International Journal of Physical Education, Sports and Health

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2016; 3(6): 460-465

www.kheljournal.com
Received: 19-09-2016
Accepted: 20-10-2016

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Determinants of vertical jump on football in Ethiopian youth sport academy

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Abstract
This study entitled "Determinants of vertical jump on football in Ethiopian youth sport academy" was designed to identify their vertical jump abilities. The population (N = 201, male =100 and female =101) was selected from Ethiopian Youth Sport Academy Football, whose ages ranged from 13 to 20 years. SPSS version 20.0 was employed to analyse multiple linear regressions with five predictor variables. Findings of the analysis show that sex is a strongest unique contributor and also age group has a significant effect on vertical jump. BMI ranges 19.1 to 21.72 kg/m^2, percentage of body fat ranges 6.095 to 7.64 % for male & 13.08 to 14.42 % female, and the normal sum of skinfold is also in the range of enabling to improve jumping abilities. Therefore, these five variables are indeed different from each other and they affect the vertical jump (Y) in different manners.

Keywords: Vertical jump, muscular power, football, youth and academy

1. Introduction

Vertical jump is a directory representing leg muscle power. The explosive movement of the upper technique is the significant to scoring in football games. Vertical jump (VJ) performance is one of the best indications of lower limbs muscle power [4]. Muscular power, defined as the rate of muscular force production throughout a range of motion, is a component of individual performance in many sports [5, 17, 19]. A VJ is used to evaluate the leg power or leg strength which is an important component of fitness testing in athletes as well as in sedentary population [21]. Other study explained that power is important components of football specific fitness training [11]. In football, performance is influenced in great extent by leg muscle power [3]. The vertical jump has been demonstrated to be a valid and reliable measure of explosive power performance [16, 14].

As peak power is the highest instant value achieved during a movement, it is typically the most important variable associated with success in sports involving sprinting and jumping activities [5]. An increase in power enables a given muscle to either produce a greater magnitude of work in the same time or the same amount of work in less time, both contributing to the importance and necessity of muscular power in sports (19). In the team sport environment, the role of jumping for height is based on the nature of the sport in focus [25], where superior vertical jump (VJ) ability provides team sport athletes an advantage over their direct opponent (e.g. in a marking contest in football or when heading the ball in soccer). Nevertheless, the preceding movement characteristics are vital to jump performance [9].

Standing vertical jump is commonly used to measure the explosive power of lower limbs [8]. Sergeant jump is the most frequently reported vertical jump test among football players. Differences in testing procedures i.e. with or without arm swing. Most studies have reported mean VJ height without arm swing in the range 37-42 and 26-33 cm for male and female elite performers, respectively [2, 6, 7, 20, 22, 23].

Football Players are required to have high levels of muscular power in order to effectively perform the tackling, lifting, pushing, and pulling tasks that occur during a match. In addition, high levels of muscular power are required to provide fast play-the-ball speed and leg drive in tackles [10]. In many investigations, football is introduced as a power sport in which optimized performance of players are mainly related to the amount of jumping. The VJ is a test for lower body power.

This is a non-resistant exercise used to measure jumping ability. This test is very important because the ability to jump is a measure of power. In many sports, such as football and basketball, power is a very important component for athletes [12]. Performance in the static jump (SJ) describes jumping ability and explosive force production of the lower extremities. The result is expressed as the height of the rise of the center of gravity. The static jump is a basic test of speed strength and it can be applied successfully to a number of sport events [24].

An individual's structural design both skeletal and muscle, will have implications for force production and overall movement performance. Specifically for vertical jumping, a number of anthropometric factors have been investigated, as to the relationship between the anthropometric variable and jump performance. It has been found that variables such as: body fat percentage, height, leg length and muscle girth have had significant associations with vertical jump performance [18].

Therefore, it is vital to determine factors that influence the vertical jump to help athletes improve their leg power. The objective of the present study was to identify determinant factors that influence vertical jump height for Ethiopian youth sport academy footballers.

2. Materials and methods

2.1 Subjects

The participants of this study were football players of Ethiopian youth sport academy. Due to reasonably controllable population size and ease of accessibility, the entire population was selected for participation (all N = 201, male =100 and female =101) whose ages ranged from 13 to 20 years old.

2.2 Procedure of Data Collection

Following approval from the administrators of the Ethiopian youth sport academy, one hour orientation and information about the significance of measurement were conducted by the researcher. Henceforth the researchers meet the athletes in the morning after identifying sex and age group. All field testing variables such as vertical jump, body mass index, sum of three skinfolds, and percentage of body fat were conducted in the academy by an independent investigator.

2.3 Procedure of variables measurement

The researcher was used ACSM'S health related physical assessment manual [1] recommended techniques to measure athletes height, weight, body mass index (BMI), sum of three site skin folds (Triceps, Suprailiac & Thigh for women and Chest, Thigh & Abdominal for men) and percentage of body fat (%). in addition to that vertical jump was measured based on [15] 101Performance Evaluation Tests.

The height was measured to the nearest 0.1 cm using Charder HM200P Portstad Portable Stadiometer. The Frankfort plane is achieved when the Orbitale (lower edge of the eye socket) is in the same horizontal plane as the Tragion (the notch superior to the tragus of the ear). When aligned, the Vertex is the highest point on the skull as illustrated in Figure 1.

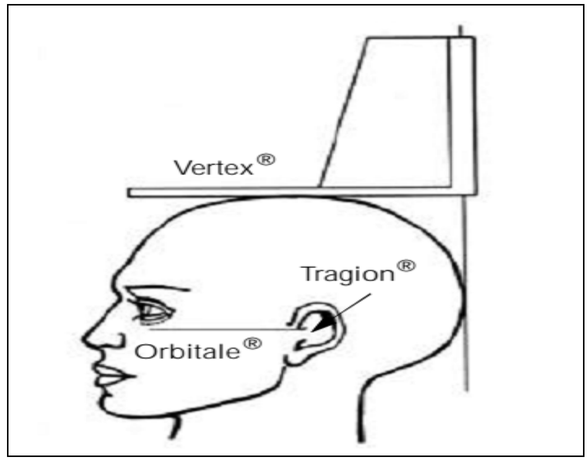


Fig 1: the head in the Frankfort plane (ISAK: International Standards for Anthropometric Assessment, 2014).

The subjects wore light clothing and were weighted to the nearest 0.1 kg using an Omron HN-286 Weighing Scale. The BMI was calculated by using one popular formula for BMI which is: Body Mass Index (kg. m^2) = WT (kg) ÷ HT (m) ^{2}. Percentage of body fat (%) and sum of three skinfolds were obtained, the technique was taken from (1) by taking Jackson and Pollock Skin fold measurement sites (illustrated in figure 2) based on the following two generalized Skin fold equations for men ("Three-Site formula (chest, abdomen, thigh) Body density = 1.10938 - 0.0008267 (sum of three skin folds) + 0.0000016 (sum of three skin folds) ^{2} - 0.0002574 (age)) and women ("Three- Site formula (triceps, suprailiac, thigh) Body density = 1.099421 - 0.0009929 (sum of three skin folds) + 0.0000023 (sum of three skin folds) ^{2}- 0.0001392 (age)) by using skinfold caliper (Lange, Cambridge Scientific Instruments, Maryland, USA).

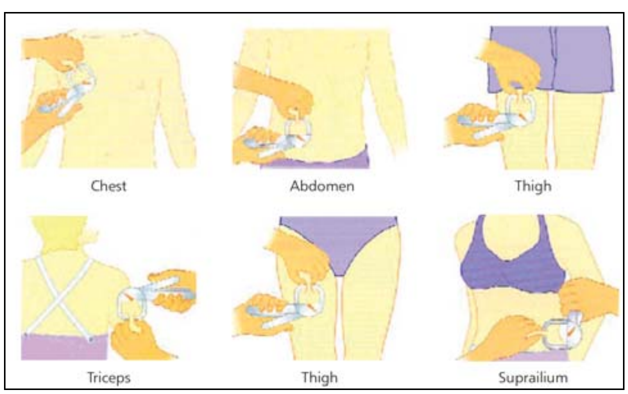


Fig 2: 101Performance Evaluation Tests. London, Mackenzie B. (2015).

Lastly, for vertical jump height recorded to the nearest 0.1 cm, the first step was measure the player's standing height. The player stands side on with the dominant shoulder facing the wall. The player then reaches up with the dominant arm and the standing height is measured at the point of their fingertips. They were asked to touch finger powder by tips of the index and middle fingers. The player is allowed to bend (flex) the knees and swing the arms prior to the jump as demonstrated in figure 3. To test VJ a smooth wall and a vertically mounted 150 cm board, measuring device; tape measure and powder were used.

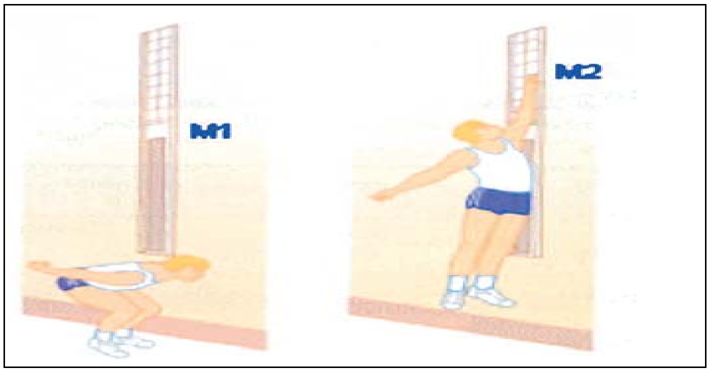


Fig 3: Vertical Jump Test (Adapted from Mackenzie B. (2015), 101Performance Evaluation Tests)

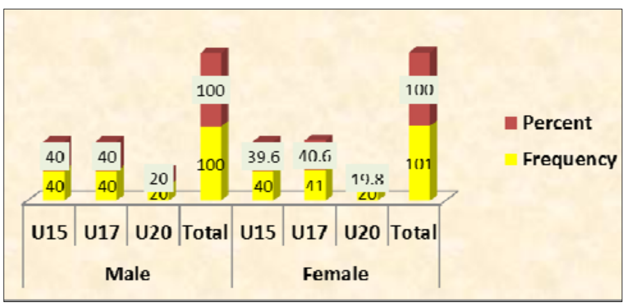
2.4 Statistical Analysis

Statistical Package for Social Science (SPSS) version 20.0 was used to analyse multiple linear regressions with five predictor variables was conducted to predict vertical jump as independent (or predictor) variable.

3. Results and Discussion

3.1 Results

As noted below figure 4, there are 40 males U15 (40 per cent), 40 females U15 (39.9 per cent), 40 males U17 (40 per cent), 40 females U17 (40.6 per cent), 20 males U20 (20 per cent) and 20 females U20 (19.8 per cent) in the sample, giving a total of 201 respondents.



Source: compiled from SPSS and Excel primary data, 2016

Fig 4: sex and age group of Ethiopian youth sport academy football player

Table 1 describes the mean and standard deviation of the variables according to sex and age groups. The mean height of male player for three age groups is 161.75±6.13 cm for U15, 168.28±4.09 for U17 and 173.3±2.72 for U20. The mean height of U17 females is taller 159.19±4.50 cm than that of U15 (157.56±6.00) and U20 (158.58±7.76) female players. On the other hand, male athletes mean and standard deviations of weight of U15 (50.1±5.68 kg), U17 (58.99±6.37 kg) and U20 (65.45±4.22 kg) age groups are presented in the descriptive table. Although U20 female athletes have higher mean weight (52.60±4.426 kg) than U15 (48.75±5.68) and U 17 females' age groups do (50.62±5.49 kg). The BMIs of male athletes fall in the normal scales [1], which are the means and standard deviations of body mass index of U15 (19.1±1.81), U17 (20.73±1.94) and U20 (21.72±.95) age groups are presented in the descriptive table. Equally this is true for female players. Hence, means and standard deviations of body mass index of U15 (19.57±1.8), U17 (19.96±1.88) and U20 (20.88±1.30) age groups are show up in table. Furthermore male means and standard deviations of sum of skinfolds of U15 (25.8±2.45), U17 (30.02±2.66) and U20 (28.7±2.7) age groups are appeared in table 4.1. In addition the female players means sum of skinfolds of U15 (31.18±1.89), U17 (30.46±4.31) and U20 (33.3±1.34) age groups are seemed in table 1. Male players of U17 age groups have higher mean body fat % (7.64±0.85%) than U15 (6.095±0.80%) and U20 (7.63±0.83%) age groups. But in female percentage body fat, U20 age groups (14.42±.56) have higher than the rest U15 (13.2±.685) and U17 (13.08±1.61) age groups.

Vertical jump is used to investigate the explosive strength of leg of the Ethiopian youth sport academy male and female football players. Hence, the means and standard deviations of vertical jump of male players as it is presented in the descriptive table male U20 age groups have higher (44.35±5.14 cm) than U15 (42±4.76) and U17 (43.3±5.79) age groups.In the same way female players value vertical jump mean of U20 age groups also higher (37.50 ± 3.90) than U15 (31.44 ±5.65) and U17 (30.46 ± 4.64) age groups.

Table 1: Descriptive statistics of Vertical jump and its determinants in Ethiopian youth sport academy football player, (mean ±SD).*

Variables	U15 (N=40)		U17		U20 (N=20)	
	M	F	M (N=40)	F (N=41)	M	F
Height (cm)	161.75±6.13	157.56±6.00	168.28±4.09	159.19±4.50	173.3±2.72	158.58±7.76
Weight (kg)	50.1±5.68	48.75±5.68	58.99±6.37	50.62±5.49	65.45±4.22	52.60±4.42
BMI (kg/m^2)	19.1±1.81	19.57±1.8	20.73±1.94	19.96±1.88	21.72±.95	20.88±1.30
Sum of 3 Skinfolds (mm)	25.8±2.45	31.18±1.89	30.02±2.66	30.46±4.31	28.7±2.7	33.3±1.34
Body Density (g/cc)	1.06±0.16	1.07±.002	1.08±0.002	1.07±.003	1.08±0.002	1.07±.001
Percentage Body Fat (%)	6.095±0.80	13.2±.69	7.64±0.85	13.08±1.61	7.63±0.83	14.42±.56
Vertical Jump (cm)	42±4.76	31.44±5.65	43.3±5.79	30.46±4.64	44.35±5.14	37.5±3.90

* Sum of four skinfolds included for men (chest, Abdomen & thigh) and women (triceps, suprailiac & thigh)

Source: compiled from SPSS and MS-Excel primary data, 2016

Multiple regressions with five predictor variables was conducted, all the independent (or predictor) variables are entered into the equation simultaneously. Each independent variable is evaluated in terms of its predictive power. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. For each value of the independent variable, the distribution of the dependent variable was normal. The relationship between the dependent variable and each independent variable were linear, normally distributed and all observations were independent.

The dependent variable is vertical jump, and the five independent variables are body mass index (X1), sum of three skinfolds (x2), percentage of body fat (x3), sex (x4) and age group (X5). The researcher find out the relationship between body mass index, sum of three skinfolds, percentage of body fat, sex and age groups to vertical jump of football players.

Based on the analysis R square value was 0.534, therefore, together the five predictors explain 53.4 % of the variance of vertical jump performance. This suggests the notation that vertical jump performance (y) is influenced by 53.4 % by body mass index (x1), Sum of 3 Skinfolds (x2), percentage body fat (%) (x3), sex (x4) and age group (x5) while the rest (100% - 53.4 %), is explained by other causes and so the model is a good model.

Table 2: summary of ANOVA in the prediction of vertical jump by Anthropometric parameters

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6233.386	5	1246.677	44.606	.000[b]
	Residual	5450.003	195	27.949		
	Total	11683.388	200			
a. Dependent Variable: Vertical Jump (cm)						
b. Predictors: (Constant), age group, sex of the respondent, body mass index (kg/m^2), sum of 3 skinfolds (mm), percentage body fat (%)						

Source: compiled from SPSS primary data, 2016

Table 2 shows the ANOVA results of the five independent variables x1, x2, x3, x4 and x5. In this table two values such as F and the Sig are very important. Here it is 44.606, which means that the value is pretty high and that x1, x2, x3, x4 and x5 will are different. On the other hand, the significant tells us the confidence level (1- Sig) of accepting the alternate hypothesis. Here the Sig is 0.000, which means (0.001 = 0.99) 99 % confident that the null hypothesis is rejected, and that x1, x2, x3, x4 and x5 not equal to each other.

Therefore, from both the F value and the Sig value that the five variables are indeed different from each other and that they affect the vertical jump (Y) in a different manner.

Table 3: Coefficients[a] of regression prediction of running vertical jump with anthropometric parameters

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	42.152	9.871		4.270	.000		
	BMI (kg/m^2)	.148	.218	.037	.676	.049	.916	1.091
	Sum of 3 Skinfolds (mm)	.238	.383	.112	.622	.001	.447	2.237
	Percentage Body Fat (%)	-.317	1.095	-.141	-.290	.002	.471	2.124
	sex of the Respondent	-9.458	5.867	-.620	-1.612	.000	.465	1.191
	Age Group	1.580	.624	.155	2.533	.000	.472	1.93
	a. Dependent Variable: Vertical Jump (cm)							

Source: compiled from SPSS primary data, 2016

In this coefficient table the collinearity statistics, the value of VIF (variance inflation factor) was less than five (or tolerance higher than 0.2) indicates no presence of multicollinearity. This table also shows structure of the model. The constant is the C, and then x1, x2, x3, x4 and x5. So it is possible to write:

Y = 0.148x1 + 0.238x2 + (-0.317) x3 + (-9.458) x4 + 1.58x5 + 42.152

Therefore, Vertical jump=0.148 (Body Mass Index) + 0.238 (Sum of three Skinfolds) + (-0.317) (Percentage of Body fat) + (-9.458) sex + 1.58(age group) +42.152

In the table 4 demonstrated that sex was a strongest unique contributor to explain the dependent variable, vertical jump. Furthermore, age group was largely significant effect on vertical jump. Besides maintaining normal body mass index, decreasing percentage of body fat, and having normal sum of skinfolds will also facilitate to have good performance in vertical jump. For further information look down the beta column and find which beta value is the largest among the five independent variables.

So body mass index has a positive relationship with vertical jump and that increase in 1 BMI (kg/m^2) leads to an increase in vertical jump by 0.218 centimetres. Then again, sum of three skinfolds in mm has a positive relationship with vertical jump, and that

1 increase in mm of sum of skinfolds leads to 0.383 increase in cm of vertical jump. Furthermore, percentage of body fat has a negative relationship with vertical jump, and that 1 increase in percentage of body fat leads to a decrease in vertical jump by 1.095 centimetres. Besides, sex has a negative relationship with vertical jump, and that change of sex leads to a decrease in vertical jump by 5.867centimetres. Additionally, age group has a positive relationship with vertical jump, and that 1 increase in group leads to 0.624 increases in cm of vertical jump.

3.2 Discussion

As it is indicated in table 1, in this research the result indicated that Ethiopian youth sport academy male U20 age groups were taller (173.3±2.72) than U17 (168.28±4.09) and U15 (161.75±6.13) age groups. On the other hand, female football players of U17 age groups were taller (159.19±4.50) than U15 (157.56±6.00) and U20 (158.58±7.76) age groups. According to the result Ethiopian male football players are shorter than US but greater than Vietnam players with reference to [13]. But female players almost in the same average range of height. Maintaining a specific body weight is important requirements for optimal football performance. Certainly many studies suggested that males are usually heavier than females. In this research body weight of the Ethiopian youth sport academy male U20 age groups were heavier (65.45±4.22 kg) than both U17 (58.99±6.37 kg) and U15 (50.1±5.68 kg) age groups. The other U17 age groups were heavier than U15 age groups.

Likewise Body weight of U20 age groups of academy female football players (52.60±4.42) were heavier than both U17 (50.62±5.49) and U15 (48.75±5.68) age groups. As of this research male players were heavier than females. Football performance is varying from player to player because of sex and age groups. Hence for both female and male Ethiopian youth sport academy when age increases, their weight also increases across age groups. Body Mass Index of Ethiopian youth sport academy male players were under normal or desirable weight (BMI values 18.5-24.9) with reference to ACSM, which is male average BMI, was 23.9 and female players was 19.9. In a wide-ranging when age increases player BMI also increases. Joined with player sex, based on their age also the result of majority players BMI was normal which is between (BMI values 18.5-24.9). Concerning sum of skinfold the highest score was recorded for U17 (30.02±2.66) age groups of Ethiopian youth sport academy male football players. However, U15 age groups of sum of skinfold (25.8±2.45) were lower than U20 (28.7±2.7) age groups. On the other hand, sum of skinfold highest score was recorded for female players of U20 (33.3±1.34) age groups. Though, U17 sum of skinfold (30.46±4.31) was lower than U15 (31.18±1.89) age groups. Male percentage of body fat of U17 (7.64±0.85 %) age groups have higher than U15 (6.095±0.80 %) age groups. Conversely female football players of U20 age groups was higher (14.42±.56 %) than U15 (13.2±.69 %) and U17 (13.08±1.61 %) age groups.

Concerning vertical jump, U20 age group of male football players had more power (44.35±5.14 cm) ability in comparison of U15 age group (42±4.76 cm) and U17 age group (43.3±5.79). Furthermore, U20 age group of female football players had more power (37.5±3.90 cm) ability in comparison of U15 (31.438±5.654 cm) and U17 (30.463±4.634 cm) age groups. With reference to Mackenzie B. (2015) the vertical jump for male and female players were in average standard.

From the multiple linear regression analysis, Together the five predictors can influence vertical jump 53.4 % while the rest (100% - 53.4 %), is explained by other causes and so the model is a good model. On the other hand from both the F value and the Sig value that the five variables are indeed different from each other. Hence the five independent variables affects vertical jump (Y) in a different manner and level.

From this analysis sex was a strongest unique contributor and age group was largely significant effect on vertical jump. Besides maintaining normal body mass index, decreasing percentage of body fat, and having normal sum of skinfolds will also facilitate to have good performance in vertical jump.

So body mass index has a positive relationship with vertical jump and that increase in 1 BMI (kg/m^2) leads to an increase in vertical jump by 0.218 centimetres. On the other hand, sum of three skinfolds in mm has a positive relationship with vertical jump, and that

1 increase in mm of sum of skinfolds leads to 0.383 increase in cm of vertical jump. Furthermore, percentage of body fat has a negative relationship with vertical jump, and that 1 increase in percentage of body fat leads to a decrease in vertical jump by 1.095 centimetres. Besides, sex has a negative relationship with vertical jump, and that change of sex leads to a decrease in vertical jump by 5.867centimetres. Additionally, age group has a positive relationship with vertical jump, and that 1 increase in group leads to 0.624 increases in cm of vertical jump.

Finally the researcher strongly believed that the following equation will be help to talent identification for Ethiopian youth sport academy football.

$Y = 0.148x1 + 0.238x2 + (-0.317) x3 + (-9.458) x4 + 1.58x5 + 42.152$

Therefore, Vertical jump=0.148 (Body Mass Index) + 0.238 (Sum of three Skinfolds) + (-0.317) (Percentage of Body fat) + (-9.458) sex + 1.58(age group) +42.152

4. Conclusion and future Research

In brief the Ethiopian football players' practice performance of vertical jump is not satisfactory with reference to international normative data. The ability to generate high levels of muscular power is an important attribute of football players. Therefore, from this research the researcher understand that the academy football players do not get sufficient training for vertical jump to improve their performance. Hence coaches as well as the academy should give attention to improve vertical jump. In the future it should be pick up the check and give consideration for athletes to improve it. Other ways in performing overhead and other activities require leg muscular power activities in football might by difficult activities for Ethiopian players.

Since in this analysis sex was a strongest unique contributor and age group was largely significant effect on vertical jump plus maintaining normal body mass index, decreasing percentage of body fat, and having normal sum of skinfolds will also enable to improve football player vertical jump.

Therefore, these five variables are indeed different from each other and they affect the vertical jump (Y) in different manners. The research concluded that the jumping abilities of Ethiopian youth football player had not been examined before their training hence the players tamed less effectively participates during a sport.

Therefore, in the talent identification for Ethiopian youth sport academy football player, it may adopt the above predictive models to identify the players with favorable jumping ability and examine the subject strength of muscular power particularly lower limp muscles.

These research finding is only focused determinant factor of Ethiopian youth sport academy football players vertical jump in general. As of the result the research reached the above conclusion but in the future for both sexes separate research is required to understand by identifying appropriate model.

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