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A comparative analysis of selected anthropometric variables and somatotyping components of Ethiopian female jumpers

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Abstract
This study was aimed at the comparative study of some selected anthropometric measurements and somatotyping components of Ethiopian female jumpers. The sample of the study was total 30 female high, long and triple jumper athletes, who participated in Ethiopian first division clubs. The stratified sampling technique was employed to select the athletes. The age of athletes was between 17-26 years. The selected anthropometric variables taken for the study were (Height, weight, BMI, thigh, calf, chest, triceps, subscapular and supraspinal skinfold, femur, humerus and arm and calf girth). The data was analyzed using SPSS 20.0 version. The result of one-way analysis of variance (ANOVA) showed significant differences among jumpers across selected anthropometric characteristics and 'F' ratio showed significant differences. The Tukey's Post-hoc test was used to investigate the mean differences and 0.05 confidence level was set. The results of the study revealed that, the mean scores for the Endomorph, thigh and calf skinfold for high jumpers was significantly different for long jumpers. In addition, the mean scores for the sum of 7 fat skinfold, body fat percent, body fat weight and body density of long jumpers were statistically significant varied for high jumper and triple jumper athletes. However, the mean scores of mesomorph, ectomorph, and lean body weight for high jump, long jump and triple jump were not statistically significant varied.
The study also revealed that the high jumpers had the highest lean body weight in comparison with other jumpers. Besides, high jumpers had the highest ectomorph component while long and triple jumpers were found to have higher mesomorph component.

Keywords: Anthropometric, somatotype, high, long, triple jumper

Introduction
Ethiopian field event athletes facing myriads of challenges through the process of reaching the climax stage of performance regarding to the talent identification process. The stakeholders have also been trying to alleviate these rampant problems. The problem encountered in Ethiopian associated with identification and selection of talented by using old methods (not scientific). One typical immediate solution that to identify athletes by anthropometric and body physique with relevant sports called ''morphological optimization''. Anthropometric is one branch of morphological aspects which is important for a specific sport. The facts of anthropometric measurements provide us, particularly athletes with the useful improvement of athletic performance. Various body measurements such as height, body weight, body mass index, leg length, thigh, calf, waist and circumference and waist height ratio are closely tied up with jumping performance. This study gives an overview of research results on anthropometric measurements and jumping performance

Anthropometric, morphological and somatotypeing characteristics play an important role in identifying the achievement of athletes. Various studies conducted by many scholars, i.e. Claessens *et al*. (1994) [5] there are many factors which contribute to the sports performance. Skill, psychological characteristics, powerful and capacious energy-production systems are all important factors in sports performance, but the main success factors in sports are body size, shape and morphology. Ranawat (2010) [13] the importance of morphological optimization varies from sport to sport. They are smaller (Hockey player), leaner (distance runner), more muscular (power lifters), fatter (sumo wrestlers), taller (basketball player), or have longer legs (high jumpers).

Another supports were about factors of performance selection in general, the selection of athletes should be primarily based on the abilities and skills that have a crucial influence on sport performance, where genetic factors could be of considerable importance Langer (2007) [26] conducted a study on somatotypes of the body to jumpers. In the overwhelming majority of measurements the particular components of somatotypes show a tendency to increase and the average somatotype of high jumpers is 3.4–3.7–4.2. Endomorphic mesomorphs (16.7%), mesomorphic ectomorphs (15.2%) and ectomorphic mesomorphs (13.5%) are other frequent somatotypes. With the high jumpers we have kept under review there is an apparent dominance of the ectomorphic component (51%), especially in the last two measurement stages. Endomorphic ectomorphs (43.8%), mesomorphic ectomorphs, ectomorphic endomorphs (identically 16.3%) and ectomorphic mesomorphs (15.2%) were the most frequent somatotypes of the female high jumpers measured. The shot put athletes showed better anthropometric measurements and somatotyping scores,

Furthermore, in the complete process for the high jump, physique and position of body parts are factors in clearance hight, and vertical forces and mass are factors in producing change in vertical velocity of the jumper (Carter J. E. L., 1990). The former studies have been shown deeply what about the extent of skinfold fat and related body composition comparing with high and low performer jumpers. the high performer jumpers had lesser skinfold measurement than the low performer jumpers. Whereas, percentage body fat was reported significantly higher in low performer jumpers. The significant differences were observed in height, weight, all segment lengths, circumferences, diameters and skinfold measurement among various groups of throwers. Anup A., Nahida P., Islam R. and Ali (2014), [1] pointed out that the male sprinters and discus throwers reported to be with a higher value of 16.4%. Similarly, the female track and field jumpers and hurdlers were performing with 20.7% fat. Highest values were observed for the female discus throwers and shot-putters, which were 25% and 28% respectively. For the Bangladeshi female athletes, an average value of 18.4% was observed which seemed to be satisfactory when compare to their other international counterparts. Whereas jumping event players was 22%. While the Bangladeshi male athletes were considered they possessed an average value of 7.9 percent. As well as the low performer high jumpers were found to have significantly higher body density and % body fat and higher endomorphic score than the high performers whereas high performer high jumpers had significantly higher lean body mass as compared to low performer high jumpers, whereas the high performer high jumpers had significantly higher mesomorphic score than the low performer high jumpers. And he compared that on the contradicts the results his study showed somatotype scores of the African middle and long distance runners who are currently the best in the world were 1.4-3.2-4.2 and 1.6-2.9-4.3 respectively.

Fortunately, recent investigations from different parts of the world suggested that certain anthropmetric measurements have been enhancing athletic performance in a specific sport. This study conducted to analyze somatotypes with jumpers. The anthropometric research that he carried out with Czech and foreign male and female high jumpers on a long term basis was especially informative. He studied many years progress measurements, the particular somatotype components show a tendency to increase (3.4–3.7–4.2), which corresponds to the category of mesomorph's ectomorphs with groups of high jumpers. Similarly with the present study result Singh (2010) stated that the manonmaniam sundaranar inter university athletes somatotype characteristics of high jumpers were ectomorphic mesomorph. Almost similar somatotype result showed in study but somewhat different such Ramzan (2013) the somatotype scores indicate that throwers are endomorphic mesomorph, middle and long distance runners ectomorphic mesomorphs and jumpers balanced mesomorphs. In track and field athletics, several studies have investigated anthropometric variables in relation to event participation (Carter, 1982; Langer, 2007).

Objectives of the study

The objective of this study was at investigating the anthropometric characteristics and somatotyping of Ethiopian female jumper athletes.

Material and methods

The present study was conducted on 30 female high, long and triple jumpers, who participated in Ethiopian senior national team athletes. The researchers were using purposive sampling techniques was to selecte from six clubs. All primary data were collected using standard anthropometric measurements and secondary data, whereas the secondary data about the background of the athletes was collected from EAF[1].

Some selected anthropometric measurements were conducted by standard tools. Anthropometric rod, Harpenden skinfold caliper, flexible steel tape and portable weight machine was used, some selected anthropometric measurements (height, weight, BMI, thigh, calf, chest, triceps, subscapular and supraspinal skinfold, femur, humerus and arm and calf girth).

Somatotyping components (endomorphy- mesomorphy-ectomorphy) were calculated according to Carter and Heath method (1990).

BMI (Kg/m2) = (Body mass in Kg)/ (Stature in m) (Meltzer *et al*., 1988).

For 17 to 19 years age group: Body Density (gm/cc) = 1.1620-0.0630 (X) (Durnin & Womersley, 1974)

For 20 to 29 years age group: Body Density (gm/cc) = 1.1631-0.0632 (X) (Durnin & Womersley, 1974) Where X = log(biceps+triceps+Subscapular+suprailliac).

% Body Fat = [4.95/ body density-4.5] * 100 (Siri, 1956)

Total Body Fat (kg) = (%body fat/100) * body mass (kg)

Lean body weight (kg) = body weight (kg) – total body fat (kg)

- Endomorphy = - 0.7182 + 0.1451(X) - 0.00068 $(X)^2$ + 0.0000014 $(X)^3$ (Where X = sum of supra-spinale, subscapular and triceps skinfold and corrected for stature by multiplying the sum of skinfolds by 170.18/body height in cm)
- Mesomorphy = (0.858 * humerus width) +(0.601 * femur width) +(0.188 * Corrected arm girth) +(0.161 * corrected calf girth) -(body height * 0.131)+4.5 (Where corrected arm girth = arm girth-biceps skinfold, corrected calf girth = calf girth-calf skinfold)
- Ectomorphy = (HWR * 0.732)-28.58 [Where HWR = (body height in cm)/ (weight in $kg)^{1/3}$]. Percentage body

[1] Ethiopian athletics federation

fat as estimated from the sum of skin folds was calculated using equations of Siri (1956) and Durnin and Rahaman (1967).

Statistical analyses

Statistical analyses were employed using SPSS 20.0 (Statistical Package for the Social Sciences) version. Descriptive and inferential statistics, such as mean, standard deviation, analysis the data so as to address the research questions. One way analyses of variance (ANOVA) were conducted to compare the differences. Where 'F' ratio values were existed significant differences, Tukey's Post-hoc test was conducted to find out the direction and degree of mean differences and 0.05 was set as level of confidence.

Results

It was hypothesized that there were no difference in weight, height and body mass index among female high, long and triple jump athletes. The results indicated that under.

One way analysis of variance of weight, height and body mass index for female high, long and triple jumper athletes.

Table 1

Variables		SS	Df	MS	F	Sig.
Weight	Between Groups	9.133	2	4.566	.148	.863
	Within Groups	834.922	27	30.923		
Height	Between Groups	.010	2	.005	1.443	.254
	Within Groups	.093	27	.003		
Body Mass Index	Between Groups	2.381	2	1.190	.169	.845
	Within Groups	189.997	27	7.037		

Source: primary data of the research (2017).

A one way of analysis of variance results indicated that weight, height and BMI score differences F (2,27)=.148, p=.863, F (2,27)=1.443, p=.254 and F (2,27)=.169, p=.845 among high, long, triple jumper athletes respectively. This implies that the variation in mean scores for height, weight and BMI were not statistically significant at $p<0.05$.

One way analysis of variance of morphological characteristics of endomorph, mesomorph and ectomorph of female high, long and triple jumper athletes.

It was hypothesized that there were no difference of endomorph, mesomorph and ectomorph among female high, long and triple jump athletes. The results indicated below:

Table 2

Variables		SS	Df	MS	F	Sig.
Endomorph	Between Groups	8.742	2	4.371	12.871	.000
	Within Groups	9.170	27	.340		
Mesomorph	Between Groups	.470	2	.235	.263	.770
	Within Groups	24.093	27	.892		
Ectomorph	Between Groups	3.852	2	1.926	1.406	.262
	Within Groups	36.981	27	1.370		

Source: primary data of the research (2017).

A one way between groups analysis of variance was performed to investigate the morphological characteristics of endomorph, mesomorph and ectomorph score of difference between groups. Participants were divided into three groups according to their field events (high, long and triple jump). The test showed that there was a statistically significant difference of endomorph F (2, 27)=12.871, p=0.000 and there was no statistically significant difference of mesomorph score of the group F (2, 27)=.263, p=.770 and ectomorph F (2, 27)=1.406, p=.262 at $p<0.05$ level score of between groups.

Post hoc comparisons using the Tukey's HSD test indicated that the mean score for the Endomorph for high jump (M=2.44, SD=0.52) was significantly different from long jump (M=3.73, SD=0.74).

A one way analysis of variance of thigh skin fold, calf skin fold and total 7 sum of fat of female high, long and triple jumper athletes.

It was hypothesized that there were no difference of weight, height and body mass index among female high, long and triple jump athletes. The results indicated belobeloww:

Table 3

		SS	df	MS	F	Sig.
Thigh skinfold	Between Groups	131.667	2	65.833	5.003	.014
	Within Groups	355.300	27	13.159		
Calf skinfold	Between Groups	70.467	2	35.233	4.994	.014
	Within Groups	190.500	27	7.056		
Sum of 7 fat	Between Groups	3868.200	2	1934.100	9.567	.001
	Within Groups	5458.600	27	202.170		

Source: primary data of the research (2017).

A one way between groups analysis of variance was conducted to compare the thigh skin fold, calf skin fold and total sum of 7 fat skinfold score of difference between groups. Participants were divided into three groups according to their field events (high, long and triple jumpers). The test revealed that there was a statistically

significant difference at the p<0.05 level in thigh skin fold F (2, 27)=5.003, p=.014, calf F (2, 27)=4.994, p=.014 and sum of 7 fat F (2, 27)=9.567, p=.001 scores between the groups at p<0.05 athletes.

Post hoc comparisons using the Tukey's HSD test indicated that the mean score for the thigh skin fold of high jumper (M=7.30, SD=1.05) were statistically significant difference from long jumper (M=11.00, SD=3.68) athletes. The same is true, the mean score for the calf skin fold of high jumper (M=7.30, SD=1.05) were statistically significant difference from long jumper (M=11.00, SD=3.68) athletes. In addition, the mean score for the sum of 7 fat site skin fold of long jumper (M=87.40, SD=17.63) were statistically significant difference from high jumper (M=60.70, SD=12.61) and triple jumper (M=67.30, SD=11.68) athletes. A one way analysis of variance of body density, fat percent, body fat weight and lean body weight for female high, long and triple jumper athletes.

Table 4

Variables		SS	df	MS	F	Sig.
Body density	Between Groups	.001	2	.000	9.558	.001
	Within Groups	.001	27	.000		
Fat percent	Between Groups	110.504	2	55.252	9.559	.001
	Within Groups	156.056	27	5.780		
Body fat weight	Between Groups	46.666	2	23.333	8.613	.001
	Within Groups	73.142	27	2.709		
Lean body weight	Between Groups	33.694	2	16.847	.663	.523
	Within Groups	685.593	27	25.392		

Source: primary data of the research (2017)

A one way between groups analysis of variance was performed to evaluate the body density, fat percent, body fat weight and lean body weight scores of difference between groups. Participants were divided into three groups according to their field events (high, long and triple jump). The test stated that there was a statistically significant difference in the body density F (2, 27)=9.558, p=.001, body fat percent F (2, 27)=9.559, p=.001, body fat weight F (2. 27)=8.613, p=.001 scores between the groups. On the contrary, the test showed that there was no a statistically significant difference in the lean body weight F (2, 27)=.663, p=.523 scores between the groups at p<0.05 athletes.

Post hoc comparisons using the Tukey's HSD test indicated that the mean score of body density for long jump (M=1.05, SD=.006) was statistically significant difference from high jump (M=1.06, SD=.005) and triple jump (M=1.05, SD=.004) athletes. Whereas, the mean score of body fat percent for long jump (M=20.92, SD=2.85) was a statistically significant difference from high jump (M=16.38, SD=2.30) and triple jump (M=17.61, SD=1.97) athletes. In addition, the mean score of body fat weight for long jump (M=12.40, SD=2.47) were statistically significantly different from high jump (M=9.51, SD=1.07) and triple jump (M=10.09, SD=.90) athletes. On the contrast, the mean scores of lean body weight for high jump (M=16.38, SD=2.30), long jump (M=20.92, SD=2.85) and triple jump (M=17.61, SD=1.97) were no statistically significant difference between athletes.

Discussion

The descriptive results demonstrated that, high jumper and long jumper had almost the similar body weight and height as compared to triple jumpers had the lowest. In the case of fat skinfold long jumpers were fatty and had higher thigh, calf and sum of 7 fat skinfold and fat percent and body fat weight.

The high jumpers had the highest lean body weight and triple jumpers had the least than jumpers. High jumpers had the highest ectomorph component and long and triple jumpers were found to have higher mesomorph component.

The ANOVA test indicated that weight, height and BMI score differences among high, long, triple jumper female athletes were not statistically significant at p<0.05. This implies that there was no difference of weight, height and BMI among females high, long and triple jumper athletes.

Post hoc comparisons using the Tukey's HSD test indicated that among females' jumpers, it was found that the highest value of endomorph has been found in the long jumpers followed by triple and high jumpers. Triple jumpers have revealed that they are found to be more mesomorph and followed by long and high jumpers. In ectomorph component high jumpers are found to be leaner as compared to long and triple jumpers. Stanković D. *et al* (2016) the most common components in female high jumpers and elite female high jumpers are endomorph and ectomorph. Kaur Tiwana (2013) [15] 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. 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. Both the endomorphic and mesomorphic components seem to help increase the momentum which results in better performance in the long jump. Similarly with the present study result Singh (2010) [13] stated that the manonmaniam sundaranar inter university athletes somatotype characteristics of high jumpers were ectomorphic mesomorph.

Previous studies demonstrated that the somatotypes of elite triple jumpers related to low performers. The somatotype scores of high performer triple jumpers are 2.4-2.5-3.7. The triple jumpers of the study are balanced ectomorph (Sodhi, 1991). [23] In other words Singh (2012) [11] reported that most of triple jumpers had greater ectomorphic component as compared to throwers. The present study result showed that the triple jumpers somatotype body component looks like (2.86-3.17-2.89) which is ectomorphic mesomorphic. But previous studies showed in the contrast way.

Hence, as had been showing in previous studies ectomorphic is vital to help jumper athletes to achieve theirperformance. May be this low level of somatotype body

component is the reason for Ethiopian jumper athletes didn't achieve a good performance.

In order to compare the thigh skin fold, calf skin fold and total sum of 7 fat score of difference between female jumper athletes. The present study results revealed that there were strong differences among female jumping events across thigh, calf and 7 skinfold fat amount in their body. Long jumpers had the maximum fat skinfold and high jumpers had the least skinfold amount in mm. Where as in calf skinfold highest amount values were observed in long jumpers and minimum amount found in high jumpers.

The sum of skinfolds can predict the jumping and throwing performance. As the present study result revealed that athletes with the best score in the jumping events, they have the lowest skinfold amounts in their body as well as athletes with the best score in throwing events, they have much skinfold amounts in their body. In addition the long jumpers had much amount of fat accumulated followed by triple and high jumpers.

Šolaja A. (2017) [24] his study results are consistent with the research where the male and female sprinters had the lowest sum of skinfolds, i.e. 46.8 mm and 60.3 mm, respectively, and male throwers (javelin) (62,8 mm) and female throwers (95,3 mm) had the highest skinfold levels.

The test stated that there were statistically significant differences in the body density, body fat percent and body fat weight between the groups. Test showed that there was no a statistically significant difference in the lean body weight scores between the groups at $p<0.05$ athletes.

Fat percent standards showed that male and female jumper athletes typically have a body fat percentage of between 7 and 12% and 10 and 18% respectively as well as male and female thrower athletes a body fat percentage of 16 to 20% and 20 and 28% respectively (S.N HK, 2017)[2].

Among Ethiopian female jumpers the highest fat percentage were found in the long jumpers (20.9%) followed by triple jumpers (17.6%) and the least fat accumulated in high jumpers (16.3). The female jumpers Ethiopian athletes also had slightly higher percentage of body fat when compared to the jumpers' athletes standard.

When compared to the Indian female jumpers triple jumpers and long jumpers are almost the same amounted of fat percent (10.15%) reported by (Ranawat 2010) [13] Others different and Indian studies showed that the number of fat percent clearly elaborated that Ethiopian female jumpers had more fat in their body as compared with them. This is maybe one of the hinder factor to be achieved low level. In addition to fat percent, the fat weight results were found very high in long jumpers followed by triple and high jumpers. According to body density in the reverse high in high jumpers followed by the same results in triple and long jumpers. Based on fact and as many studies revealed that the amount of fat accumulates in the body being hampers from more engaging activities especially jumping events. This study was conducted to determine the anthropometric measurements and body composition of selected national athletes. The percentage average body fat for both male and female athletes were 13.8 ± 4.5% and 24.7 ± 5.3%, respectively. Ranawat (2011) fat (% & kg) among the men jumpers highest percentage of at is found in the high jumpers. Among women, triple jump and long jump women have reported with almost the same amount of fat (%).

[2] Sport nutrition, Human kinetics, 2017

Conclusion

Based on the findings of this study, it is concluded that the descriptive result demonstrated that, high and long jumpers had almost the similar body weight and height as well as triple jumper had the lowest. In the case of fat skinfold long jumpers were fatty and had higher thigh, calf, sum of 7 fat skinfold, fat percent and body fat weight. The high jumpers had the highest lean body weight and triple jumpers had the least than jumpers. High jumpers had the highest ectomorph component and long and triple jumpers were found to have higher mesomorph component.

The anova results of the study revealed that, the mean score for the Endomorph, thigh and calf skinfold for high jump was significantly different from long jump. In addition, the mean score for the sum of 7 fat skinfold, body fat percent, body fat weight and body density of long jumpers were statistically significantly different from high jumper and triple jumper athletes.

Among Ethiopian female jumpers the highest fat percentage was found in the long jumpers (20.9%) followed by triple jumpers (17.6%) and the least fat accumulated in high jumpers (16.3). The female jumpers Ethiopian athletes also had slightly higher percentage of body fat when compared to the jumpers' athletes with normal fat. The weight, height, BMI, lean body weight, mesomorph and ectomorph score differences among high, long, triple jumper female athletes were not statistically significant at $p<0.05$. In most of the anthropometric variables there were strong significant differences among high, long and triple jumper athletes.

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