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A Study on the Factor Structure of Selected Anthropometric Variables of University Level Women Kabaddi Players

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Abstract:
Kabaddi is a game that finds its origins in India. The sport is also popular in Nepal, Bangladesh, Canada, Sri Lanka, Japan, Britain and Pakistan. The sport has a long history dating back to pre-historic times. It was probably invented to ward off croup attacks by individuals and vice-versa. The game was very popular in the southern part of Asia played in its different forms under different names. The game is known by many names, all of Tamil origin: Kabaddi, Sadugudu, Gudugudu, Palinjadugudu and Sadugoodatthi. The word 'Kabaddi' could have originated from the Tamil words 'kai' (hand) and 'pidi' (catch). The game, known as Hu-Tu-Tu in Western India, Ha-Do-Do in Eastern India & Bangladesh, Chedugudu in Southern India and Kaunbada in Northern India, has undergone a sea chance through the ages. Modem Kabaddi is a synthesis of the game played in its various forms under different names. Performance at optimal levels requires high levels of technical, tactical and physiological skills. Identification and selection of talented kabaddi players are not straightforward procedures. The data collected was analyzed by applying Descriptive statistics such as mean, mode, median, standard deviation, minimum score and maximum score were found out and Factor analysis was done to found out the prominent factors comprising of any one or all of the selected 10 anthropometric variables namely such as Height, Sitting height, Weight Arm length Leg length Thigh girth Calf girth, BMI, ponderal index, Crural index of selected among women kabaddi players the unloaded factors obtained were then rotated by very max method to the final solution. This was used to find out the factor structure of selected anthropometric variables of university level women kabaddi players.

Keywords: kabaddi, anthropometric, performance, factor analysis

1. Introduction

People all over the world are becoming more and healthier conscious, the priority has been shifting from everything else to the fact that the most important thing in life, is to keep oneself in shape and fit, to enjoy things in life. Keeping fit, means capturing the days of youth and all the fun of those days alive. Man can give up everything for the sake of keeping himself young. In spite of all the kinds of treatments that have been flourishing the market, the people have not been driven crazy, they still trust the basic natural way of keeping in shape, i.e., by exercising regularly and maintaining a working routine. It is very necessary to go for a complete fitness training, which takes care of all the aspects of making a fit body, beginning from making note about the right kind of diet and right kind of exercises which suits the physical conditions of the body. Physical activity offers a broad range of benefits, including the prevention of obesity, improved self confidence, and an overall sense of well-being. Physical education programs within the school setting can set the stage for how children view physical fitness, activity levels, and future health. Physical education programs also include general health and safety information in addition to providing opportunities for players to learn how to cooperate with one another in a team setting. Physical education has a considerable role in a planed education it is a part of total education. The term education does not confine intellectual field alone. It has a wider notation in the realms of physical mental and spiritual existence of mankind.

2. Background of the Study

The research scholar has gone through related literature available which were relevant to the present Study. The relevant study found in the various sources which the researcher has come across are enumerated bellow

Agar-newman dj et al. (2015) anthropometric and physical qualities of international level female rugby sevens athletes based on playing position. The purpose of this study was to profile international level female sevens athletes and determine if anthropometric and physical qualities are able to differentiate between backs and forwards. Twenty-four subjects with a mean (±SD) age of 22.8±4.0 years and body weight of 69.4±5.2kg were sampled from a national team training program, ranked in the top 3 on the IRB Women's Sevens World Series. Anthropometric (height, body mass and sum of 7 skinfolds) and performance measures (power clean, front squat, bench press, neutral grip pull up, 40m sprint and 1600m run) were collected across the 2013-2014 centralized period and compared across playing position. The thirteen backs (mean age±SD= 21.3±3.5 years) and eleven forwards (mean age±SD= 24.5±4.0 years) had significant differences in body mass (66.40±3.48kg vs. 72.87±4.79kg) and initial sprint momentum (366.8±19.8 kg·m·s vs. 399.2±22.4kg·m·s). However no other measures showed positional differences.The lack of positional differences in female rugby sevens may be due to the multifarious physical requirements of a sevens athlete, leading to a generic athletic profile or perhaps due to a lack of selective pressure. Also, it is conceivable that the anthropometric and physical qualities measured in this study lacked the necessary precision or failed to capture the unique attributes of each position. In conclusion, this is the first investigation profiling international level female sevens athletes. The normative data presented within this paper highlights the physical requirements of female sevens athletes for strength and conditioning practitioners. In addition, the lack of positional differences discovered should impact training program design.

Márquez Costa MV and Alberici Pastore C.(2015)Nutritional screening tool versus anthropometric assessment in hospitalized children: which method is better associated to clinical outcomesHospitalization contributes to worsening of the nutritional status and malnutrition is associate to increase in morbidity and mortality. The aim of the study was to asses nutritional status/risk using anthropometry and the Screening Tool for Risk on Nutritional Status and Growth (STRONGkids), comparing their results to clinical outcomes. For that propose, was conducted an observational longitudinal study with children up to one month of life, hospitalized in Pediatric ward of a teaching hospital. Nutritional status was assessed by Body Mass Index for age and weight for age. Nutritional risk was classified as high, intermediate or low. The length of stay, clinical outcome and complications were taken of the medical records. This project was approved by the Ethics Committee on Research. Were evaluated 181 children, from both sexes. The median age was 8.8 (IQR 3.3; 26.9) months and the median length of stay was 7 (IQR 4; 10) days. There was 20.8% of malnutrition in children younger than one year. Most of the children (55.3%) were classified as in intermediate nutritional risk. The length of stay was associated to nutritional risk, while anthropometry was associated to only in those younger than one year. There were five infectious complication, not associated to nutritional status/risk. Therefore, nutritional risk was significantly associated to length of stay, showing that STRONGkids was a better method compared to anthropometric nutritional assessment to predict this outcome

3. Methodology

In this chapter the methodology adopted for the study, namely selection of subject, selection of variables, reliability of data, testers competency, instrument reliability, testers reliability, criterion measures, orientation of the subject, collection data, test administration and analysis were presented.

3.1. Selection of Subject

Thirty (N=30) women kabaddi players who belong to Calicut University and M.G University participant in the inter University women kabaddi tournament was selected as the subjects for the study. The age of the subjects ranged between 19 to 24

3.2. Selection of Variables

The following variables were selected for the study:

The following anthropometric variables are selected for the study

Height, sitting height, Weight, Arm length, Leg length, Thigh girth, Calf girth.BMI, ponderel index, crural index

 i.   Instrument reliability: The instrument used for the collection of data is of international standard and their test reliability was already set.
 ii. Tester's reliability: The tester's competency was established by test retest method under the supervision of experts in the field of physical education and sports.
 iii. Reliability of Data: The reliability of data was censured by establishing the instrument reliability and testers competency.

3.3. Criterion Measures

3.3.1. Anthropometric Variables

Height	Stadiometer	centimeters
Sitting height	Stadiometer	centimeters
Weight	Weighing machine	kilograms
Arm length	Steel measuring tape	centimeters
Leg length	Steel measuring tape	centimeters
Thigh girth	Steel measuring tape	centimeters
Calf girth	Steel measuring tape	Centimetres
BMI	$\dfrac{\text{(weight in kilograms)}}{\text{height in meters}^2}$	points
ponderel index	Mass/ height^3	points
crural index	$\dfrac{\text{Lower leg length}}{\text{Thigh length}}$	points

Table 1

No	Variables	Co-efficient of Correlation
1	Height	0.97
2	Sitting height	0.92
3	Weight	0.92
4	Arm length	0.91
5	Leg length	0.95
6	Thigh girth	0.96
7	Calf girth	0.93
8	BMI	0.98
9	ponderel index	0.91
10	crural index	0.92

Table 2: Correlation on test retest scores of selected anthropometric variables to the tester's competency

3.3.2. Orientation of the Subject
Before measuring the anthropometric the investigator had briefly explained to the subject the purpose of study and their role in the study.

3.3.3. Collection of Data
The data pertaining to selected anthropometric measurements such as height, weight, arm length, leg length, thigh girth, calf girth, BMI, Ponderal index, Croral index were collected by administrating appropriate standard tests using correct measurement procedure

3.4. Test Administration

3.4.1. Anthropometric Variables

1. Weight
Purpose   :   To measure the weight of the subject
Equipment   :   Weighing machine
Procedure   :   The weight of the subject was taken with a level type laboratory anthropometric weighing machine. The subject stood at the centre of the weighing machine and weight evenly distributed between both feet. The weight was recorded from the indicator needle of dial.
Scoring   :   The weight was read and recorded correct to the half of a kilogram

2. Height
Purpose   :   To measure the standing height of the individual
Equipment   :   Stadiometer, Hard board
Procedure   :   Height is the erect body length from sole of the foot to vertex. The subjects stood bare footed, erect, buttocks and upper back in contact the scale, the arms were hung naturally on the sides. The flat hand board was placed horizontally on his head and marked on the wall, the subject was asked to step out and the reading indicated by the hard board was read from the scale.
Scoring   :   The highest point of the head was recorded to the nearest centimetre.

3. Sitting Height
Purpose   :   To measure the sitting height of the individual
Equipment   :   Stadiometer, Hard board
Procedure   :   Height of the point vertex from horizontal table top which the subject sit with his / her hanging down while the thighs completely rest on the table top
Scoring   :   The highest point of the head was recorded to the nearest centimetre.

4. Arm Length
Purpose   :   To measure the arm length of the subject
Equipment   :   Steel tape
Procedure   :   The subjects wore sleeveless banyan. The initial end of the measuring tape was placed on the acromion process and the arm was brought to abduction position, the tape was brought firmly up to the arm with the middle finger and the tape.
Scoring: :   The reading was taken to the nearest $1/100^{th}$ of a centimetre

5. Leg Length
Purpose   :   To measure subjects leg length
Equipment   :   Measuring steel tape, Pencil, Score sheet
Procedure   :   The subject wore ideal clothing at the time of measuring the measuring tape's initial end was placed on the greater trochanter of femur (or anterior superior spine of the ilium) and firmly brought towards the sole of the foot and the tape recording was recorded.
Scoring   :   The reading was taken nearest $1/100^{th}$ of a centimetre.

6. Calf Girth
Purpose   :   To measure the circumference of the calf
Procedure   :   Calf girth was measured with a tape is wrapped horizontally around the naked lower leg of the subject at the maximal bulge of the calf muscle with slight up and down movements of the steel tape keeping it in a horizontal direction. The maximal circumferential measurements give the value of calf circumference.
Equipment   :   Measuring steel tape
Scoring   :   Measurement was taken in Centimetre.

7. Thigh Girth
Purpose   :   To measure the circumference of the thigh at midpoint of femur length.
Equipment   :   Measuring steel tape
Procedure   :   Thigh Circumferences was measured with a tape placed around the thigh at a midpoint of femur length horizontally.
Scoring   :   Measurement was taken in Centimetre

8. BMI
Purpose   :   To measure Body mass index
Equipment   :   BMI index scale
Procedure   :   (weight in kilograms)
                      height in meters^2
Scoring   :   points

9. Ponderal Index
Purpose   :   To measure ponderal index
Equipment   :   ponderal index scale
Procedure   :   Mass/ height^3
Scoring   :   points

10. Crural Index
Purpose   :   To measure crural index
Equipment   :   Crural index scale
Procedure   :   Lower leg length /Thigh length
Scoring   :   points

3.5. Statistical Technique

Descriptive statistics such as mean, mode, median, standard deviation, minimum score and maximum score were found out and this have given an idea of distribution of scores and features obtained from the data collected for the purpose of the study on all the 10 anthropometric variables namely such as Height**,** Sitting height, Weight Arm length Leg length Thigh girth Calf girth, BMI, ponderal index, Crural index of selecd women kabaddi players. Factor analysis was done to found out the prominent factors comprising of any one or all of the selected anthropometric variables among women kabaddi players the unloaded factors obtained were then rotated by very max method to the final solution.

4. **Analysis of Data and Result of the Study**

The statistical analysis of data collected from all subjects and result of the study have been presented in this chapter For the purpose of the study totally 30 women kabaddi players who participated in all India inter university women kabaddi tournament were chosen as subjects descriptive analysis was done on all the selected 10 Anthropometric variables namely Height, Weight, sitting height, Leg Length, arm length, Calf Girth, Thigh Girth, BMI, ponderal index, Crural index of selected women kabaddi players to find out the mean, median, mode, standard deviation, coefficient correlation minimum score and maximum score. This has given in idea of the distribution of scores and feature obtained from the data collected for the purpose of this study.

4.1. Factors Analysis

Factor analysis describes a procedure to identify those linear combinations of variables (called as factors), which have large variances, ignoring the linear combination, which have small variances. In this study the principal component method was selected for the primary solution of factor analysis. Scores on all the 10 Anthropometric variables of women kabaddi players were subject to correlation analysis which is shown in table 4 in the form of correlation matrices. Correlation matrices obtained for the women kabaddi players used in the principal component analysis. With the help of principal component analysis, the entire 10 Anthropometric variable were divided into various factors. The unloaded factors obtained were then rotated by varimax method to find the final solutions. The rotation of the factor is important in order to avoid the overlapping of variable in different factors. Each of the two factors obtained from the selected women kabaddi players were interpreted and given names. Items with loading greater than or equal to 0.70 of varimax solution were selected for discussing each factor.

4.2. Findings

Variables	Valid N	Mean	Median	Mode	Minimum	Maximum	Std dev
Height	30	156.83	158.00	154.50	140.00	169.00	7.03
Sitting height	30	78.10	78.00	78.30	72.00	84.00	3.49
weight	30	50.93	50.50	51.80	40.00	67.00	7.58
Arm length	30	70.77	70.50	71.30	62.00	77.00	3.90
Leg length	30	94.37	95.50	92.10	70.00	104.00	6.81
calf girth	30	32.33	32.00	33.00	30.00	35.00	2.01
Thigh girth	30	48.57	48.00	49.70	43.00	59.00	4.64
BMI	30	20.63	20.40	21.09	17.75	25.78	2.13
Ponderal index	30	13.17	12.94	13.64	11.35	16.11	1.36
Crural index	30	1.22	1.20	1.26	1.05	1.60	0.12
P rating	30	5.8	6	5.40	4	8	1.03

Table 3: Descriptive profile of selected anthropometric Variables of women kabaddi players

Table number 3 was indicates the scores of descriptive profile such as mean, median, mode, standard deviation, minimum score, and maximum score of the selected anthropometric variable namely Height, Weight, sitting height, Leg Length, arm length, Calf Girth, Thigh Girth, BMI, ponderal index, Crural index of the women kabaddi players.

Variables	H	S H	W	A. L	L.L	T.G	C.G	BMI	P.I	C.I	P.R
Height	1.000										
Sitting Height	0.8069	1.000									
Weight	0.7178	0.6565	1.000								
Arm length	0.7607	0.5112	0.5592	1.000							
Leg length	0.7312	0.5487	0.6291	0.4771	1.000						
Calf girth	0.4395	0.4042	0.7614	0.354	0.4729	1.000					
Thigh girth	0.4316	0.4848	0.8882	0.3012	0.4148	0.7688	1.000				
BMI	0.1947	0.2709	0.8219	0.1637	0.3034	0.7164	0.8936	1.000			
Ponderal index	-0.2502	-0.0828	0.4921	-0.1844	-0.0176	0.5072	0.6889	0.8998	1.000		
Crural index	-0.0307	-0.0569	-0.2354	-0.1025	-0.027	-0.0114	-0.2917	-0.3116	-0.2835	1.000	
Performance Rating	0.4047	0.3799	0.3735	0.2196	0.1877	0.2669	0.3204	0.2002	0.0212	-0.0186	1.000

Table 4: Correlation matrix on selected anthropometric variables of women kabaddi players

Table number 4 was indicates the scores of correlation matrix of the selected Anthropornetric variable namely Height, Weight, sitting height, Leg Length, arm length, Calf Girth, Thigh Girth, BMI, ponderal index, crural index of the men hockey player women kabaddi players Height, Weight, sitting height Leg length was significantly correlates the women kabaddi players performance among this study.

	FACTOR 1	FACTOR 2
Eigen value	5.143886	2.45221
Total variance. Exp	51.44	24.5
Cum. Variance. Exp	51.44	75.96
Height	0.720782	0.664031
Sitting height	0.687882	0.478097
Weight	0.984936	-0.02576
Arm length	0.579331	0.554112
Leg length	0.675332	0.416492
Calf girth	0.814065	-0.17566
Thigh girth	0.895766	-0.33876
BMI, ,	0.801179	-0.57684
ponderal index	0.470489	-0.86106
Crural index	-0.24718	0.285831

Table 5: Principal Component Analysis of women kabaddi Players (Un-Rotated Factor Loading)

	FACTOR1	FACTOR 2	
Eigen value	5.143886	2.45221	
Total variance. Exp	51.44	24.5	
% Variance. Exp	51.44	75.96	
Height	0.979928	0.014341	0.99828
Sitting height	0.828057	0.126556	0.751789
Weight	0.696816	0.69657	0.9959
Arm length	0.801657	-0.00327	0.669391
Leg length	0.776587	0.162642	0.70083
Calf girth	0.469688	0.687714	0.765364
Thigh girth	0.416703	0.862272	0.919355
BMI	0.184222	0.969896	0.999712
Ponderal index	-0.25132	0.948512	0.998981
Crural index	0.017399	-0.37748	0.468627

Table 6: Principal Component Analysis of women kabaddi Players (Rotated factor loading)

Item No	Name of the Variables	Factor Loading
1	Height	0.979928
2	Sitting height	0.828057
3	Weight	0.696816
4	Arm length	0.801657
5	Leg length	0.776587

Table 7: Factor 1 Women kabaddi players after rotated factor loading (Varimax solution)

Factor 1 Women kabaddi players in table 7 was characterized by 5 anthropometric variable of selected 10 variables namely height, sitting height, weight, arm length, leg length since the length variable such as height, sitting height, arm length, leg length are heavy loaded items. This factor could be called as Length factors, this factor accounted for 51.44% of the total common factors accounted by all the two factors.

Item No	Name of the Variables	Factor Loading
4	Calf girth	0.857051
5	Thigh girth	0.826999
6	BMI	
7	Ponderal index	

Table 8: Factor 2 Women kabaddi players after rotated factor loading (Varimax solution)

Factor 2 Women kabaddi players in table 8 were characterized by 4 anthropometric variables of selected 10 variables namely calf girth, thigh girth, BMI, ponderal index. Since the girth variables such as calf girth and thigh girth are heavy loaded items. This factor could be called as girth factor. This factor accounted for 24.5% of the total common factors accounted by all the two factors.

4.3. Discussion of Findings
The factor one length factor comprising of the height, sitting height, weight, arm length, leg length are contributing heavily to the performance of the women kabaddi players. Height and leg length are closely related to each other and contributing factor for performance in hence leg length and arm length are help to attain maximum reach in riders and anti riders it help to easy ankle catches and thigh catches in struggle and ridding in women kabaddi players.
The second factor is known as girth factor comprising of calf girth, thigh girth, BMI and ponderal index. The girth factor is closely related to the total performance of women kabaddi players. Thigh girth and calf girth are contributing factors for the strength (maximum strength and explosive strength) as the muscle mass increase the maximum strength increase and the maximum strength may transfer to explosive strength. Maximum strength and explosive strength contribute hereby to the performance during the ridding and struggling in women kabaddi. BMI denotes the total composition of the body such as height and weight as the BMI improve total strength also improve

4.4. Discussion of Hypothesis
The result of the study enables hypothesis was formulated to be accepted as two prominent contributing factors have been extracted after rotated principal component analysis in women kabaddi players' length factor, girth factor. Based on the factor analysis of the study, only 9 anthropometric variables of selected 10 variables influence the women kabaddi players' performance. Crural index is not influence the women kabaddi performance.

5. Summary Conclusion Recommendation

5.1. Summary
The purpose of the study was to find out the prominent contributing factors to performances in women kabaddi players from among the selected anthropometric variables.30 women kabaddi players who participated in all India interuniversity women kabaddi championship were selected as the subject of the study .Each subject were measured for 10 related anthropometric measurements namely Height, Weight Sitting height, Leg length, Arm length, Thigh girth Calf girth, BMI, ponderal index, Crural index are selected for the study. Factor analysis (principal component analysis) was done to find out prominent factors comprising of any one or all of the selected anthropometric variables among the selected 30 women kabaddi players. The unloaded factors obtained were then rotated by varimax method to find out the final solution. Item with loading greater than or equal to $\pm$ 0.70 of varimax solution were selected for discussing each factor.

5.2. Conclusions
Based on the analysis and within these limitations of the present study the following conclusions can be drawn. In women kabaddi players, the two prominent factors extracted after factor analysis were length factor and girth factor. Length factor was heavily loaded with variable of arm length and leg length. Girth factor was heavily loaded with the variable of calf girth and thigh girth.

5.3. Recommendations
1. The result may be used by teachers and coaches in selection of women kabaddi players.
2. Similar study may helpful to the physical education teachers and coaches to evaluate the   performance of their players.
3. Similar study may be helpful to prepare different level women kabaddi team.
4. Similar study may be also conducted state level and national level men kabaddi players.
5. Similar study may be conducted for boys
6. This study may be conducted for other games.
7. Similar study may be conducted with subject of different age group   other than used in this study.

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