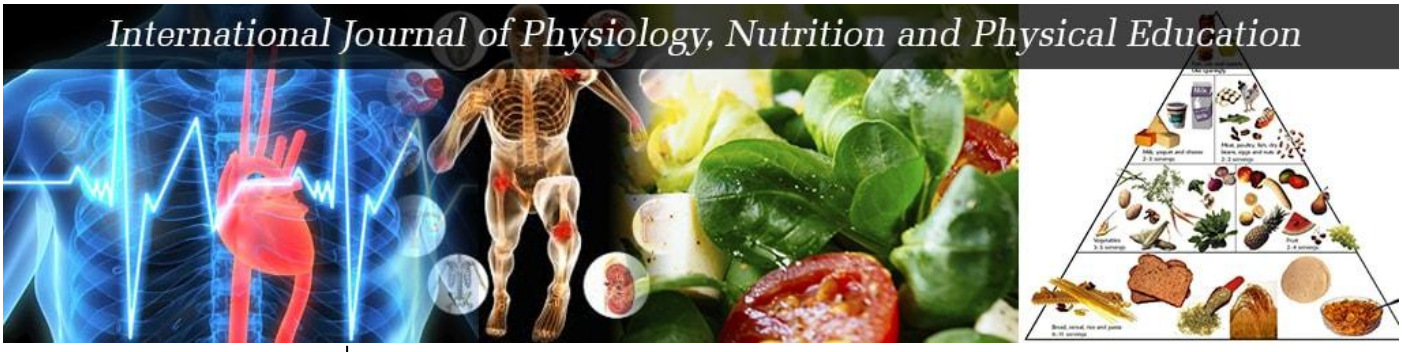

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Event wise anthropometric variables as predictor of performance in power lifting

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Abstract
The purpose of the study was to predict the performance of power lifting on the basis of anthropometric variables. To attain this aim, a total of twenty one (N=21) elite power lifter of Uttarakhand were selected as subject for the purpose of this study. Height, weight, arm length right, arm length left, leg length right, leg length left, waist circumference, hip circumference, right thigh circumference, left thigh circumference, left calf circumference, right calf circumference were the selected anthropometric variables. The performance of squat, bench press and dead lift was measured in numbers. To find out the relationship of selected anthropometric variables with performance pearson's product moment correlation was used and to predict the performance of power lifters on the basis of selected anthropometric variables regression analysis was employed by using Step-Wise method. Two models and regression equation for prediction of squat performance were developed. Among both the models the second model in which arm length left and height was observed 54.9% which was highest in comparison to the first model. Hence second is most suitable and adaptable for squat performance in power lifting and in predicting the performance of bench press the first model in which arm length left was observed 36.1% which was highest. Hence it is most suitable for bench press performance and in predicting the dead lift performance first model in which arm length left was observed 57.3% which was highest. Hence it is suitable for predicting the dead lift performance in power lifting.

Keywords: Power lifting, Squat, Bench press, Dead lift

1. Introduction
It is very well said by Sir Herbert Spencer that "Survival of the fittest" to be fit we need strength in our body. Strength is the basic component of fitness of the athletes. Athlete's performance always very because of strength. Strength is the primary ingredient of athletic performance. Power lifting's lifts are the definitive measure of strength. Power lifting is the ultimate strength competition. The power lifting athlete competes in three specific disciplines, each designed to measure different areas of human strength. The sum or total of the best lift in each discipline determines the winner. Power lifting is an exciting sport where athletes compete against the force of iron as well as other athletes. Now a day power lifting is very famous sport it is very fast spreading in all over the world.
Whenever we think about the game of power lifting the first thing comes in our mind is the strength and the physical characteristics of a power lifter. To lift the weight in the game of power lifting it is very important that the athlete should be strong because of their strong physical characteristics they look like strong man. We can measure their physical characteristics with the help of anthropometry. It helps us to know about the physical characteristics of the power lifter.

1.1 Objectives of the Study
The objectives of the study were
1. To describe the characteristics of the power lifters.
2. To determine the relationship of selected anthropometric variables with performance.
3. To develop a regression equation model for talent identification.

2. Methodology

2.1 Selection of Subjects

For the purpose of this study a total of twenty one (N=21) elite power lifter of Uttarakhand were selected as subject. Their age group ranged from 18-28 years. It was assumed that all power lifters were physically well trained and were of international medallist, national medallist and national participation level. The anthropometric measurement was collected from the centre for power lifting at Kashipur (Uttarakhand), height, weight, arm length right, arm length left, leg length right, leg length left, waist circumference, hip circumference, right thigh circumference, left thigh circumference, left calf circumference, right calf circumference were taken into consideration for anthropometric measurement. Weighing machine, stadiometer and gullick tape were the tools used for the measurements, whereas the performance was observed by best lift of squat, bench press and dead lift of power lifters.

2.2 Statistical Technique

To describe the characteristics of power lifters descriptive statistics was used, to find out the relationship of selected anthropometric variables with performance pearson's product moment correlation was used and to predict the performance of power lifters on the basis of selected anthropometric variables regression analysis will be employed.

3. Results and Discussion

The results and findings of the present study were analyzed and presented in different tables as follows-

Table 1: Descriptive Statistics Values of Selected Anthropometric and Power lifting Variables

S. No.	Anthropometric variables	Mean	S.D.
1.	Height	170.38	5.04
2.	Weight	89.43	18.43
3.	Arm Length Right	58.24	3.06
4.	Arm Length Left	56.71	3.65
5.	Leg Length Right	96.24	4.29
6.	Leg Length Left	97.62	3.40
7.	Waist Circumference	90.62	12.64
8.	Hip Circumference	104.62	14.45
9.	Right Thigh Circumference	63.24	6.53
10.	Left Thigh Circumference	62.33	6.38
11.	Right Calf Circumference	38.33	3.25
12.	Left Calf Circumference	38.71	3.35
13.	Age	25.43	2.96
14.	Squat	270.71	53.25
15.	Bench Press	151.66	34.76
16.	Dead Lift	261.00	51.20

Table 1 indicates the descriptive statistics values of selected Anthropometric variables, which shows that the mean and SD values of Height 170±5.04, Weight 89.43±18.43, Arm length Right 58.43±3.06, Arm length left 56.71±3.65, Leg Length right 96.24±4.29, Leg Length left 97.62±3.40, Waist Circumference 90.62±12.64, Hip Circumference 104.62±14.45, Right thigh circumference 63.24±6.53, Left thigh circumference 62.33±6.38, Right calf circumference 38.33±3.25, Left calf circumference 38.71±3.35, Age 25.43±2.96, Squat 270±53.25, Bench Press 151.66±34.76, Dead lift 261±51.20 respectively.

Table 2: Pearson Product Moment Correlation of Selected Anthropometric Variables with Squat, Bench Press and Dead Lift Performance of Power lifters**.**

S. No.	Variables Correlated	Correlation Coefficient (R)		
		Squat	Bench Press	Dead Lift
1.	Height	.541*	.363	.556**
2.	Weight	.580**	.546*	.513*
3.	Arm Length Right	.451*	.369	.286
4.	Arm Length Left	.643*	.601**	.757**
5.	Leg Length Right	.498*	.468*	.497*
6.	Leg Length Left	.209	.150	.236
7.	Waist Circumference	.380	.195	.304
8.	Hip Circumference	.291	.362	.364
9.	Right Thigh Circumference	.452*	.379	.482*
10.	Left Thigh Circumference	.560**	.554**	.540*
11.	Right Calf Circumference	.405	.372	.431
12.	Left Calf Circumference	.460*	.432	.423
13.	Age and Squat	.057	.015	.031

Table 2 shows that there is significant relationship between squat performance and anthropometric variables i.e. Height, Arm length right, Arm length left, Leg length right, Right thigh Circumference and Left Calf Circumference found significant at .05 level and Weight, Left thigh circumference were found significant at .01 level. On the other hand there exists an insignificant relationship between Squat performance and anthropometric variables i.e. Leg length left, Waist circumference, Hip circumference, Right Calf circumference and Age of the power lifters as the significant value was found higher than the .05.

Relationship between Bench press performance and anthropometric variables i.e. Weight, Leg Length Right were found lesser than .05 significant level and Arm length left and Left thigh circumference were found significant at .01 significant level. On the other hand insignificant relationship between Bench press performance and anthropometric variables i.e. Height, Arm Length Right, Leg Length Left, Waist Circumference, Hip Circumference, Right Thigh Circumference, Right Calf Circumference, Left Calf Circumference and Age as the significant value was found higher than the .05 level of significance.

Relationship between Dead Lift performance and anthropometric variables i.e. Weight, Leg Length Right, Right Thigh Circumference, Left Thigh Circumference were found significant at .05 level of significance and Height, Arm Length Left were found significant at .01 level of significance. On the other hand there were insignificant relationship between Dead lift and anthropometric variables i.e. Arm Length Right, Leg Length Left, Waist Circumference, Hip Circumference, Right Calf Circumference, Left Calf Circumference and Age as the significant value were found higher than the .05 level of significance.

Table 3: Model Summary Showing Pearson's Correlation between Selected Anthropometric Variables with Squat Performance of Power Lifters.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.643[a]	.414	.383	41.83719	.414	13.402	1	19	.002
2	.741[b]	.549	.499	37.69962	.135	5.399	1	18	.032
a. Predictors: (Constant), Arm length left									
b. Predictors: (Constant), Arm length left, Weight									

There are two regression model have been presented in table-3. In the second model the value of R square is .549 which is maximum and, therefore second model was selected to develop regression equation. It also can be seen from table that in second model there are two independent variables viz. Arm length left and weight have been identified so regression equation will be developed these two independent variables only. Since R square value for second model is shows that 54.9% of squat performance is obtained by these two independent variables.

Table 4 shows that the utility of the linear regression model. The second model has found useful in estimating the squat performance on the basis of two independent variables i.e. arm length left and weight, since F value(10.952) has found significant (P<0.05).

Table 4: ANOVA Table Showing F-Values for all the Models.

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	23457.620	1	23457.620	13.402	.002[b]
	Residual	33256.666	19	1750.351		
	Total	56714.286	20			
2	Regression	31131.584	2	15565.792	10.952	.001[c]
	Residual	25582.702	18	1421.261		
	Total	56714.286	20			
a. Dependent Variable: Squat						
b. Predictors: (Constant), Arm length left						
c. Predictors: (Constant), Arm length left, Weight						

Table 5: Regression Coefficient of Selected Variables in Different Models Along with Their T-Values.

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-261.591	145.692		-1.796	.088
	Arm length left	9.386	2.564	.643	3.661	.002
2	(Constant)	-242.166	131.549		-1.841	.082
	Arm length left	7.238	2.488	.496	2.909	.009
	Weight	1.145	.493	.396	2.324	.032
a. Dependent Variable: Squat						

Table 5 shows that the quantification of relationship between selected anthropometric variables with squat performance.

The above table reviewed that significance of regression model. For both the model anova value is significant as the P value is less than .05. Thus, it may be concluded that the variables; arm length left and weight significantly explains the squat performance of the power lifters.

Regression equation using regression coefficient (B) of both the model are shown in table 9, the regression equation can be developed as follows:

Regression Equation/Model – 1
Y (Squat) = -261.591 + 9.386 (Arm Length Left)
Regression Equation/Model – 2
Y (Squat) = -242.166 + 7.238 (Arm Length Left) + 1.145 (Weight)

Table 6: Regression Model Summary of Anthropometric Variables in Relation to Bench Press Performance of Power Lifters.

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.601[a]	.361	.328	28.50032	.361	10.752	1	19	.004
a. Predictors: (Constant), Arm length left									

Table 6 shows that there is one regression model has been presented. In this model the value of R square is .361 which is maximum and, therefore this model was selected to develop regression equation. It also can be seen from table that model one had one independent variables viz. Arm length left has been identified so regression equation will be developed by that independent variable only. Since R square value shows that 36.1% of Bench Press performance is obtained by this one independent variable.

Table 7 shows that in ANOVA table model one has found useful in estimating the Bench Press performance on the basis of one independent variable i.e. arm length left, since F value(10.752) has found significant (P<0.05).

Table 7: Anova Table Showing F Values for Model

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8733.570	1	8733.570	10.752	.004[b]
	Residual	15433.096	19	812.268		
	Total	24166.667	20			
a. Dependent Variable: Bench press						
b. Predictors: (Constant), Arm length left						

Table 8

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-173.132	99.248		-1.744	.097
	Arm length left	5.727	1.747	.601	3.279	.004
a. Dependent Variable: Bench press						

The regression coefficients in this model has been shown in table 8. In the model t-value for regression coefficients is significant as their significance value (P-value) is less than 0.05. Thus, it may be concluded that arm length left explains the bench press performance. The regression equation can be developed as follows:

Regression Equation/Model – 1
Y (Bench Press) = -173.132+ 5.727 (Arm Length Left)

Table 9: Model summary along with the value of R and R^2**.**

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.757[a]	.573	.551	34.31657	.573	25.522	1	19	.000
a. Predictors: (Constant), Arm length left									

Table-9 reveals the multiple regression value for anthropometric variables in relation to dead lift performance. In present model only arm length left was observed that explained 57.3% variability (R square=.573) and this model was also significant as F value (25.52) was found significant (*P*<.05.

Table 10: ANOVA Table Showing F-Values for Model

ANOVA[a]						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	30055.090	1	30055.090	25.522	.000[b]
	Residual	22374.910	19	1177.627		
	Total	52430.000	20			
a. Dependent Variable: Dead Lift						
b. Predictors: (Constant), Arm length left						

In table-10 F-value for model 1 has been shown. Since F-value for the first model is significant, it may be concluded. that the model selected is efficient.

Table-11: Regression Coefficients of Selected Variable in Different Models Along with their T-Values

Coefficientsa						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-341.528	119.502		-2.858	.010
	Arm length left	10.624	2.103	.757	5.052	.000
a. Dependent Variable: Dead Lift						

The regression coefficients in model have been shown in table 11. In this model t-value for regression coefficients is significant as their significance values (P-values) are less than 0.05. Thus, it may be concluded that the variable arm length left explains the dead lift performance, the regression equation can be developed as follows:
Regression Equation/Model – 1
Y (Dead Lift) = -341.528+ 10.624 (Arm Length Left)

4. Conclusion

Results of the study clearly reported that anthropometric variables are positively correlated with the performance of power lifters but anthropometric variables were not found significantly correlated. Arm length left and weight of the power lifters are only anthropometric variables which predicted the performance of squat. Bench press and dead lift are predicted by only arm length left. On the basis of findings it may be concluded that practically only one or two anthropometric variables are not responsible for the performance in the game of power lifting because a power lifter has to use his full body to lift the weight. All the anthropometric variables play a vital role to lifting the weight, so we can say that all the anthropometric variables are very much important for performance but only arm length left and weight are predicting the performance of power lifting the reason may be the power lifters have more strength in arm length left or may be at the time of lifting the weight they use arm length left more so that their mechanism of body has developed like this. It may also be concluded that by improving right side as well as left side of the body equally the performance may be enhance. Weight was also predicted the performance in bench press because the reason may be power lifters should have a healthy weight according to their weight category. If their weight would vary their category will also vary that is why they need to maintain their weight for the best performance in their weight category.

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