

Development of a Discriminant Model to Classify Volleyball Players According to Their Position

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Abstract – This study has been conducted with a purpose to develop a discriminant model to classify the spiker and libero players in volleyball. Thirty six volleyball players have been selected from the sixteen teams at All India Inter-University Championship, Kanpur, India (2019). The players were examined on the particular variables just after the finish of the tournament. The variables which were selected for the purpose of the study are vital capacity, fat percentage, lean body weight, resting heart rate, resting respiratory rate, negative breath holding capacity, positive breath holding capacity, thigh length, calf girth, thigh girth, leg length, hand length, upper arm girth, trunk length, standing height, forearm length, arm length and body weight. A robust and significant discriminant model has been constructed to classify the spikers and liberos. Among all the selected variables, upper arm girth and standing height were found to have significant discriminating power.

Keywords: Discriminant Model, Physical, Physiological, Volleyball, Spiker, Libero

INTRODUCTION

Volleyball is a difficult game of uncomplicated abilities. The object of the diversion is to send the ball over the net so as to ground it on the adversary's court, and to forestall a similar exertion by the rival. The ball is spiked from up to 60 cm over the height of a basketball circle (about 3.65 meters) and takes parts of one moment to venture out from the spiker to the recipient. That implies the beneficiary must assess approaching point, choose where to pass the ball and afterward control their go in a split second. The fundamental example of development in making an assault incorporates a burrow (an underarm pass), a set (an overhead pass made with the hands), and a spike (the overhead assaulting shot). Groups can likewise attempt to obstruct the adversary's spike as the ball crosses the net (International Volleyball Federation, 2008).

There are 5 positions filled on each volleyball squad at high level. These are Libero/Defensive Specialist, Opposite Hitter/Right Side Hitter, Middle Hitter, Outside Hitter/Left Side Hitter and Setter. Every one of these positions plays a particular key job in winning a volleyball competition (Benson Siyawareva, UTC Volleyball, 2015). Most ideal physique is clearly an assistance to volleyball performance. A volleyball squad together outfitted with the entire perfect anthropometric attributes can win the amazingness in a game (Chen, 2005). Among all the physical execution pointers, speed and power are of the most

significance. For the most part, hopping stature is significant for the usage of strategies and strategies (Jin et. al., 2007). Japan Volleyball Association exhibited a critical connection between's the vertical hopping list and the focused capacity of the volleyball players. It was discovered that the bouncing limit had a positive connection with the quantity of spiking, blocking and serving in a diversion and the absolute achievement rates of spiking (Tian, 2006).

Arm length had a huge connection with the performance over the volleyball net, particularly in attacking (You and Huang, 2000). Longer arm is additionally significant in defense. The length of the arm span of first class volleyball players has been observed to be around 5 cm longer than his/her tallness. The arm span and the standing reach height are observed to be firmly related (Zeng, 1992). To perform volleyball skills and strategies, players need abnormal amounts of physical performance especially in muscle quality, movement speed, arm spiking, bounce with and without running up, movement stamina, spryness, and flexibility of shoulders, midsection, knees, and wrist, and so on. (Chen, 2005). Stature has been accounted for to be a segregating factor among fruitful and non-effective groups in a university competition (Morrow et al., 1979), associating altogether with the last standings of an open national competition (Gladden and Colacino, 1978). The tallness over the net is a significant factor for volleyball games, controlled by the competitors' stature and hopping tallness, and

appeared in blocking tallness and spiking tallness. All these present the interest for explicit build of volleyball competitors (Gao, 2006).

Yang (1996) had gathered 106 testing things for physical performance (China (23), Japan (26), USA (26), Canada (10), previous Soviet Union (14), and Holland (7)), and classified 61 test things that were generally utilized in these nations to six areas that were believed to be firmly identified with volleyball performance, including stamina, explosive power, deftness, muscle quality, coordination, balance and adaptability. Besides, 10 testing things were chosen, including spiking jump, 20-meter run beginning from an inclined position, 3-step frog-jump, sit-ups, medicine ball throw, 12-minute race, 36-meter shuttle run, 3-meter shuttle run, profound squat with free weight (Yang, 1996).

Gabbett et al. (2006) chose the accompanying things to quantify physical performance of volleyball players: muscular power of upper body (medicine ball throwing over-head), muscular power of lower body (spike jump and vertical jump), speed (5 m and 10 m dash), maximal aerobic power, and agility (T-test). The anthropometry of a volleyball athlete combined with their natural mechanical abilities, are the most important factors, which can restrain the specialized and strategic dimension of an opponent during a match (Papadopoulou, 2001). In any case, there have been not many reports on the connection between the anthropometric qualities and physical performance of world class volleyball players, especially at various playing positions. With this reason, the analyst has endeavored to make a discriminant model to group the spikers and liberos. The discriminant model will help us in knowing the factors which are useful in segregating these players.

PURPOSE OF THE STUDY

- To classify the subjects (libero and spikers) into groups using a discriminant function.
- To determine the percentage of variance in the dependent variable described by the independents.
- To remove those independent variables which do not have discriminating power in classification.

METHODOLOGY

Selection of Participants

This study is based on randomly selected 36 Inter-University male Indian volleyball players (18 liberos and 18 spikers) aged 18–25 years (mean 19.15±1.38 years) from the sixteen Indian universities which has reached to the All-India Inter-University Championship (inter-zonal) held at CSJM University Kanpur, India. The age of the participants was recorded from the DOB enlisted in their institutes.

The information was gathered under characteristic ecological conditions in morning. (between 8 a.m. to 11a.m.).

Selection of Variables

Vital capacity, fat percentage, lean body weight, resting heart rate, resting respiratory rate, negative breath holding capacity, positive breath holding capacity, thigh length, calf girth, thigh girth, leg length, hand length, upper arm girth, trunk length, standing height, forearm length, arm length and body weight has been undertaken in the study to construct a discriminant model.

Statistical Techniques

Descriptive statistics has been calculated for the data of selected variables. Normality of data has been checked with the Shapiro-Wilk test. Outliers have been checked with the Box Plots. Discriminant Analysis has been done to classify the selected specialized position players.

RESULTS

The outcomes generated have been presented in the tables below.

The descriptive statistics for the scores on selected variables have been presented in the table 1.

TABLE 1

DESCRIPTIVE STATISTICS FOR THE DATA ON SELECTED VARIABLES FROM BOTH THE GROUPS

Variables	Spikers		Liberos	
	Mean	S.D.	Mean	S.D.
Standing Height	190.02	2.186	174.61	2.64
Body Weight	82.05	3.733	67.83	3.76
Arm Length	80.36	1.65	72.27	1.55
Forearm Length	35.11	1.74	32.27	1.48
Trunk Length	77.47	2.41	72.11	1.83
Upper Arm Girth	28.94	1.58	19.83	1.61
Hand Length	23.16	1.33	21.27	1.90
Leg Length	111.50	2.47	102.05	2.75
Thigh Girth	58.72	6.37	49.66	3.92
Calf Girth	42.83	1.68	36.50	6.45
Thigh Length	59.94	5.82	56.05	2.73
Pos. Breath Hold. Cap.	48.55	6.74	39.50	3.74
Neg. Breath Hold. Cap.	27.72	2.46	23.50	3.51
Resting Respiratory Rate	14.55	1.82	14.27	1.44
Resting Heart Rate	60.38	2.30	60.94	2.64
Lean Body Weight	68.94	4.08	54.83	3.77
Fat Percentage	13.52	1.11	13.50	1.15
Vital Capacity	3.93	.211	4.11	.41

Table 1 shows the descriptive statistics (i.e. means and SDs) of the scores of the selected variables.

The UCD (unstandardized canonical discriminant) function coefficients have been presented in the table 2.

TABLE 2

UNSTANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	Function
	1
Standing	.280
Height	
Upper Arm	.272
Girth	
(Constant)	-57.639

Table 2 shows the UCD function coefficients which were used for creating discriminant function. As it was an explorative study, the stepwise method was used in the analyses and only 2 variables namely standing height and upper arm girth could be retained in the model due to their discriminating power.

Thus, discriminant function can be constructed by using the values of constant and coefficients of these two variables as shown in Table 2.

$$Z = (\text{Standing Height} \times 0.280) + (\text{Upper Arm Girth} \times 0.272) - 57.639$$

The table for the values of Wilks' Lambda and Chi-Square test has been presented in table 3.

TABLE 3

WILKS' LAMBDA AND CHI-SQUARE TEST

Test of Function(s)	Wilks' Lambda			Sig.
	Wilks' Lambda	Chi-square	df	
1	.076	85.192	2	.000

The value of Wilks' Lambda shown in the Table 3 was found to be 0.076. Since, the value of Chi-Square shown in the table 3 is significant as its p-value is equal to 0.000 which is less than 0.05, it may be inferred that the discriminant model is highly significant.

The classification matrix which illustrates the right and incorrect classification of participants in both the sets on the basis of the established discriminant model has been presented in the table 4.

TABLE 4

CLASSIFICATION MATRIX^a

	Position	Predicted Group Membership		Total
		Spiker	Libero	
Original Count	Spiker	18	0	18
	Libero	0	18	18
Percentage	Spiker	100.0	.0	100.0
	Libero	.0	100.0	100.0

a. 100.0% of original grouped cases correctly classified.

Table 4 shows that out of 18 subjects in both the categories all were correctly classified in their corresponding category. Thus, out of thirty six subjects all subjects (100%) were correctly classified by the model which is very high, hence, the model can be considered as valid. Since, this model was developed on the basis of a small sample, therefore, the level of accuracy shown in the classification matrix may not be true for all future classification of new cases.

The SCD (Standardized Canonical Discriminant) function coefficients have been presented in the table 5.

TABLE 5

COEFFICIENTS OF SCD FUNCTION

Variables Selected	Function
	1
Standing Height	.678
Upper Arm Girth	.437

Table 5 shows the discriminating power of the variables selected in the model. Since, absolute function of the standing height (0.678) is higher than that of upper arm girth (0.437), standing height is more powerful variable in this model in comparison to upper arm girth in discriminating the libero and spiker players.

The means of the transformed group centroids are presented in the table 6.

TABLE 6

FUNCTIONS AT GROUP CENTROID

Position	Function
	1
Spiker	3.397
Libero	-3.397

Unstandardized canonical discriminant functions evaluated at group means

Table 6 shows the means for the transformed group centroids. Thus, the new mean for spikers is 3.397 and for libero players is -3.397. This indicates that the midpoint of these two is 0.

Means for the transformed group centroids have been presented in the Figure 1 below.

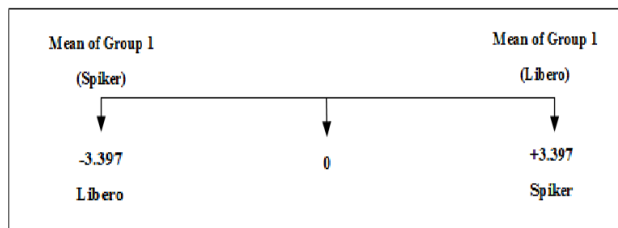


Figure 1: Means of the transformed group centroids

The above table gives the decision rule for classifying any new subject into any of the two categories.

DISCUSSION OF FINDINGS

In this study apart from conventional anthropometric variables, some important physiological variables also have taken into consideration eg. resting respiratory rate (RRR), positive breath holding capacity (PBH), negative breath holding capacity (NBH), resting heart rate (RHR) and vital capacity (VC). The selected variables have been analyzed and putted into the exploratory method (step-wise method) for the formulation of a discriminant model. Standing height and upper arm girth of the spiker and libero players was found to have a discriminating power. Other variables which have not found to have a significant discriminating power were dropped after getting the output. The UCD function coefficients were 0.280 (for Standing Height), 0.272 (for Upper Arm Girth) and -57.639 (Constant). With these UCD function coefficients the discriminant function was constructed i.e. $Z = (\text{Standing Height} \times 0.280) + (\text{Upper Arm Girth} \times 0.272) - 57.639$. The robustness of the model was calculated through Wilks' Lambda and the model was found to be robust enough. Chi-Square for the model was found significant which again shows that the discriminating model is highly significant. It was found through classification matrix that 100.0% of original grouped cases were correctly classified. Through SCD function coefficients, it was found that standing height is more powerful variable in this model in comparison to UAG in discriminating the libero and spiker players.

In Volleyball, 2 sets of player styles can be discriminated. There are middle blockers, outside hitters, and opposites, who mainly blocks and spikes. These are usually taller, heavier and have an upper wall touch in comparison to the further players. SH and UAG was found to have a significant discrimination power in this study. Elaheh K et al. (2013) found that among the elite volleyball players, the tallest mean height is related to the spikers and

the shortest mean height is related to the liberos. These results of the present study approve earlier researches in relation to the physical capacities and positions (Marques et al., 2009; Gualdi-Russo and Zaccagni, 2001; Fattahi et al., 2012; Sheppard et al., 2009). Marques et al. (2009) and Malousaris et al. (2008) has also suggested in their research that the height of liberos used to be shorter than spikers. Palao J. M. (2014) conducted a study on Volleyball players and found the differences b/w height, block reaches and spike by their position. The upper arm girth of the spikers was more in comparison to the liberos may be because of their big stature. However, these findings are not in conformity with findings of Duncan et al. (2006), since, in his findings, Duncan showed that there is no significant difference between different game positions in regard with height.

CONCLUSIONS

This study was conducted with an aim to construct a discriminant function to discriminate among spikers and liberos in volleyball. The discriminant function has been successfully constructed with only two variables as these variables have been found to have a high discriminating power.

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