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DEVELOPMENT OF DISCRIMINANT MODEL FOR CLASSIFYING THE VOLLEYBALL PLAYERS ON THE BASIS OF SELECTED ANTHROPOMETRIC VARIABLES ACCORDING TO THEIR PLAYING POSITION

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Abstract:
The aim of the study was to identify anthropometric variables that discriminate the male volleyball players according to different playing positions i.e., libero (n=16), setter (n=16), and middle blocker (n=20). The anthropometric variables included Standing height, Body weight, Arm length, Wrist circumference, Palm width, Thigh circumference, Calf circumference and Leg length. Multiple Discriminant functions revealed five significant function ($p<0.05$) i.e. height, weight, arm length, thigh circumference and wrist circumference; which primarily represented in different playing positions. After validation, the analysis showed that 90.4 % of players were correctly classified in their respective playing position.

Keywords: volleyball, discriminant analysis, player positions, anthropometric variables

1. Introduction

An athlete's anthropometric characteristics represent important prerequisites for successful participation in any given sport. It has been suggested that volleyball players at different positions have different anthropometric characteristics, especially in height. Success in sport competitions has been associated with specific anthropometric characteristics (Jiang D et al. 2007). Only when a volleyball team is collectively equipped with all the ideal anthropometric characteristics can the team win the dominance in the height over the net is a decisive factor for volleyball games, determined by the athletes' stature and jumping height, and shown in blocking height and spiking height. The height over the volleyball net always means the mastery of the game. The height is decided by a combination of the athlete's body height and the

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jumping height, and usually it is shown in blocking height and spiking height. A team will lose its capacity of winning a score if there is a lack of predominance over the net (Tian, 2006). The knowledge of these characteristics is necessary to establish their importance for the success in competitive sport. Specifically speaking the role played by the player in relation to the position in which he plays different from others.

2. Methods

Fifty two subjects namely Libero (n=16), Setter (n=16) & Middle blocker (n=20) were purposely selected from top eight teams of Senior National Volleyball Championship, 2013. The eight selected anthropometric variables namely Standing height, Body weight, Arm length, Palm width, Wrist circumference, Thigh circumference, Calf circumference and Leg length were selected to construct a multiple discriminant model. Height was measured with the help of Stadiometer in Centimeters. Weight was measured with the help of weighing machine in Kilograms. Palm width was measured with the help of Sliding caliper. Arm length, Leg length, Wrist circumference, Thigh circumference, Calf circumference was measured with the help of Gullick tape in Centimeters. The data were analyzed with the help of Descriptive statistics- Mean and Standard Deviation and Multiple Discriminant analysis to determine which variables were most predictive for volleyball and to determine how accurately the model predicted the groups.

3. Results

The data were analyzed by using multiple discriminant analysis for developing discriminant function for classifying volleyball players according to their playing positions. The analyses were carried by using IBM SPSS software package (ver. 20.0). The results so obtained are discussed in this section**.**

Table 1: Group statistics: mean and standard deviation of all the independent variables in different group

Player Position	**Mean**		**Sd**
Libero	Height	175.7500	2.32379
	Weight	72.5000	4.66776
	Arm Length	75.8750	2.39792
	Wrist Circumference	16.4375	1.14186
	Palm Width	8.5000	.48854
	Thigh Circumference	53.1875	2.26477
	Calf Circumference	34.1563	1.38707
	Leg Length	88.3581	2.82464
Setter	Height	186.1875	4.81966
	Weight	77.0625	7.62976
	Arm Length	79.8125	2.68871
	Wrist Circumference	16.1813	.81993
	Palm Width	8.6188	.42929

	Thigh Circumference	54.7500	3.58701
	Calf Circumference	35.3750	1.53297
	Leg Length	94.9000	4.61534
Middle Blocker	Height	195.6500	4.09460
	Weight	83.3700	7.76504
	Arm Length	86.3250	1.81133
	Wrist Circumference	17.1555	.74220
	Palm Width	9.0700	.47251
	Thigh Circumference	54.6750	2.62215
	Calf Circumference	36.4950	1.76082
	Leg Length	104.1000	4.49151
Total	Height	186.6154	9.15264
	Weight	78.0846	8.18903
	Arm Length	81.1058	4.98305
	Wrist Circumference	16.6348	.98464
	Palm Width	8.7558	.52222
	Thigh Circumference	54.2404	2.89098
	Calf Circumference	35.4308	1.83491
	Leg Length	96.4256	7.76999

Table 2: Eigen values

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	6.443[a]	93.1	93.1	.930
2	.479[a]	6.9	100.0	.569
a. First 2 canonical discriminant functions were used in the analysis.				

Table 2 shows the eigenvalue and canonical correlation values. This table shows that the values of canonical correlations of function 1 & 2 are .930 and .569 respectively. Since square of the correlation explains the variance, hence function 1 explained 86.49 %($=.930^2$) of the variation in categorizing the volleyball player in to Libero or (Setter and Middle blocker) whereas function 2 explained 33.91 % ($=.569^2$) of the variation in categorizing the volleyball player in to Middle blocker or (Setter and Libero) by the independent variables in the developed model.

Table 3: Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.091	112.724	10	.000
2	.676	18.381	4	.001

Wilks' lambda indicates the significance of the discriminant function. The **Table 3** shows that both the functions developed were highly significant as the p-values for both the functions were .000 and .001 respectively.

Table 4: Standardized canonical discriminant function coefficients

	Function	
	1	**2**
Height (X1)	.909	-1.093
Weight (X2)	-.555	.420
Arm Length (X3)	.535	.836
Thigh Circumference (X4)	.461	-.865
Wrist Circumference (X5)	.177	.810

Table 4 shows the discriminating power of the variables in the model. The variables having higher magnitude of the absolute function value is more powerful in discriminating the volleyball player in to different playing position. Since for function 1 the absolute function value of height was .909, hence this variable had the highest discriminating power in categorizing volleyball player in to libero or (setter and middle blocker) whereas the wrist circumference variable had least discriminating power because its absolute function value was .177 which is least. For function 2 the absolute function value of height was -1.093 hence this variable had the highest discriminating power in categorizing volleyball player in to middle blocker or (setter and libero) whereas the variable weight had the least discriminating power because its absolute function values was .420 which is least.

Table 5: Canonical discriminant function coefficients (unstandardized coefficients)

	Function	
	1	**2**
Height (X1)	.206	-.247
Weight (X2)	-.080	.061
Arm Length (X3)	.234	.365
Thigh Circumference (X4)	.161	-.303
Wrist Circumference (X5)	.195	.896
(Constant)	-63.108	13.394

The unstandardised discriminant coefficients shown in the Table 5 were used for constructing discriminant functions. The stepwise method was used in this analysis and only five variables were retained in the model due to its significant discriminating power. Remaining variables did not get selected in the model as they were not found to have sufficient discriminating power. Thus, the discriminant functions one (Z_1) was constructed by using the values of constants and unstandardized discriminant coefficients of the five identified variables in the model whereas the second function (Z_2) was developed by using five variables identified in the model as shown in Table 5 .

$$Z1 = -63.108 + .206 \times (X1) - .080 \times (X2) +. 234 \times (X3) + .161 \times (X4) + .195 \times (X5)$$

$$Z2 = 13.394 - .247 \times (X1) + .061 \times (X2) + .365 \times (X3) - .303 \times (X4) + .896 \times (X5)$$

Table 6: Functions at group centroids

Player Position	**Function**	
	1	**2**
Libero	-3.166	.520
Setter	-.302	-1.004
Middle Blocker	2.774	.387
Unstandardized canonical discriminant functions evaluated at group means		

Table 6 shows the means for the transformed group centriods. These three means have been plotted on the two functions as shown in the Figures 1 and2.

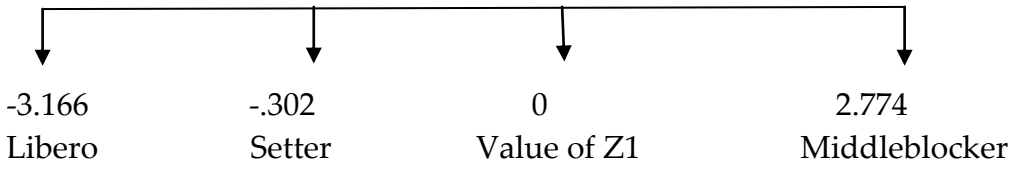

Figure 1: Means of the transformed group centriods in the first function z_1

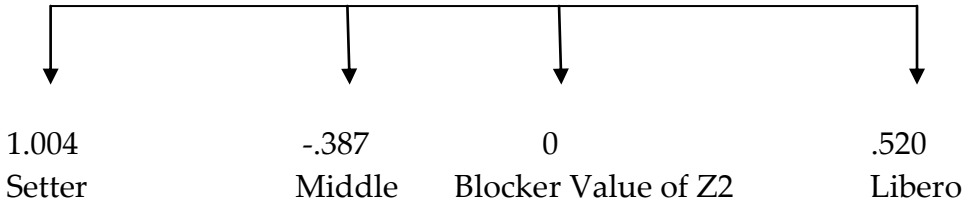

Figure 2: Means of the transformed group centriods in the first function z_2

Figure 1 gives the decision rule for classifying any volleyball player into different playing position as per their suitability. If the discriminant score of any volleyball player on the first function is less than zero ($Z_1<0$), he is classified into libero and setter and if it is greater than zero ($Z_1>0$), he is classified as middle blocker. Figure 2 gives the decision rule for classifying any subject into any of the three groups. If the discriminant score of any volleyball player is greater than zero ($Z_2>0$), he is classified as libero and if it is less than zero ($Z_2<0$), he is classified into setter and middle blocker.

Table 7 is a classification matrix which shows the number of correctly classified cases into different groups by the developed model. The model correctly classified 95 % volleyball player into middle blocker whereas 75 % and 100.0 % into setter and libero respectively. . Thus out of 52 Cases 47 (90.4 %) cases were correctly classified by the model. Overall the model correctly classified 90.4 % of the original cases.

Table 7: Classification matrix of predicted group membership

Classification Results[a,C]						
			Predicted Group Membership			
		Player Position	**Libero**	**Setter**	**Middle Blocker**	**Total**
Original	Count	Libero	16	0	0	16
		Setter	2	12	2	16
		Middle Blocker	0	1	19	20
	%	Libero	100.0	.0	.0	100.0
		Setter	12.5	75.0	12.5	100.0
		Middle Blocker	.0	5.0	95.0	100.0
A. 90.4% Of Original Grouped Cases Correctly Classified.						

4. Discussion

The purpose of this investigation was to study the discriminating power of anthropometric characteristics of elite Indian volleyball players at different playing positions (libero, setter and middle blocker).Multiple discriminant analysis was computed to develop a multiple discriminant model to identify the suitability of volleyball player into three different playing positions (libero, setter and middle blocker). Multiple discriminate analyses generated two discriminant functions. Function 1 accounted 86.49 % of the variance and function 2 accounted for 33.91 % of the variance. The developed models overall classified 90.4 % of the original cases correctly. The discriminant function model correctly classified middle blocker, setter and libero with 95.0 %, 75.0 % and 100.0 % accuracy. The variables having higher magnitude of the absolute function value is more powerful in discriminating the volleyball players in to different playing positions. Since for function 1 the absolute function value of height was .909 hence this variable had the highest discriminating power in categorizing volleyball player in to libero or (setter and middle blocker) whereas the wrist circumference variable had least discriminating power because its absolute function value was .177 which is least. For function 2 the absolute function value of height was -1.093 hence this variable had the highest discriminating power in categorizing volleyball player in to middle blocker or (setter and libero) whereas the variable weight had the least discriminating power because its absolute function values was .420 which is least. This model can be used to classify the volleyball players into different playing positions as per their suitability.

Bigger wrist breadth contributes to hitting the ball during the attack. Height of player is considered as most determinant factor for good performance and the selection of promising volleyball players (Malousaris, et al. & Grantov's et al.). They concluded that, greater height provides better reach above the net. The taller player in volleyball has an advantage because they can easier control both, defensive and offensive actions over the top of the net in comparison to short stature player, as they take more time to reach above the net than the taller players. Arm length had a significant correlation with the performance over the volleyball net, especially in attacking and too in defense, as supported by (You and Huang, 2000). As we know longer the lever greater the force

generated, also players having longer arm length can contact the ball at greater height and cover more area during blocking situations.

5. Conclusion

Volleyball players at different positions have different anthropometric characteristics. Anthropometric profiles indicate whether the player would be suitable for the competition at the highest level in a specific sport , anthropometric parameters have significant role on performing all technical and tactical components especially block and Spike. It is concluded that the importance of tall stature in volleyball is considered as dominant factor for elite level of performance in all the aspects of volleyball may be in terms of spike, block and floor defense. Arm length, weight, wrist girth also play significant contribution in the performance of spike. By keeping the above discriminant functions in mind, coaches may select the players for the talent identification.

A volleyball team collectively equipped with all the ideal anthropometric characteristics can have the dominance in a game (Chen, 2005). Height has been reported to be a discriminating factor between successful and non-successful teams (Morrow et al., 1979).

Coaches can use these results to make training programs more specific, e.g., players positions should spend more time improving their efficacy in task related to their specific positions.

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