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The study of relationship and factors to predict selected anthropometric variables of male and female jumpers

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Abstract
This study was aimed at the relationship and predictions of some selected anthropometric measurements as compared with Ethiopian male and female high and long jumpers. The sample of the study was total 30 female high and long 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 (Height, weight, BMI, lean body weight, weight height ratio, lower leg length, waist, thigh, hip and calf circumference). The data were analyzed using SPSS 20.0 version. The result of Pearson product moment correlation coefficient showed the relation between anthropometric variables and jumping performance while regression revealed to identify predictor factors.
These study findings elucidated that there were existed statistically positive significant relationships between athletic performance and body height for both sexes high and long jumper athletes. The study also demonstrated that athletic performance was negatively strong correlated to body weight in both sexes. Thus, it is important parameter to help to identify successful athletes positively for some types of sports.
While as compared to body mass index and lean body weight with athletic performance was found highly negative significant relationship for both sexes in high and long jumper athletes.
There were strong negative correlation existed between waist and hip circumference for both male and female athletes while positive relation observed between lower leg length and athletic performance in both sexes among high and long jumpers.
Hence, the long and high jump performance predicted by some anthropometric measurement variables while showing significant related to its performance of height, lean body weight and lower leg length.

Keywords: anthropometric, high, long, jumper

Introduction
Ethiopia is one of the owners of famous and recognized athletes from some competitor countries. It has been competing a world class, particularly in middle and long distance running called ‘’land of runners’’. In case of field events (jumping and throwing), still on the ground but becoming better and better through time.
The performance of athletics has been commonly influenced to a great extent by genetic, physiological, sociological, environmental, sex, age, muscle type, physical, nutrition, altitude, and lifestyle variables. In the recent, anthropometric, physical and psychological variables of sports have been over focused to achieve athletic performance.
Related anthropometric variables are needed to be successful in certain sporting events positively and negatively influence for others. For instance, weight is valuably crucial for throwers and hamper negatively for jumpers. It is evident from the combined contribution of the height, weight, body mass index, lean body weight, thigh, calf, waist, hip circumference, weight hip ratio and lower leg length are strongly significant correlated to the performance in jumpers.
The recent studies are discussing the relationship between anthropometric characteristics and athletic performance has highly correlated each other. Under here the researcher discussed about each anthropometric characteristic of association, difference and determinant or predictor factors influencing athletic performance. Many studies were revealed that, the athletes standing height and body weight of both sexes was highly related to jumping athletic performance. The study by Coh, M., Embersic, D. and Zvan, (2001) reported top results achieved by the athletes who are tall and relatively low weight of the body and shows strong evidence that there is a positive association between standing height and athletic performance. Ranawat (2010) [8] discussed about Indian female jumpers. It is found that Indian high jumpers women are tallest, followed by triple jumpers and long jumpers. KaurTiwana (2013) [9] this study compared jumping events. Other similar studies revealed that the influence of height as a variable is important when selecting athletes to their various events (Ogunleye, 1999). The high Indian female jumpers are the tallest with long trunks and largest arm spans and lightest with less muscle at thigh, calf and the forearm. Goswami, N. (2013) [5] the long jump performance can also be predicted by anthropometric measurement variables which have shown a significant relationship to long jump performance lower arm length, calf (lower leg) and thigh girth. Shailaja (1992) supported in a related way to this study that the height of an individual plays an important role in his motor abilities. It

helps the athlete in running and jumping as their dynamic equilibrium will be better due to a higher centre of gravity. Weight is one of important parameter which used to help identify successful athletes positively for some types of sports and negatively to others.

Fortunately, the result of present study assisted by Shailaja (1992) he discussed the momentum of a body highly depends on its weight. Especially the jumpers need optimum weight to develop sufficient momentum while the jumpers convert their linear motion to vertical momentum. Another study also declared that Singh (2011) body weight among Indian jumpers, men high jumpers have been found to possess the lowest body weight followed by triple jumpers and the long jumpers. The other related to some anthropometric characteristics like upper arm, chest and thigh circumferences (K. Singh, P. Singh & C. Singh, 2012).

Various studies have shown a negative association between thigh circumference and athletic performance for most female and male jumper. The long jump performance can also be predicted by anthropometric measurement variables which have shown significant related to its performance of calf girth and thigh girth. Singh *et al*. (2013) female jumpers were recorded larger leg length with respect to female sprinter. Numerous studies demonstrated that leg length and arm length had directly relationship and significant important for jumpers and throwers.

Objectives of the study

- To find out the relationship between selected anthropometric variables with performance of female and male high and long jumper athletes.
- To predict the performance of male and female high and long jumpers on the basis of selected anthropometric variables

Material and methods

The present study was conducted on total 50 male and female high and long jumpers, who they were participating in Ethiopian senior national team athletes. The researcher was using stratified purposive sampling was selected from six clubs. All primary data and secondary information on athletes' background 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, lean body, thigh, calf, waist, hip circumference, WHR and lower leg length).

Statistical analyses

Statistical analyses were employed using SPSS 20.0 (Statistical Package for the Social Sciences) version of the data was presented as descriptive statistics such as mean, standard deviation. Pearson Product Moment Correlations for evaluating the relationship of jumping performance with selected anthropometric variables. Multiple correlations for evaluating the combined effect of independent variables on dependent variables were used. Regression model for predicting the performance from dependent variables were used and 0.05 was set as level of confidence.

Hence, the present researcher has made an attempt to find out the relations between anthropometric measurements and jumping performance. The study of relationship between selected anthropometric variables and athletic performance of high and long jumpers

Results

Table 1: Correlation results of jumpers and athletic performance

Variables	The correlation between Anthropometric characteristics and jumping performance			
	High jump		Long jump	
	Female N=10	Male N=15	Female N=10	Male N=15
Height	.813**	.570*	.785**	.714**
Weight	-0.366	-.799**	-.746*	-.921*
Body mass index	-0.718*	-.776**	-.890**	-.855**
Lean body weight	-.682**	-.793**	-.655**	-.917**
Thigh circumference	-0.541	-.600*	-.660*	-0.18
Calf circumference	-0.175	-.770**	-0.541	-0.404
Waist circumference	-0.457	-.710*	-0.597	-0.449
Hip circumference	-0.316	-0.711**	-0.526	-0.841**
Weight height ratio	-0.592	-0.801	-.849**	-.891**
Lower leg length	0.522	.560*	.657*	.534*

***Source*:** primary data of the researcher, (2017)

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

The Pearson product moment correlation coefficient of results explained the relationship between some selected anthropometric variables with athletic performance of male and female high and long jumper athletes.

There were existed positive statistically significant relationship between athletic performance and body height female high and long jumpers (r=.813** and r=.785**, p<0.01) as well as male high and long jumpers (.570* and .714**, p<0.05 and p<0.01) respectively.

Athletic performance was negatively significant correlated to body weight female of high and long jumper (r=-0.366, and -.746*, p<0.05) respectively. Moreover, table 1. Obviously showed that weight of male of high and long jumper athletes had a negative and significant correlation to athletic performance (r=-.799** and r=-.921*, p<0.01 and p<0.05) respectively.

Athlete's body mass index and athletic performance have been found highly negative significant relationship for female high and long jumper athletes (r=-.718* and r=-.890**, p<0.05 and p<0.01) respectively. The same is true negatively significant correlated body mass index and athletic performance for male high and long jumper athletes (r=-.776** and -.855**, p<0.01) respectively. While a negatively significant correlated of lean body weight with athletic performance for female (r=-.682** and r=-.655**, p<0.01) respectively. In other words, there were found negatively correlated but significantly with athletic performance for male high and long jumper athletes (r=--.793** and r=-.917**, p<0.01) respectively.

As Table 1, indicated that there were a strong negative association between thigh circumference and athletic performance for female high and long jumper (r=-0.541 and r=-.660*, p<0.01) respectively. The same is true that there

[1] Ethiopian athletics federation

were found negative strong association between thigh circumference and athletic performance for male high and long jumpers (r=-.600 and r=-0.18, p<0.01) respectively.

Coefficient of correlation have been revealed a strong positive association between calf circumference and athletic performance for female high and long jumper (r=-0.175 and r=-0.541, p<.0.05) respectively. Moreover, there was found negative strong correlation male high and long jumper (r=-.770* and r=-0.404, p<0.05) respectively. There were strong negative correlation have been existed between waist circumference and athletic performance for female high and long jumper (r=-0.457 and -0.597, p<0.05 respectively. On the other hand, there was a strong negative relationship for male high and long jumper (r=-.710 and r=-0.449, p<0.05) respectively.

There were existed strong positive association between hip circumference and athletic performance female high and long jumper (r=-0.316 and r=-0.526, p<0.05) respectively. In other words hip circumference has been found negative strong association with athletic performance for male high and long jumpers (r=-.711** and r=-.841**, p<0.01) respectively.

There were strong positive relation observed between lower leg length and athletic performance for female high and long jumpers (r=0.522 and .657*, p<0.05 and the same is true for male (r=.560* and .534*, p<0.05) respectively. There were found negative strong association between weight height ratio and athletic performance for female high and long jumpers (r=-.592, p<0.05, r=-.849**, p<0.01 and, p<0.05) respectively. Similarly there were existed negative strong correlation male high and long jumpers (r=-.801, p<0.05 and r=-.891**, p<0.01) respectively.

A multiple linear regression was conducted to predict female high jump performance based on selected anthropometric variables.

Table 2: Regression model and coefficients for factors predictive of athletic performance in female high and long jumper athletes.

Model		B	Std. Err	Beta	t	P	Model sumary		ANOVA	
							R	ARS	F	P
1	(Constant)	.026	.276		.095	.927	.914[a]	.789	17.79	.002[b]
	Height	.683	.169	.660	4.044	.005				
	lower leg length	.007	.003	.445	2.727	.029				
2	(Constant)	.534	2.009		.266	.798	.901[a]	.759	15.184	.003[b]
	Height	3.803	1.005	.648	3.783	.007				
	LBW	-.039	.014	-.464	-2.709	.030				

a. Dependent Variable: Athletic performance
b. Predictors: (Constant), 1, lower leg length, Height, 2, Lean body weight, height

***Source*:** primary data of researcher, (2017)

Multiple regression analysis was used to develop a model for predicting athletic performance from the various possible predictors such as body height and lower leg length. The multiple regression model with the two predictors produced adjusted R square (R=. 789), indicating that 78.9% of the variance in the athletic performance is explained by the independent variables such as body height and lower leg length. On the other hand, the remaining 21.1% variation in athletic performance is explained by other factors, which is not seen in this study. Similarly, the analysis of variance a one way ANOVA revealed F(2, 7)=17.79; p<.05, indicating the relationship between the athletic performance and the predictors is statistically significant at p<0.05.

Athletes' predicted their performance is equal to .026 + (.683 x 1.71) + (.007 x 55). Where, athletic performance will be increase 0.683cm for each meter of body height and increase 0.007 meter for each cm of body lower leg length.

As well as multiple regression analysis was used to develop a model for predicting long jumper performance from the various possible predictors such as body height and lean body weight. The multiple regression model with the two predictors produced adjusted R square (R=. 759), indicating that 75.9% of the variance in the athletic performance is explained by the independent variables such as body height and lean body weight. On the other hand, the remaining 24.1% variation in athletic performance is explained by other factors, which is not seen in this study. Similarly, the analysis of variance a one way ANOVA revealed F(2, 7)=15.18; p<.05, indicating the relationship between the athletic performance and the predictors is statistically significant at p<0.05.

Athletes' predicted their performance is equal to .534 + (.3803 x 1.702) + (-0.039 x 46.509). Athletic performance increased 0.683cm for each meter of body height and decreased 0.039 cm for each kg of lean body weight.

A multiple linear regression was conducted to predict male high jump performance based on selected anthropometric variables.

Table 3: Regression model and coefficients for factors predictive of athletic performance in male high and long jumper athletes.

Model		B	Std. Err	Beta	t	P	Model summary		ANOVA	
							R	ARS	F	P
1	(Constant)	2.45	.135		18.245	.000	.799[a]	.610	22.932	.000[b]
	Weight	-.010	.002	-.799	-4.789	.000				
2	(Constant)	18.45	1.353		13.641	.000	.921[a]	.836	72.465	.000[b]
	Weight	-.177	.021	-.921	-8.513	.000				

a. Dependent Variable: Athletic performance
b. Predictors: (Constant), Weight of athlete, Weight of athlete

Source: primary survey data of the researcher, (2017)

Multiple regression analysis was used to develop a model for predicting athletic performance from the possible predictor which is weight. The multiple regression model with the one predictor produced adjusted R square (R=. 610), indicating that 61% of the variance in the athletic performance is explained by the independent variables such as body weight. Similarly, the analysis of variance a one way ANOVA revealed F(1, 13)=22.93; p<.05, indicating the relationship between the athletic performance and the predictors is statistically significant at p<0.05. Athletes' predicted their performance is equal to 12.575 + (-.01 x 65.43). Where, athletic performance will be decrease 0.01m for each kg of body weight.

As well as multiple regression analysis was used to develop a model for predicting athletic performance from the possible predictor which is weight. The multiple regression model with the one predictor produced adjusted R square (R=.836), indicating that 83.6% of the variance in the athletic performance is explained by the independent variables such as body weight. Similarly, the analysis of variance a one way ANOVA revealed F(1, 13)=72.46; p<.05, indicating the relationship between the athletic performance and the predictors is statistically significant at p<0.05. Athletes' predicted their performance is equal to 18.459 + (-.177 x 64.96). Where, athletic performance will be decreased 0.177cm for each kg of body weight.

Discussion

The relationship between some anthropometric characteristics and athletic performance has highly correlated each other. Under here discussed about each some anthropometric characteristic of association with athletic performance.

The present study findings elucidated that there were existed statistically positive significant relationships between athletic performance and body height for both sexes high and long jumper athletes. The findings of the current study well supported by Coh, M., Embersic, D. and Zvan, (2001) reported top results achieved by the athletes who are tall and relatively low weight of body and shows strong evidence that there is a positive association between standing height and athletic performance. Thus, according to the study finding body height was one of the fundamental and crucial parameter to identify field event athletes. According to previous studies reference the average height of the present study athletes were comparatively less than Indian athletes in both sexes whereas relatively similar with African athletes. The mean height values of Indian and Ethiopian jumpers were males (176cm and 182cm) respectively reported by (Singh *et al*, 2010). Hence, standing height was one of the influential factors in determining better athletic performance besides other anthropometric variables.

Weight is one of important parameter which used to help identify successful athletes positively for some types of sports and negatively to others.

The finding of the current study was demonstrated that athletic performance was negatively strong correlated to body weight in both sexes negatively significant correlated with high and long jumper athletes.

Fortunately, the result of present study assisted by Shailaja (1992) He discussed the momentum of a body highly depends on its weight. Especially the jumpers need optimum weight to develop sufficient momentum while the jumpers convert their linear motion to vertical momentum.

Another study also declared that Singh (2011) body weight (kg) among Indian jumpers, men high jumpers have been found to possess the lowest body weight followed by triple jumpers and the long jumpers.

Hence, it was concluded that weight is one of a primary determinant factor of field event athletic performance in both sexes.

In the recent study findings showed that athlete's body mass index and athletic performance were found highly negative significant relationship for female and male high and long jumper athletes.

Therefore, the present study demonstrated that athletes with a relatively less BMI, body fat weight, lean body weight and BD execute better in jumping events while athletes with relatively higher, perform better in throwing events.

The recent study showed positively significant correlated of lean body weight with athletic performance for both sexes of discus, javelin and shot put thrower athletes. In other words, there were found negatively correlated with athletic performance for both sexes high and long jumper athletes. Skinfolds are commonly used for the purpose of body fat estimation and as there is no actual measure of the body fat percentage of living individuals, methods of body composition assessment are merely estimates (Carter, *et al*., 1999 and Wagner, *et al*., 1999).

This study also indicated that there were a negative association between thigh circumference and athletic performance for female high and long jumper. While a significant negative relation was seen between calf circumference and athletic performance of male high and long jumper athletes.

The long jump performance can also be predicted by anthropometric measurement variables which have shown significant relationship to its performance of the calf and thigh circumference.

There were strong negative correlation were existed between waist and hip circumference for both male and female athletes.

There were strong positive relation observed between lower leg length and athletic performance for male and female among high and long jumpers. The results of the study suggest that high strength and stiffness values for the lower limbs and strength and velocity characteristics for upper limbs may be associated with athletic throwing performance.

Recently studies showed that there is a statistically important influence by the anthropometric length of the arm, the arm range and body mass can influence the achievement of results in shot put, while the length of the legs plays no statistically important role in the achievement of results (Tesanovic, 2010). The center of gravity of the human body is a hypothetical point around which the force of gravity appears to act. Or it is the point at which the combined mass of the body appears to be concentrated (Wikipedia, 2017).

The result of the present study revealed that height and lower leg length are best predictors of jumping performance of high jumper athletes and predicted 78.9% of the variability in the athletic performance. Ranawat (2010) [8] discussed about

Indian female jumpers. It is found that Indian high jumpers women are tallest, followed by triple jumpers and long jumpers. KaurTiwana (2013) [9] this study has been compared jumping events. The high Indian female jumpers are the tallest with long trunks and largest arm spans and lightest with less muscle at thigh, calf and the forearm. Singh B., Yadav J. and Yadav D. (2012) the high jumper athletes were significantly taller than shot putter athletes. Goswami, N. (2013) [5]. The long jump performance can also be predicted by anthropometric measurement variables which have shown a significant relationship to long jump performance, lower arm length, calf (lower leg) and thigh girth. Height and lower leg length have a great strong relationship with each other. So the height is helpful for lifting the center of gravity of the body, thus it is crucial to raise his body properly while jumping a far distance. The center of gravity of the body is determined by the body to a great extent. Longer legs are helpful when longer strides are required. The higher center of gravity is useful in crossing greater heights (Shailaja, 1992). Lower leg length is an important body part related to the increase of center of gravity and stride length, particularly for high jumpers due to the maximizing the level of jumping performance. Jumper athletes with a lower leg length with a better jumping performance. Hence, body height and lower leg length are typical predictor for female high jumper athletes. The present study was determined body height and lean body weight as the predictors of jumping performance for female long jumper athletes at 0.05 level of confidence.

The result of the study determined that weight was the best predictor of male high jump performance and negatively predicts by 61% of the variance in the athletic performance. Shailaja (1992) well supported this idea of the importance of height and weight the jumpers convert their linear momentum to vertical momentum (Shailaja, 1992). So then weight is typical negative predictors for jumping performance, but optimal weight is a valuable predictor for male high jumpers. As decreasing body weight simultaneously increasing, jumping performance. Therefore, the present study result showed that weight is a negative predictor of long jumpers.

Conclusion

Based on the findings of this study, it is concluded that the relationship between anthropometric characteristics and athletic performance has highly correlated each other. The present study findings elucidated that there were existed statistically positive significant relationships between athletic performance and body height for both sexes high and long jumper athletes. Thus, according to the study finding body height was one of the fundamental and crucial parameter to identify field event athletes. The mean height values of Indian and Ethiopian jumpers were males (176cm and 182cm) respectively reported by (Singh *et al*, 2010). Hence, standing height was one of influential factors in determining better athletic performance besides other anthropometric variables.

The finding of this study was demonstrated that athletic performance was negatively strong correlated to body weight in both sexes negatively significant correlated with high and long jumper athletes.

Hence, it was concluded that weight is one of a primary determinant factor of field event athletic performance in both sexes.

In recent study findings showed that athlete's body mass index and athletic performance were found highly negative significant relationship for female and male high and long jumper athletes.

Therefore, the present study demonstrated that athletes with a relatively optimum BMI and lean body weight and BD execute better in jumping events while athletes with relatively higher, perform better in throwing events. This study also indicated that there were a negative association between thigh and calf circumference and athletic performance of male and female high and long jumper.

There were strong negative correlation were existed between waist and hip circumference for both male and female athletes. There were strong positive relation observed between lower leg length and athletic performance for male and female among high and long jumpers.

The result of the this study revealed that height and lower leg length are best predictors of jumping performance of high jumper athletes and predicted 78.9% of the variability in the athletic performance. Height and lower leg length have a great strong relationship with each other. So the height is helpful for lifting the center of gravity of the body. Thus, it is crucial to raise his body properly while jumping a far distance. Hence, body height and lower leg length are typical predictor for female high jumper athletes. The present study was determined body height and lean body weight as the predictors of jumping performance for female long jumper athletes at 0.05 level of confidence.

The result of the study determined that weight was the best predictor of male high jump performance and negatively predicts by 61% of the variance in the athletic performance. As decreasing body weight simultaneously increasing, jumping performance. Therefore, the present study result showed that weight is a negative predictor of long jumpers.

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