

Factor analysis of selected anthropometric and physical variables of elite Indian volleyball players

■ NANDKISHOR PAWAR

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Author for correspondence

NANDKISHOR PAWAR
Lakshmbai National Institute of
Physical Education, GWALIOR
(M.P.) INDIA
Email: nandkishor1017@yahoo.in

■ **ABSTRACT**

The purpose of the study was to identifying selected anthropometric and physical variables representing selection criteria of elite Indian volleyball players under through identifying the factorial structure of these variables. For this purpose (n=104) male volleyball players were purposively selected from Senior National volleyball Championship. The age of these subjects ranges from 19 to 33 years. 15 anthropometric parameters were measured namely, Height, Weight, Arm Length, Hand Length, Palm Width, Arm Girth Relax, Arm Girth Flex, Fore Arm Circumference, Wrist Circumference, Chest Circumference, Thigh Circumference, Calf Circumference, Ankle Girth, Leg Length, Foot Length, Foot Width, Speed, Shoulder Strength, Explosive leg Strength, Agility, Flexibility, Abdominal Strength and body Composition. Principal component factor analysis was used for extracting factor scores from the factor, which were adopted as an indicator of the performance capability in volleyball. Findings revealed four extracted factors, according to the content of their respective items, and were named Anthropometric factor, Girth factor, Strength factor and Physical factor.

■ **KEY WORDS** : Factor analysis, Anthropometric and physical variables, Volleyball players

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Success in sport competitions has been associated with specific anthropometric characteristics, body composition and somatotype Duncan *et al.* (2006). Good selection of players is a guarantee for success. An athlete's anthropometric characteristics represent important prerequisites for successful participation in any given sport Gualdi-Russo and Zaccagni (2001a). It can be assumed that an athlete's anthropometric characteristics can in some way influence his/her level of performance Carter and Heath (1990). Each sports activity has its own requirements; these requirements are manifested in specific anthropometric and physical

characteristics of athletes involved in such activities. Therefore, these characteristics should be identified to be used in athletes' selection and categorization along with achieving higher performance levels.

The performance level of an athlete can not improve unless the coach is fully aware of the athlete's morphological aspects, along with anatomical aspects and body structure and its relations to some functional aspects, including any functional changes and limits of body systems and body response to training loads Abd El-Fattah and Hasanain (1997).

Selection is a precise choice of athletes during

preparation phases through testing their physical, functional, psychological and mental capabilities and measuring their anthropometric characteristics specific to the involved technical activity. Basic criteria of selection include anthropometric measurements, especially during initial phases, so that sports goals can be achieved Ahmed (1999) and Ali (1999).

Anthropometric measurements are very important as there is a clear relation between international performance levels and body composition and type. Physical abilities and anthropometric measurements affect motor skills learning. They also affect body responses to different conditions. They provide sports coaches with valuable data about body indices and measurements according to age and sports levels Khater and Al-Beek (1996). It is also clear that there is a relation between the player's body composition (height – weight – limb length) and the potentiality of achieving higher performance levels as each sports activity needs special body attributes Mostafa (2005).

Individual fitness to sports activities is identified with the suitability of body composition to the required performance Morehouse (1991). It is clear that anthropometric measurements are very important in selecting individual athletes to involve in specific sports activities based on their physical capabilities. Physical selection of athletes depends on some anthropometric measurements that serve as indicators for athletic achievement Esmaeel (2000).

In modern volleyball games focuses on the dominance over the net, and the best way to win this dominance is to recruit athletes who are taller with greater jumping ability. In summary, volleyball is a team sport which requires specific anthropometric characteristics of players for elite performance, particularly in relation to dominance over the net. Volleyball coaches have been paying greater attention on anthropometric characteristics in recruitment of potential players. Therefore a greater attention should be paid to the anthropometric characteristics of elite athletes and the relationship between the anthropometry characteristics and performance indicators. These may be helpful in identifying potential players with promising future, and making the training more effective.

Objective:

The objective of the present study was to identifying

anthropometric and physical variables representing selection criteria of elite Indian volleyball player's through identifying the factorial structure of these variables.

■ METHODOLOGY

Selection of subjects :

A total of 104 male volleyball players from senior national volleyball championship were selected for the study. The ages of the subject ranged from 19 to 33 years and were selected purposively. Anthropometric and physical variable was selected for the purpose of this study.

Criterion measures :

Height was measured with the help of stadiometer in centimeters. Weight was measured with the help of weighing machine in kilograms, arm length, hand length, fore arm circumference, wrist circumference, thigh circumference, calf circumference, ankle girth, leg length, foot length was measured with the help of gullick tape in centimeters. Speed was measured by 50 mtr. Dash run in seconds, shoulder strength was measured by medicine ball throw test in mtr., explosive leg strength was measured by sargent jump test in cm, agility was measured by t- shuttle run test in seconds, flexibility was measured by sit and reach test in cm, abdominal strength was measured by one min sit ups test and body composition was taken with the help of skinfold caliper in mm

Statistical analysis :

Factor analysis technique was employed for all variables to identify the relevant variable for talent in volleyball which was exploratory in nature. The level of significance chosen was 0.05. The data was analyzed with the help of IBM SPSS software 20th version.

■ OBSERVATIONS AND DISCUSSION

Table 1 shows the values of mean and Std. deviation of anthropometric and physical variables of volleyball players.

The Table 2 shows Kaiser-Meyer-Olkin (KMO) and Bartlett's test. The KMO test measures the sampling adequacy. The KMO value was (0.786) which was ($p > 0.05$). So, it was conclude that the sample was sufficient for applying the factor analysis in the present study. Further, Bartlett's test of sphericity was used to test as



Table 1 : Descriptive statistics of anthropometric and physical variables of elite Indian volleyball players		
Variables	Mean	SD
Height	187.6154	7.13845
Weight	78.4846	7.21619
Arm length	82.0750	4.09036
Hand length	20.0072	.96042
Fore arm circumference	26.5971	1.05926
Wrist circumference	16.9520	.86260
Thigh circumference	54.7476	3.23492
Calf circumference	35.7081	1.71158
Ankle girth	21.8077	.97280
Leg length	97.6849	6.16435
Foot length	27.8154	1.17033
Speed	6.7492	.38112
Shoulder strength	10.2577	.58245
Explosive leg strength	63.4135	10.76367
Agility	6.9939	.63161
Flexibility	37.9135	2.98251
Abdominal strength	61.4231	6.56956
Body composition	13.7740	3.58302

Table 2 : KMO and bartlett's test of factor analysis for anthropometric and physical variables		
KMO and bartlett's test		
Kaiser-Meyer-Olkin measure of sampling adequacy		0.786
Bartlett's test of sphericity	Approx. chi-square	957.953
	Df	153
	Sig.	.000

Table 3 : Total variance explained by all the factors									
Component	Initial eigen values			Total variance explained			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1.	6.107	33.930	33.930	6.107	33.930	33.930	5.654	31.412	31.412
2.	2.054	11.412	45.342	2.054	11.412	45.342	2.339	12.996	44.408
3.	1.866	10.364	55.706	1.866	10.364	55.706	1.923	10.685	55.093
4.	1.277	7.095	62.801	1.277	7.095	62.801	1.387	7.708	62.801
5.	0.990	5.498	68.299						
6.	0.926	5.145	73.444						
7.	0.768	4.266	77.709						
8.	0.714	3.965	81.674						
9.	0.586	3.258	84.932						
10.	0.561	3.116	88.048						
11.	0.422	2.345	90.394						
12.	0.397	2.204	92.598						
13.	0.369	2.048	94.646						
14.	0.316	1.755	96.401						
15.	0.240	1.334	97.735						
16.	0.181	1.004	98.738						
17.	0.153	0.853	99.591						
18.	0.074	0.409	100.000						

Extraction method : Principal component analysis

Table 4 : Rotated component matrix : varimax rotated solution

Variables	Rotated component matrix ^a			
	Component			
	1	2	3	4
Height	0.909	0.119	0.023	0.024
Weight	0.481	0.513	-0.062	0.472
Arm length	0.867	0.153	0.110	0.047
Hand length	0.854	0.051	0.103	0.092
Fore arm circumference	0.581	0.341	-0.161	-0.083
Wrist circumference	0.351	0.354	0.141	0.437
Thigh circumference	0.031	0.833	0.093	-0.012
Calf circumference	0.344	0.695	0.157	0.046
Ankle girth	0.375	0.357	0.430	0.082
Leg length	0.830	0.288	0.011	-0.011
Foot length	0.818	0.098	-0.004	-0.021
Speed	-0.014	0.103	0.815	-0.136
Shoulder strength	0.205	-0.048	-0.577	0.334
Explosive leg strength	0.778	-0.262	0.095	0.062
Agility	0.228	-0.421	0.280	0.186
Flexibility	-0.171	0.102	-0.725	-0.248
Abdominal strength	0.211	0.130	0.079	-0.774
Body composition	-0.515	0.335	-0.127	0.343

Extraction method : Principal component analysis
 Rotation method : Varimax with kaiser normalization
 A : Rotation converged in 8 iterations

Table 5 : Factors

	Loadings
Factor 1: Growth factor	
Height	0.909
Arm length	0.867
Hand length	0.854
Leg length	0.830
Foot length	0.818
Factor 2: Girth factor	
Thigh circumference	0.833
Calf circumference	0.695
Factor 3: Physical factor	
Speed	0.815
Flexibility	-0.725
Factor 4: Strength factor	
Abdominal strength	-0.774

Table 6 : Test battery for screening the volleyball players

Height	0.909
Arm length	0.867
Thigh circumference	0.833
Speed	0.815
Abdominal strength	-0.774

to whether the correlation matrix was an identity matrix or not. As Bartlett's Test of Sphericity was significant, the factor model developed in the present study was appropriate.

Table 3 shows the factor extracted and the variance explained by these factors. After applying varimax rotation first factor explained 31.4 per cent, second factor explained 12.99 per cent, third factor explained 10.68 per cent and last factor explained 7.70 per cent of variability. Thus, all the four factors together explained (62.80%) of the total variance.

Table 4 indicates that the varimax rotated solution about the variable explaining the factor. If the variable have factor loading more than 0.6, it indicates that the factor extract sufficient variance from the variables. Result shows that the four component factors have more than 0.06 loading thus they were considered as factors.

Table 5 shows the four factors extracted namely Anthropometric Factor, Girth Factor, Physical Factor, and Strength Factor. Factor 1 Anthropometric factor included height, arm length, hand length, leg length, foot length which were considered as a relevant factor for test item screening in volleyball players. Factor-2 Girth factor included thigh and calf circumferences. Factor-3 Physical factor includes speed and flexibility. Factor-4 Strength factor included abdominal strength.

Conclusion :

In the light of these results, the researcher concluded the following distinctive anthropometric and physical variables that can be used as selection indicators for elite Indian volleyball players: height, arm length, hand length, leg length, foot length, thigh circumference, calf circumference, speed, flexibility and abdominal strength. Finally we can conclude as out of 18 items selected in the preliminary phase on the basis of literature review and researchers own understanding, only 5 items were found suitable to be retained in the test battery under the

four extracted factors head, Anthropometric factor, Girth factor, Physical factor and Strength factor. Thus it is suggested to the researchers interested in constructing test item for screening of volleyball players to deal with the 5 items finally extracted from this study.

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