.0	62.5	44.60*	22.20 (Gold Medalist) 22.39(Avg.)
Tokyo1964(Hirata, K.L., 1979)	24	172.0	62.2	43.41*	23.02
Munich 1972 (Novak et al.,1972)	45	175.3	62.8	44.10*	22.70

Comparison of Stature, Body Weight, Pondreal Index and Height/Weight Ratio of Present Study (Long Jumpers) Table 8

Countries	No.	Height	Weight	Height/Weight Ratio	Pondreal Index
Present Study	20	160.9	51.1	43.31	23.15
Brazil (Guimaraes et al. 1978,80)	16	164.5	51.9	44.10	
Maxico City 1968(de Garay et al., 1974)	8	166.4	55.2	43.70*	
Montreal 1976(Carter,J.E.L.,1982)	41	170.0	59.5	43.55*	26.10 (Gold Medalist) 25.13(Avg.)
Tokyo1964(Hirata, K.I., 1979)	32	167.8	58.2	43.30*	23.03
Munich 1972 (Novak et al.,1972)	34	169.5	59.5	43.42*	25.14

- Calculated from the Avg. Values (Table 7 & 8)

REFERENCES

- [1] Miller,D.M.(1974).Some Historical Roots Coaching female athlete. Lea Febiger Philadelphia
- [2] Howe,E.m 1978, ‘ A Little too strenuous for women? In report of the 1st international conference on women in sports.
- [3] Sodhi, H.S. and Sidhu, L.S. (1984). Physique and selection of sportsman. Punjab Publishing House Patiala.
- [4] de Garay, A.L., Levine, L. and carter, J.E.L. (1979) Genetic and Anthropological studies of Olympic Athletes. Academic Press, New York, London.
- [5] Carter, J.E.L. (1982). Physical structure of Olympic athletes. Part-1. The Montreal Olympic Games. Anthropological project carter, J.E.L. (E.d.) med. And sport. 16.S. karger, Basel.
- [6] Hirata, Kin-itsu (1979). Selection of Olympic Champions. Department of Physical Education, Chukyo University Press, Toyata, Japan.
- [7] Novak, L.P., woodward, W.A., Bestit, C., Mellerowicz, H. (1972) working capacity, body composition and anthropometry of Olympic female athletes. In Jungmann, Sportwissenschaftliche Untersuchungen wahrend der XX. Olympischen Spiele, Munchen (Demeter, Graferlfing 1976)
- [8] Guimaraes, A.Rose. E.H.de: (1978) Somatoptes of Brazilin track and field student athletes. Paper presented 21st world conference in sports medicine, Brazilin.
- [9] Westlake, D.J. (1967). The somatotypes of female track and field competitors, M.A. Thesis, San Diego State College.

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