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Prediction of Volleyball Playing Ability from Selected Fundamental Skill Performances and Anthropometric Measurements of Volleyball Players

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Abstract

The intension of this study is the prediction of volleyball playing ability from selected fundamental skill performances and anthropometric measurements of volleyball players. To attain this aim, the investigator selected one hundred and ninety two male, inter-collegiate level Anna university volleyball players as subjects. Random group design was used for this investigation, as it is considered most suitable. The age of the selected subjects ranged from eighteen to twenty five years. In this study one criterion (volleyball playing ability) and eight determinant variables are included. Pearson product moment correlation was utilized to verify the association between criterion (volleyball playing ability) and determinant variables. The relationship between criterion and determinant variables as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. To test the hypothesis, 0.05 level of confidence was fixed. The selected fundamental skill performance and anthropometric measurements such as leg length, spiking ability, passing ability and thigh girth, of the volleyball players were highly correlated with playing ability of inter-collegiate level in Anna university volleyball players.

Keywords: Skill performances, Anthropometric measurements and Volleyball players

INTRODUCTION

Volleyball games typically have short bursts of play, that require start and stop action. Cardio exercises to improve endurance should be included in volleyball drills that mimic the bursts of stamina needed in a volleyball game. Circuit training helps to condition a volleyball player's technique to improve spiking, blocking and serving. Starting a workout routine that includes high intensity interval training with a variety of cardio equipment and strength training will also help to improve endurance and fitness. Volleyball players can use interval training to condition them for quick volleyball maneuvers through bursts of intense exercises and drills.

Today volleyball requires players to develop good physical endurance, speed, explosive power and strength endurance. Vertical jump ability is vital for success in volleyball. Jumping is utilized during the jump set, jump serve, blocking and spiking. A successful player must not only be able to jump high, but must also be able to reach that height quickly. This requires an ability to generate power in a very short time. The use of strength during the play is determined by the fact that the usage of maximum strength lasts from 0.5 to 0.7 seconds, however, most of the explosive moments take substantially less time.

The ability to react rapidly and powerfully is clearly a condition for the development of young volleyball players. Speed is the ability to execute any work in the minimum possible time. Speed is the frequent movement of limbs, whether legs of a runner or the arms of the shot putter or the arms of a volleyball spiker. Speed is an essential part of every sport. Speed is the capacity of a moving limb or part of the body's lever system or the whole body with the greatest possible velocity. In volleyball it is an important aspect as the speed of upper limbs (arms) is most used by spikers, while spiking and by players during serving the ball. Also speed is the product of the rate of striding and the length of the stride. Through training, it is possible to lengthen the stride without affecting the cadence, thus increasing the effective sprinting speed. A volleyball spiker needs this ability while approaching attacking skills.

Volleyball is a team sport involving short explosive activity bursts, such as serves, receptions, passes, spikes, short sprints, jumps and high speed movements with change of direction (**Hank et al., 2015; Lidor and Ziv, 2010a; Valladares et al., 2016; Vlantes and Readdy, 2017**). Successful volleyball players are tall and lean, and are characterized by a high level of jumping ability, as well as technical and tactical skills (**Gabbett et al., 2007; Malousaris et al., 2008; Rikberg and Raudsepp, 2011; Sheppard et al., 2009)**. Previous research has shown that anthropometric and physical variables are able to discriminate players as starters Vs. non-starters or selected Vs. non-qualified (**Gabbett et al., 2007; Milic et al., 2017; Smith et al., 1992).** For example **Lidor and Ziv (2010b)**, in a review of literature, it concluded that anthropometric data were correlated with volleyball skills' proficiency and game performance, especially in female players. Furthermore, **Gabbett and Georgiev (2007)** highlighted the importance of anthropometric characteristics in junior volleyball players, by showing that as the playing level increased, junior volleyball players were taller and leaner. In contrast, **Smith et al. (1992)** found that volleyball players of a national team did not differ in anthropometric characteristics compared with a university team, but were significantly faster and had greater vertical jump performance, as well as superior strength and aerobic fitness. Based on these results, it seems that volleyball performance is multidimensional (**Rikberg and Raudsepp, 2011**) and successful players are leaner and taller with greater motor abilities compared with lower level players (**Milic et al., 2017**).

Successful participation in volleyball games, needs high level of technical and tactical skills, also requires suitable anthropometric characteristics. Anthropometric characteristics are almost exclusively genetically determined. Therefore length and breadth measurements cannot be changed with training. Therefore, many previous studies have evaluated anthropometric profiles of volleyball players **(Bandyopadhya, 2007; Bayios et al., 2006; Duncan et al., 2006).**

The present study is mainly focused on selected skill performance and anthropometrical variables. As far as the performance of volleyball team is concerned, above said variables are vital. The researcher reviewed number of journals, books, e-resources, unpublished thesis, dissertations and coaching manuals, in which it was observed that the standard skills of volleyball players are based on these selected skill performance and anthropometrical variables. Based on these observations, the investigator selected this investigation.

METHODOLOGY

Selection of Subjects

The study under investigation was intended to identify the factors influencing the playing ability of intercollegiate volleyball players from selected fundamental skills, performances and anthropometric variables. To achieve the purpose of the study investigator selected one hundred and ninety two intercollegiate level men volleyball players from different colleges in Tamilnadu state, India. The subjects were in the age group of 18 – 25 years and were selected from those teams that entered the pre-quarter final in the inter zonal intercollegiate tournaments held at Paavai engineering college of Anna university in the year 2019-2020.

Selection of Variables

Criterion Variable: The subjective rating of the experts, who were designated to evaluate the volleyball playing ability of the selected subjects.

Game skill Performances: The following game skill performances namely spiking ability, serving ability and passing ability were selected.

Anthropometric Measurements: The following anthropometric variables namely height, leg length, arm length, thigh girth and calf girth were selected.

Collection of Data

The playing ability of the subjects were assessed by judges rating and the selected game skill performances and anthropometric measurements were measured through standard test and measurements.

Statistical Techniques

In this study, one criterion (volleyball playing ability) and eight determinant variables are included. Pearson product moment correlation was utilized to verify the association between criterion (volleyball playing ability) and determinant variables. The relationship between criterion and determinant variables, as well as inter-correlations among determinant variables was calculated by using Pearson product-moment correlation formula. To test, the hypothesis 0.05 level of confidence was fixed.

Result

The range, minimum, maximum, mean and standard deviation values on selected skill performance, anthropometrical and playing ability of volleyball players are presented in table-I.

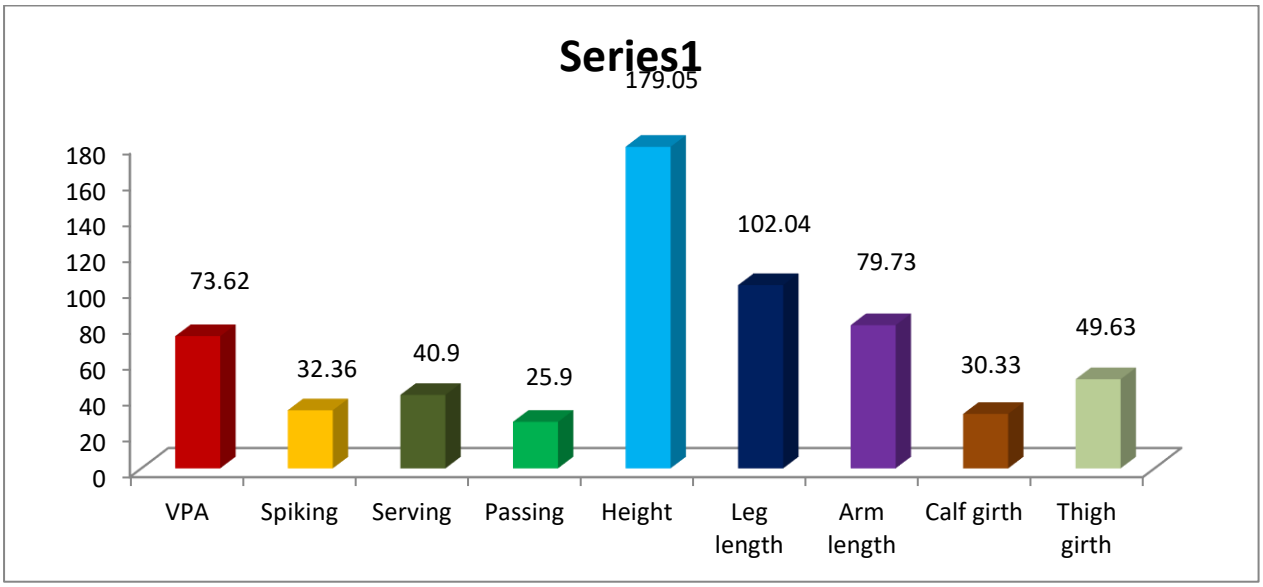
Table-1

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
VPA	192	70	79	73.62	2.07

Spiking	192	26	38	32.36	2.63
Serving	192	37	46	40.90	2.69
Passing	192	21	30	25.90	2.56
Height	192	175	186	179.05	2.93
Leg length	192	94	112	102.04	4.76
Arm length	192	74	86	79.73	2.82
Calf Girth	192	27	34	30.33	1.80
Thigh Girth	192	43	54	49.63	2.28

The obtained mean and standard deviation values on selected skill performance and anthropometric measurements variables such as playing ability (73.62 ± 2.07) , spiking ability (32.36± 2.63), serving ability (40.90 ± 2.69) and passing ability (25.90 ± 2.56), height (179.05 ± 2.93), leg length (102.04 ± 4.76), arm length (79.73 ± 2.82), calf girth (30.33 ± 1.80) and thigh girth (49.63 ± 2.28) of the inter-collegiate volleyball players were calculated and it is graphically displayed in figure-I.

Figure –I : Diagram Showing the Mean Value on Selected Volleyball skill performance and Anthropometric Variables of Volleyball Players



To determine the relationship between criterion and determinant variables, and also to find out the interrelationship between the determinant variables, Pearson product moment correlation was used and the obtained results are given in table-II.

Table –II: Inter Correlation Matrix

	VPA	SPIKE	SERVE	PASS	Ht	LL	AL	CG	TG
VPA		.809**	.785**	.737**	.775**	.657**	.743**	.659**	.670**
SPIKE			.847**	.853**	.748**	.721**	.781**	.776**	.817**
SERVE				.865**	.788**	.753**	.808**	.847**	.859**
PASS					.755**	.788**	.819**	.915**	.933**

Ht						.911**	.852**	.730**	.737**
LL							.870**	.770**	.787**
AL								.820**	.785**
CG									.923**
TG									

**The required table 'r' value is 0.34 at 0.05 level of confidence.*

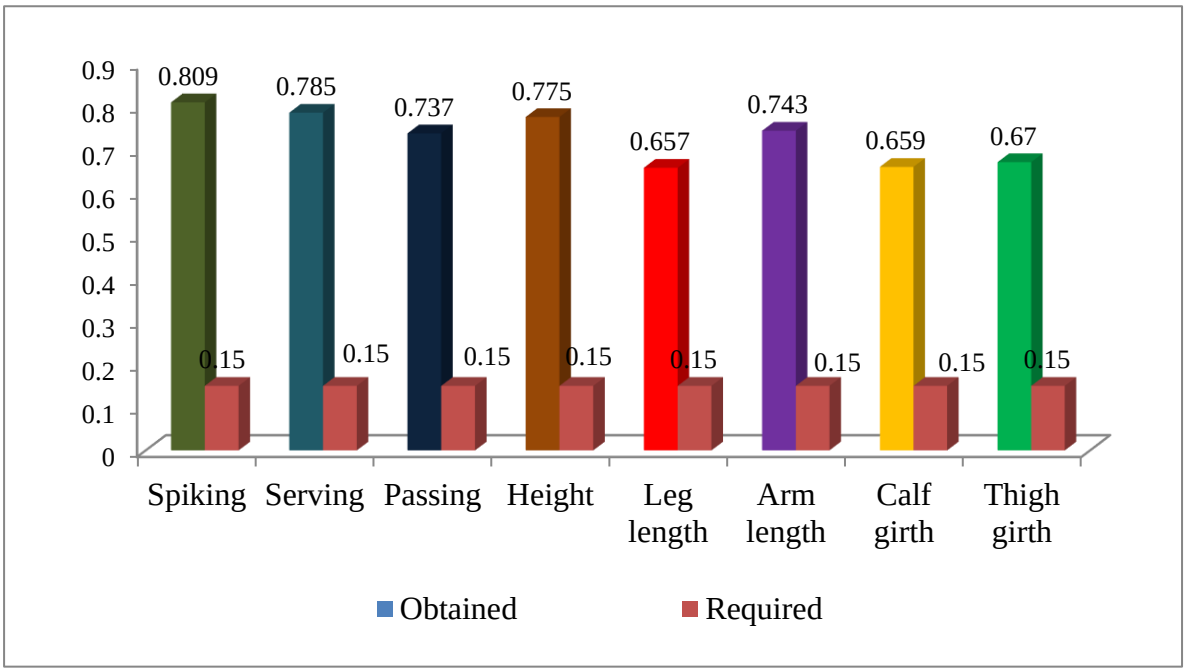
Table –III: Abbreviations

VPA	Playing Ability	LL	Leg Length
SPIKE	Spiking ability	AL	Arm Length
SERVE	Serving ability	CG	Calf Girth
PASS	Passing ability	TG	Thigh Girth
Ht	Height		

Relationship with skill performance and Anthropometric variables

The correlation value obtained for the selected volleyball skills such as spiking ability, serving ability and passing ability are 0.809, 0.785 and 0.737, height, leg length, arm length, calf girth and thigh girth are 0.775, 0.657, 0.743, 0.659, and 0.670 respectively. These obtained and the required correlation values (0.15) are displayed in figure-II.

Figure-II: Diagram Showing the Correlation Coefficient Values between Volleyball Playing Ability and the Selected Skill Performance and Anthropometric Variables



Analysis of Variance Results

The analysis of variance for the influence of predictor variables on volleyball playing ability among volleyball players is given in table -IV.

Table –IV: Analysis of variance

Model		Sum of Squares	df	Mean Square	F
1	Regression	536.985	1	536.985	359.23
	Residual	284.015	190	1.495	
	Total	821.000	191		
2	Regression	590.787	2	295.393	242.51
	Residual	230.213	189	1.218	
	Total	821.000	191		
3	Regression	614.735	3	204.912	186.76
	Residual	206.265	188	1.097	
	Total	821.000	191		
4	Regression	622.342	4	155.585	146.45
	Residual	198.658	187	1.062	
	Total	821.000	191		
5	Regression	626.950	5	125.390	120.18
	Residual	194.050	186	1.043	
	Total	821.000	191		

The found ‘F’ values 359.23, 242.51, 186.76, 146.45 and 120.18 are highly significant (0.05levels). It establishes that all chosen determinant variables have collectively influenced the volleyball player’s playing ability.

Since the ANOVA ‘F’ values are very much significant, the computation of multiple regressions was performed. Multiple regression equation was calculated, because the multiple correlations were adequately high to warrant prediction from it. Then, the correlation identified, the independent variables to be included and their order in the regression equation.

Multiple correlations were computed by step-wise argument method and the results are presented in table – V.

Table – V: Multiple correlations

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.809[a]	.654	.652	1.22
2	.848[b]	.720	.717	1.10
3	.865[c]	.749	.745	1.04
4	.871[d]	.758	.753	1.03

5	.874[e]	.764	.757	1.02
a. Predictors: (Constant), Spiking ability				
b. Predictors: (Constant), Spiking ability and Height				
c. Predictors: (Constant), Spiking ability, Height and Leg length				
d. Predictors: (Constant), Spiking ability, Height, Leg length and Arm length				
e. Predictors: (Constant), Spiking ability, Height, Leg length, Arm length and Serving ability				

From Table – V it was found that the multiple correlations co-efficient for predictors, such as spiking ability, height, leg length, arm length and serving ability was 0.874 which produced the highest multiple correlations with volleyball playing ability. 'R' square values show that the percentage of contribution of predictors to the volleyball playing ability (Dependent variables) is in the following order.

1. About 65.4% of the variation in the volleyball playing ability was explained by the regression model with one predictor such as spiking ability.

2. About 72.0% of the variation in the volleyball playing ability was explained by the regression model with two predictors such as spiking ability and height. An additional 6.60% of the variance in the volleyball playing ability was contributed by height.

3. About 74.9% of the variation in the volleyball playing ability was explained by the regression model with three predictors such as spiking ability, height and leg length. An additional 2.9% of the variance in the volleyball playing ability was contributed by leg length.

4. About 75.8% of the variation in the volleyball playing ability was explained by the regression model with four predictors such as spiking ability, height, leg length and arm length. An additional 0.9% of the variance in the volleyball playing ability was contributed by arm length.

5. About 76.4% of the variation in the volleyball playing ability was explained by the regression model with five predictors such as spiking ability, height, leg length, arm length and serving ability. An additional 0.6% of the variance in the volleyball playing ability was contributed by serving ability.

Multiple regression equation was calculated and the obtained results are presented in table – VI.

Table –VI: Multiple Regression

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	53.064	1.088		48.754	.000
	Spiking ability	.635	.034	.809	18.953	.000
2	(Constant)	11.617	6.313		1.840	.067
	Spiking ability	.409	.046	.521	8.979	.000
	Height	.272	.041	.385	6.646	.000

3	(Constant)	-15.410	8.329		-1.850	.066
	Spiking ability	.439	.044	.559	10.042	.000
	Height	.522	.066	.738	7.901	.000
	Leg length	-.182	.039	-.418	-4.672	.000
4	(Constant)	-16.457	8.205		-2.006	.046
	Spiking ability	.389	.047	.496	8.321	.000
	Height	.490	.066	.694	7.430	.000
	Leg length	-.228	.042	-.526	-5.430	.000
	Arm length	.163	.061	.222	2.676	.008
5	(Constant)	-12.524	8.343		-1.501	.135
	Spiking ability	.325	.056	.414	5.858	.000
	Height	.463	.067	.655	6.938	.000
	Leg length	-.225	.042	-.518	-5.399	.000
	Arm length	.134	.062	.182	2.163	.032
	Serving ability	.124	.059	.161	2.102	.037
a. Dependent Variable: VPA						

From the Table – VI, the following regression equations were derived for playing ability of volleyball players. Regression equation is obtained scores form = PA.

$$\mathbf{Y^1 = C + b_1 x_1 + b_2 x_2 + b_3 x_3 + b_4 x_4 + b_5 x_5}$$

Volleyball Playing Ability (VPA) = 53.064 + 0.325 (Spiking ability) + 0.463 (Height) – 0.225 (Leg length) + 0.134 (Arm length) + 0.124 (Serving ability).

The regression equation for the volleyball playing ability includes spiking, height, leg length, arm length and serving ability. As the multiple correlations on volleyball playing ability with the combined effect of these independent variables are highly significant, it is apparent that the obtained regression equation has a high predictive validity.

DISCUSSION ON THE FINDINGS

In this study, the volleyball playing ability was predicted from 192 intercollegiate level, volleyball players with the help of selected predictor variables such as spiking ability, serving ability, passing ability, height, leg length, arm length, calf girth and thigh girth. The volleyball playing ability was determined by subjective rating by three experts it is was used as the criterion variable. The step wise selection in multiple regression method was used to determine the prediction equation **(Thomas and Nelson, 1990).**

The step wise regression selection method begins with the squared multiple correlation of all the predictor variables with independent variables. The predictor variables are deleted from the regression equation one at a time, and the last two 'R' square due to deletion of the variable is studied, that is, each variable is treated as if it were entered last in the equation. Thus, it is possible to find out which variables adds least when entered last in the equation, and the loss in 'R' square is compared against a criterion of meaningfulness as well as significance. Thus, when a variable does not add meaningfully or significantly to prediction it is deleted. And when no variable is deleted, the analysis is terminated.

In the present study, for a multiple correlation of 0.874 with the following ten variables were excluded from a total of variables, namely i) Spiking ability, ii) Height, iii) Leg length, iv) Arm length and v) serving ability with the probability. Hence spiking ability, height, leg length, arm length and serving ability were included in the equation with the multiple correlations (R) of 0.874, beyond which the size of the multiple correlation no longer increases to any extend **(Thomas and Nelson, 1990).**

Among the fundamental skill performance variables studied, spiking ability and serving ability were found to be the best predictor for volleyball playing ability with significant correlations. The above findings are supported with the study conducted by **Diyanto et al. (2018)** Volleyball playing ability was predicted from the game skill variables servicing, passing and setting, **Antony Isabel Rani (2008).** Volleyball playing ability had a significant relationship with serving, overhead pass, grip strength, agility, leg explosive power, height, arm length. **Benitto Justus (2012)** the pass, leg strength were the best predictors of playing ability in intercollegiate level volleyball players. **Maganathan (2010)** reported that volley and leg length were good predictors for volleyball playing ability.

Among the anthropometrical variables height, leg length and arm length found as the best predictor for volleyball playing ability with significant correlations. **Kuldeep and Ram (2013)** showed that the playing ability had significant relationship with standing height, sitting height, total arm length, upper arm length, leg length, thigh length, lower leg length, hand length and hand breadth of handball players. **Sudhakara, (2018)** has showed significant relationship of Height, Leg length, Arm Length, Forearm length, Fore arm circumference, Upper arm girth, Chest Girth, Thigh Girth & Calf Girth with volleyball playing ability of volleyball players. **Virender and Amanendra, (2019)** has proved significant relationship between Anthropometric Variables and playing ability of Volleyball players. **Kushwant and Nandalal, (2012)** has proved that women volleyball players standing height (0.376), height sitting (0.360), arm length (0.494), and leg length (0.457) speed (0.312), grip strength (R) (0.471), and power (0.314) had significant correlation with volleyball playing ability and showed significant positive correlation. **Kusdinar et al., (2018)** has explained that the equation illustrates that increasing the skills of playing volleyball variables predicted by anthropometric variables at 0.742. **Manjunatha and Bujurke, (2020)** has proved the relationship between anthropometric, physical and physiological measurement and playing performance. Very few anthropometric measurements were found to be significant with skill performance. **Govindaraj and Murugesan (2020)** has revealed that the leg length, standing height, agility, arm length and calf girth are the common characteristics which can be used to predict the volleyball playing ability of the college level men players.

Conclusion

Among the selected determinant variables spiking ability, serving ability, passing ability, height, leg length, arm length, calf girth and thigh girth of the volleyball players were highly correlated with volleyball playing ability. The predictor variables namely spiking ability, height, leg length, arm length and serving ability can be used to predict the volleyball playing ability of the Inter-collegiate level Anna University volleyball players. The ability of a player in a team game like volleyball depends largely in the various skill performance and

anthropometric parameters of the players. Present science is very much interested in estimating the optimum skill performance and anthropometric make-up of a player. So the scanning and selection of a particular volleyball player may be achieved successfully to a great extent by measuring skill performances and anthropometrical variables.

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