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ESTIMATION OF STATIC BALANCE ON THE BASIS OF ABDOMINAL AND BACK STRENGTH IN UNIVERSITY LEVEL PLAYERS

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Abstract

Purpose: -The main purpose of the study was to determine the correlation and joint contribution between Independent Variables (abdominal strength and back strength) and Dependent Variable (static balance). Another purpose of the study was to establish regression equation for predicting Dependent Variable on the basis of Independent Variables. **Methodology: -** Total of 42 male university level players were selected from Guru Ghasidas University Bilaspur. Age of the subjects was ranging between 19 to 24 years. Selected Variables were abdominal strength and back strength (Independent Variables). Static balance was considered as Dependant Variable. The selected variables were measured by different tests and instruments. To find out correlation & joint contribution between Independent Variables (abdominal strength and back strength) and Dependent Variable (Static balance), Product Moment correlation method and multiple correlation method were used. Regression equation was established for predicting Static balance on the basis of abdominal strength and back strength. **Findings: -** There exists a significant relationship between Static balance *and* abdominal strength ($r = .721$, $p < .05$), back strength ($r = .713$, $p < .05$). Regression equation Static balance = -14.172 + 0.609 (abdominal strength) - 0.235 (back strength).

Keywords: Static balance, abdominal strength, back strength, sports person.

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INTRODUCTION

Balance is the ability to maintain the Center of Gravity (COG) of a body within the base of support with minimal postural sway. Maintaining balance is coordinated by three systems. The first input is from the vestibular system. The second balance coordinator is the proprioceptive system originating from somatosensory receptors in muscles, tendons, and joints for kinesthetic sense, body posture and spatial awareness. Finally, the visual system which sends visual signals about body's position (Guskiewicz, 2011; Nashner, 1997; Gary, & Gambetta, 2000).

Theoretically balance has been defined as static and dynamic, while static balance is the body's ability to keep COG in base of support; dynamic balance is the active movement of center of pressure during standing, walking or execution of sports skill. From the functional view, balance has been categorized as static, dynamic and semi dynamic. There are several methods of balance assessment (Browne, & O'Hare, 2011). Objective or quantitative measurements have been preferred rather than subjective or qualitative ones. The single leg stance test is more sensitive for assessing normal balance (Browne, & O'Hare, 2011; Ageberg, 2003).

As mentioned before, sufficient endurance of core muscles has an essential role in balance, coordination and sports specific tasks. A number of isometric tests of trunk muscle endurance have been described for extensors, flexors and lateral musculature of the trunk (Evans, et al., 2007).

In literature, the aim of many studies describing the relationship between trunk muscle & balance has been therapeutic and rehabilitative intervention and core muscle strength has been emphasized (Suri, et al., 2009). Meanwhile, the role of trunk muscle endurance in balance & coordination has not been clear so in the study this relationship has been taken into consideration.

Objectives of the study

- To determine the correlation & joint contribution between Independent Variables (abdominal and back strength) and Dependent Variable (static balance).
- To establish regression equation for predicting Dependent Variables (static balance) on the basis of Independent Variables (abdominal and back strength).

METHODOLOGY

Selection of subjects

A total of 42 Male university level players were selected from Guru Ghasidas Vishwavidyalaya Bilaspur. Age of the subjects was ranging between 19 to 24 years.

Table 1
Characteristics of selected subjects

	N	Minimum	Maximum	Mean	Std. Deviation
Age	42	19.00	24.00	21.6667	1.28151
Height	42	158.00	178.00	1.6965E2	4.83050
Weight	42	51.00	76.00	62.0164	6.42731

Participants were expelled if they had any type of injuries. Before testing began, the aim and procedures of the study were explained to the participants.

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Procedures

All measurements were taken on the same day under the direction of researcher and supporting staffs. Subjects got an oral and visual exhibit of the best possible procedures required to effectively finish every test before they were requested that perform them. To ensure proper recovery time, participants completed one trial at a time with at least 2 to 5 minutes between trials. Verbal encouragement was given to all participants.

Table 2
Selected variables and their criterion measures

Sr. no.	Variables	Nature	Tools/Tests	Measuring Unit
1	Static Balance	Dependent	Stand stroke test	Sec.
2	Abdominal strength	Independent	One minute Sit Ups test	Numbers
3	Back strength	Independent	Dynamometer (Back)	KG.

Age

Date of birth mentioned in athlete's college certificates were considered as age (years) of athletes.

Weight and Height

The measurements of the weight and height were done with digital weighting scale (kg) and stadiometer (cm).

Static Balance

The stork stand was used to measure static balance. For the stork stand the subjects completed the test on the dominant foot. The subjects kept their hands on their hips with the uninvolved foot against the medial side of the knee of the stance leg. Each subject maintained this position while standing on the ball of the foot for the maximum possible time. The trial ended when the heel of the involved leg touched the floor, the hands came off of the hips, or the opposite foot was removed from the stance leg. The best of three trials was recorded for analysis.

Abdominal Strength

The abdominal strength was measure with the help of 60sec. bent knee sit-ups test. To assume the starting position, the subject lies on his back with knees flexed, feet on floor, with the heels between 12 and 18 inches from the buttocks. The arms are crossed on the chest with the hands on the opposite shoulders. The feet are held by the partner to keep them in touch with the testing surface. The subject, by tightening his abdominal muscles, curls to the sitting position. Arm contact with the chest must be maintained. The chin should remain tucked on the chest. The sit-up is completed when the elbows touch the thighs. To complete the sit-up the student returns to the down position until the mid back makes contact with the testing surface. The timer gives the signal, "Ready, go," and the sit-up performance is started on the word "go." Performance is stopped on the word "stop."The number of correctly executed sit-ups performed in 60 seconds was the score of an individual (AAHPERD, 1980).

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Back Strength

Back strength of subjects was measure by dynamometer in kg. To assume the starting position, the subject take the standing position with trunk lightly flexed (10-15 degree) forward at the hip, holding the dynamometer bar, one hand from above and other hand from below the bar. This is achieved by adjusting the bar at a level just below finger tips when the subject stands erect with hands on the front of thigh. The hands are spread apart equal to the width of shoulders. The body weight is balanced on the feet which are placed about 6 inches apart. The knees and the back are kept straight throughout the lift and the lift moves steadily upward without jerking. The subject is asked not to lean backward on the heel. The higher of the two reading is recorded in kilogram as score (Kansal, 2008).

Statistical technique

The descriptive statistics i.e. mean, standard deviation etc. were calculated for all selected variables. Pearson product-moment correlations and multiple correlations were calculated to examine the relationship joint contribution between independent & dependent variables. Regression analysis (enter method) was used to established equation for predicting static balance (dependent variable) on the basis of selected abdominal and back strength. An alpha level of $p \leq 0.05$ was used to determine correlation significance. All statistics were calculated with the help of SPSS 16.0 version.

RESULT AND FINDINGS OF THE STUDY

Table 2

Descriptive Statistics of selected variables

	Mean	Std. Deviation	N
Static balance	34.8610	12.57748	42
Abdominal strength	45.5238	7.30599	42
Back strength	90.7119	22.19562	42

Table 2 shows that the descriptive analysis (Mean, SD & N) of selected variables i.e. Static balance, abdominal strength and back strength.

Table 3

Residuals statistics for checking outliers

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	12.8870	49.8395	34.8610	9.33817	42
Residual	-20.3070	17.17387	.00000	8.42565	42
Std. Predicted Value	-2.353	1.604	.000	1.000	42
Std. Residual	-2.351	1.988	.000	.975	42

Dependent Variable: static balance

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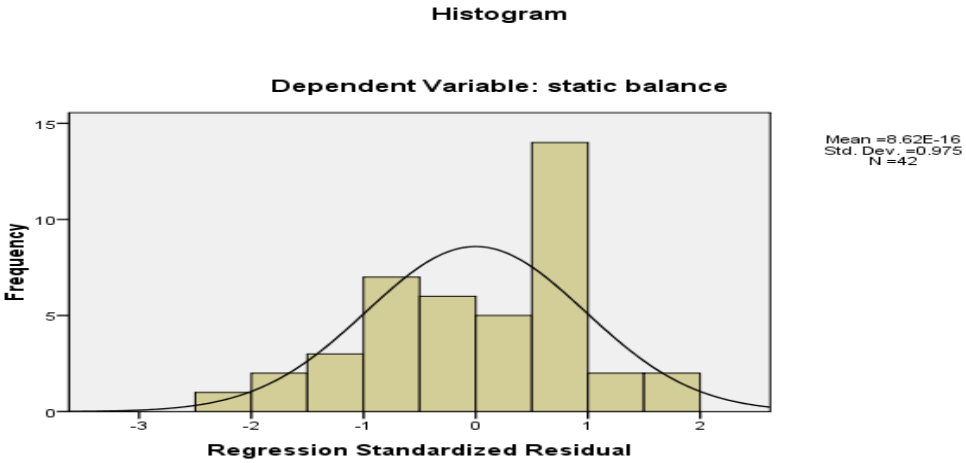
The table 3 reveals that std. (standardized) residual, maximum value (1.988) and minimum value (-2.351), both values doesn't exceed +3 & -3. This proves that the range doesn't have any outliers.

Fig. 1
Normality curve in relation to static balance of university level players



It evident from Fig. 1 that the distribution of residuals satisfies the normal assumption**.**

Table 4
Correlation between Dependent Variable (static balance) and Independent Variables (abdominal strength and back strength)

Variables	N	Correlation coefficient (r)	Sig. value
Abdominal strength	42	.713*	.000
Back strength	42	.721*	.000

Table - 4 clearly indicates that there exists a significant relationship between static balance *and Independent Variables i.e.* Abdominal strength, and Back strength as the sig. values were found lesser than the .05.

Fig. 2
Scatter diagram shows relationship among the selected variables

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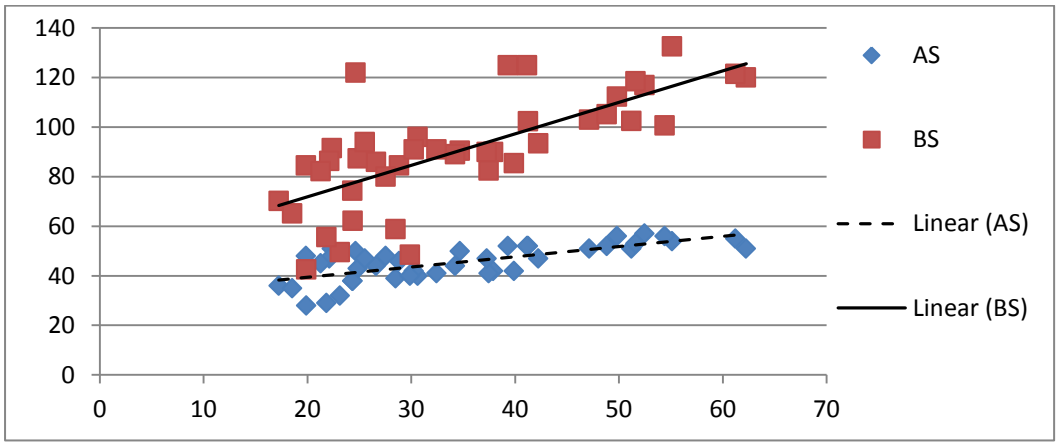

Table 5

Model Summary showing Pearson's correlation between speed ability and selected anthropometric variables

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.742[a]	.551	.528	8.63899	.551	23.953	2	39	.000	1.437

a. Predictors: (Constant), back strength, abdominal strength
b. Dependent Variable: static balance

In table 5 shows that the joint contribution of independent variables to predicting static balance (R = .742). R Square is .551, which impales that 55.1% of static balance can be obtained by these variables (abdominal strength, back strength).

Table 6

The ANOVA table of the linear regression model in relation to static balance on the basis of abdominal strength and back strength

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3575.257	2	1787.628	23.953	.000[a]
	Residual	2910.653	39	74.632		
	Total	6485.909	41			

a. Predictors: (Constant), back strength, abdominal strength
b. Dependent Variable: static balance

Table 6 shows that the usefulness of the linear regression model. This model has found useful in estimating the static balance ability on the basis of abdominal strength and back strength, since F value (23.953) has found significant ($p<0.05$).

Table 7

Regression coefficient of selected variables in predicting static balance

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Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-14.172	9.225		-1.536	.133
	abdominal strength	.609	.370	.354	1.644	.108
	back strength	.235	.122	.415	1.927	.061

a. Dependent Variable: static balance

Table 7 shows that the quantification of relationship between selected independent variables (abdominal strength and back strength) and static balance.

Regression model for estimating static balance on the basis of abdominal strength and back strength

Model 1

Y = 0.609 (X1) - 0.235 (X2) -14.172

Where: Y= static balance, X1= abdominal strength, X2 = back strength

DISCUSSION OF THE FINDINGS

The primary purpose of this study was to determine the relationships between static balance and abdominal strength and back strength. The findings of this study include significant positive relationships between: i) static balance and abdominal strength (r=0.713); ii) Static balance and back strength (r=0.721). Suri et al assessed the relationship of trunk muscle attributes and balance and mobility in elderly and found an average correlation (41%) between balance and trunk muscle endurance **(Suri P. et al., 2009).**

Based on a literature review, trunk extensor fatigue has affected static balance through increased postural sway. Carpes described positive effects of trunk strength program on low back pain pelvis kinematics, and body balance **(Carpes et al., 2008).** Sarvin et al. suggested that relevant factors to core muscle endurance and improvement exercises of core muscle endurance be concentrated on **(Sarvin et al., 2015).** Our data also agree with the results of a study by Carter et al. (2002) and Binda et al., (2003) who found a significant relationship between strength and balance.

We assessed abdominal and back strength through tests that elicited isometric muscle contractions of the trunk musculature during the time. The single leg stance test was used to measure static balance quantitatively and a positive correlation was found between abdominal & back strength and static balance. Due to the correlation type of study, we can be inferred that with improvement in one, we can expect the better result in another one.

The fact that which variable is the main concern to be worked on for development is not well known but concerning that the core is where the center of gravity is positioned and operates as integrated functional units where the kinetic chain starts from, it considers trunk muscle as our essential issue to work on it. On the other hand, the trunk area contains shoulder and pelvic girdles, so stabilizing muscles should be activated dynamically in the beginning of movement to provide a strong foundation from which force is created and movement begins **(Lederman, 2010; Bressel, et al., 2007).**

CONCLUSIONS

Overall, the study findings suggest that the abdominal strength and back strength were positively correlated with static balance. On the basis of Multiple Relationship (R) between static balance and abdominal strength & back strength, study also suggested that 55.1% (R^2= .551) of static balance is obtained by abdominal & back strength. Another findings of Regression analysis suggested an equation [**static balance =** 0.609 (abdominal strength) - 0.235 (back strength) - 14.172] to predict the static balance.

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