International Journal of Physiology, Nutrition and Physical Education

Sunitha KB
Research Scholar, Kannur
University, Kerala, India

Maneesha Abraham
Research Scholar, University of
Calicut, Thenhipalam, Kerala,
India

Dr. Maria Martin Joseph
Associate Professor, Mary Matha
Arts and Science College,
Mananthavady, Kerala, India

A factor structure study on selected anthropometric variables of national level women hockey players in Kerala

Sunitha KB, Maneesha Abraham and Dr. Maria Martin Joseph

Abstract
The study was to identify those prominent Anthropometric factors among national level women hockey players in Kerala. Total of 36 women Hockey players were selected for the study and the age of the subjects ranged from 17-25 years. The subjects were selected from SN College Kannur and SAI Kollam. Descriptive analysis were done on all the selected anthropometric variables namely; weight, height, sitting height, arm length, leg length, calf girth, thigh girth, ponderal index and crural index. In this study the principal component method was selected for the primary solution of factor analysis. Since there was very less study on anthropometric variables done on Hockey players, The scholar has undertaken this study to explore the importance of Anthropometric variables among Hockey players. The length factor (factor 1) comprises of height, arm length were heavily loaded items, the index factor (factor 2) which comprises the ponderal index was heavily loaded item, the another loaded factor of girth factor (factor 3) which comprising of thigh girth and calf girth were heavily loaded items among female hockey players.
The present study revealed that the length factor (factor 1) comprises of height, arm length were heavily loaded items, the index factor (factor 2) which comprises the ponderal index was heavily loaded item, the another loaded factor of girth factor (factor 3) which comprising of thigh girth and calf girth were heavily loaded items among female hockey players.

Keywords: Anthropometry, ponderal Index (=weight/(height meter)3 and crural Index. (=leg length/thigh length.)

Introduction
The field of sports is currently undergoing remarkable scientific changes. Research has revamped the whole concept of sports, Highly technological innovation through contributions from various disciplines like medicine, engineering, human biology, psychology, etc, have made the sports field more authentic, glamorous and appealing. Different methods are tried to spot out potential talents and train them near ideal environments. Hockey is a dynamic team game played by both sex requiring high level of skills, excellent conditioning and coordinated team effort. Modern Hockey demands that all the players should be adapted to all the situations either defending or attacking. Hockey is a game which calls for strenuous, continuous, thrilling action and therefore attracts the youth all stimulating and satisfying to any child Anthropometric techniques (skinfold fat, circumference and diameter measurements) are popular for predicting body composition because they are not much expensive, require little space and can be performed easily (Behenke and Wilmore, 1974 and Pollock and Wilmore, 1990). Anthropometry is often used in physical education, sports science, physical activity and biomedical sciences. Anthropometric measurements can be divided into height, weight and lengths, breadth or width, circumferences or girths, depths and skinfolds. All measurements of individual are external dimensions of the body. Anthropometric measurements, body composition, body size and proportions are playing an important role in physical performance and fitness of the sportsman. Height and weight both are the indicators of overall body size and have been used for the grouping of children and youth in various kinds of activity according to their age and sex. Anthropometry is the systematized measurements that express the dimensions of human body. The research on anthropometric measurements may be useful in selecting the suitable game or sport for any individual.

Correspondence
Dr. Maria Martin Joseph
Associate Professor, Mary Matha
Arts and Science College,
Mananthavady, Kerala, India

The idea behind the choice of a game or event by an individual of his interest is to give out the best possible abilities.

Methodology
Selection of subjects
To achieve the above purpose of the study National level women hockey players of Kerala were selected. Total 36 Subjects were selected for the study and the age of the subjects ranged from 17-25 years. The subjects were selected from SN College Kannur and SAI Kollam.

Selection of variables and tests
Nine Anthropometric variables such as Height, Weight, Sitting height, Leg length, Arm length, Thigh girth, Calf girth, Ponderal Index(=weight/(height meter)3 and Crural Index. (=leg length/thigh length.)

Analysis of data and result of the study
Descriptive analysis were done on all the selected anthropometric variables namely; weight, height, sitting height, arm length, leg length, calf girth, thigh girth, ponderal index, crural index Factor analysis describes a procedure to identify those linear combinations of variables (called 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 selected nine anthropometric national level women hockey players of Kerala were subjected to correlation analysis in the form of correlation matrices. These correlation matrices were used in the principal component analysis. The unloaded factors obtained were then rotated by varimax method to find the final solutions. Rotation of the factors is important in order to avoid the overlapping of variable in different factors. Each of these factors obtained from the selected groups namely anthropometric, Items with loading greater than or equal to ± 0.60 of varimax solution were selected for discussing each factor.

Descriptive Analysis
Descriptive analysis of anthropometric variables were presented in the following table.

Table 1: Descriptive statistics of anthropometric variables

	Weight	Height	Sitting Height	Arm Length	Leg Length	Calf Girth	Thigh Girth	Ponderal Index	Crural Index
N	36	36	36	36	36	36	36	36	36
Mean	1882	5785	2907	2614	3410	1707	1237	390.3	55.33
Median	52.28	160.69	80.75	72.61	94.72	47.42	34.36	10.84	1.54
Mode	52	161	81	73	95	47	35	10.97	1.57
Std. Dev.	52	164	80	72	96	45	35	11.25	1.6
Kurtosis	3.55	5.04	3.15	3.44	5.14	4.17	3.65	0.67	0.19
Skweness	-0.82	-1.01	-0.36	-0.80	4.95	4.38	0.76	-0.82	20.54
Co-Eff. Variance	0.03	0.05	-0.31	-0.45	-1.45	-1.05	0.39	-0.24	-3.97
Minimum	12.61	25.36	9.91	11.84	26.38	17.39	13.32	0.45	0.04
Maximum	45	151	74	66	75	32	28	9.55	0.56
Range	59	170	87	78	103	56	45	11.99	1.81
25th Percentile	14	19	13	12	28	24	17	2.44	1.25
50th Percentile	50	156.75	79	70	92	45	32	10.3425	1.4775
75th Percentile	52	161	81	73	95	47	35	10.97	1.57

Factor Analysis
Factor analysis of anthropometric, were done in the process of factor analysis, the correlation matrix of the related anthropometric variables were obtained and is presented in table.

Anthropometric variables

Table 2: Correlation matrix of anthropometric variable

	Weight	Height	Sitting Height	Arm length	Leg length	Thigh Girth	Calf Girth	P. Index	C. Index
Weight	1.00								
Height	0.40	1.00							
Sitting Ht	0.34	0.40	1.00						
Arm length	0.26	0.57	0.31	1.00					
Leg length	-0.04	0.45	0.17	0.24	1.00				
Thigh girth	-0.18	-0.50	-0.12	-0.30	0.22	1.00			
Calf Girth	0.39	0.22	-0.04	0.28	-0.32	-0.43	1.00		
P. Index	0.89	-0.07	0.18	0.00	-0.27	0.06	0.32	1.00	
C. Index	-0.18	-0.02	-0.22	-0.23	-0.08	0.05	-0.19	-0.20	1.00

With the help of principle component analysis, all the above variables divided in to various factors. With the help of Kaiser's criteria suggested by Guttmann, only those factors having latent rules greater than one were retained in each group and are presented in table.

Table 3: Principal component analysis of anthropometric variables (un-rotated factor loadings)

	Factor 1	Factor 2	Factor 3
Eigen value	2.843	1.946	1.432
Total Variance. Exp	31.585	21.618	15.915
Cum. Variance. Exp	31.585	53.203	69.118
Weight	0.8	0.386	0.318
Height	0.696	0.581	0.123
Sitting Height	0.529	0.256	0.395
Arm length	0.643	0.432	0.095
Leg length	0.055	0.745	0.45
Thigh Girth	0.527	0.103	0.699
Calf girth	0.58	0.363	0.482
Ponderal Index	0.526	0.711	0.41
Crural Index	0.364	0.053	0.246

The unloaded factors obtained were then rotated by varimax method to find the final solutions. Rotation of the factors is important in order to avoid the overlapping of variable in different factors. And is presented in table.

Table 4: Principal component analysis of anthropometric variables (varimax solution)

	Factor 1	Factor 2	Factor 3
Eigen value	2.843	1.946	1.432
Total Variance. Exp	31.585	21.618	15.915
Cum. Variance. Exp	31.585	53.203	69.118
Weight	0.196	0.893	0.234
Height	0.864	0.062	0.294
Sitting Ht	0.557	0.417	0.132
Arm length	0.716	0.124	0.283
Leg length	0.674	0.119	0.541
Thigh Girth	0.324	0.105	0.812
Calf girth	0.004	0.3	0.781
Ponderal Index	0.217	0.944	0.107
Crural Index	0.197	0.396	0.01

Each of these factors obtained from anthropometric variables were interpreted and given names. Items with loading greater than or equal to ±0.60 of varimax solution were selected for discussing each factors obtained from among the anthropometric variables and are presented in table below.

Table 5: Factor one of anthropometric variables after rotated factor loadings (varimax solution)

Item No.	Name of the variables	Factor loadings
1	Height	0.864
2	Arm length	0.716
3	Leg length	0.674

Factor 1 of anthropometric variables of national level women hockey players were characterized by three variables from the selected nine variables namely height, arm length, leg length. Since, the length factor such as height, leg length and arm length were heavily loaded items, this factor can be called as length factor. This factor accounted for 31.58% of the total common factor accounted by all the three factors.

Table 6: Factor two of anthropometric variables after rotated factor loadings (varimax solution)

Item No.	Name of the variables	Factor loadings
1	Weight	0.893
2	Ponderal Index	0.944

The table 6 shows that factor 2 of anthropometric variables of national level women hockey players were characterized by two variables from the selected nine variables namely, weight and ponderal index. Since, the index factor such as ponderal index factor was the heavily loaded item; this factor can be called as index factor. This factor accounted for 21.62% of the total common factor accounted all the three factors.

Discussion of findings
Within the limitations of the study the following findings were drawn from the present study applicable to female hockey players. The length factor (factor 1) comprises of height, arm length were heavily loaded items, the index factor (factor 2) which comprises the ponderal index was heavily loaded item, the another loaded factor of girth factor (factor 3) which comprising of thigh girth and calf girth were heavily loaded items among female hockey players. To achieve the above purpose of the study National level women hockey players of Kerala were selected. Total 36 subjects were selected for the study and the age of the subjects ranged from 17-25 years. The subjects were selected from SN College Kannur and SAI Kollam. Descriptive analysis were done on all the selected anthropometric variables namely; weight, height, sitting height, arm length, leg length, calf girth, thigh girth, ponderal index and crural index. In this study the principal component method was selected for the primary solution of factor analysis. Since there was very less study on anthropometric variables done on Hockey players, The scholar has undertaken this study to explore the importance of Anthropometric variables among Hockey players.

Conclusions
Within the limitations of the study the following conclusions were drawn from the present study applicable to female Hockey players. The length factor (factor 1) comprises of height, arm length were heavily loaded items, the index factor (factor 2) which comprises the ponderal index was heavily loaded item, the another loaded factor of girth factor (factor 3) which comprising of thigh girth and calf girth were heavily loaded items among female hockey players.

Recommendations
The investigator makes the following recommendations for the research scholars, teachers, physical teachers, coaches and hockey players. Since there was very less study on anthropometric done on Hockey players so, Similar studies may be conducted using university level women Hockey players. The same study may be extended to the large no of sample size. Similar studies may be conducted using female Hockey players of other states. It is also recommended that coaches and trainers design the training plan for actual performance.

References
1. Gabbett T, Kelly J, Ralph S, Driscoll D. Physiological and anthropometric characteristics of junior elite and sub-elite rugby league players, with special reference to starters and non-starters. J Sci Med Sport. 2009; 1(1):215-222.

2. Koley S, Kashyap K. An evaluation of anthropometric characteristics in Indian inter university female cricketers. Sports Science Review. 2010; 19(6):121-130.

3. Ahmed Nabieh Ibrahim Mohamed. Anthropometric Measurements as a Significant for Choosing Juniors in Both Volleyball and Handball Sports (Factorial Analysis Study). World Journal of Sport Sciences. 2010; 3(4):277-289.

4. Ajay Karkare. Anthropometric Measurements and Body Composition of Hockey Players with Respect to their Playing Positions. Indian Streams Research Journal. 2011; 1(X):1-4.

5. Nande PJ, Mudafale V, Vali SA. Anthropometric profile of female and male players engaged in different sports disciplines. The Internet Journal of Nutrition and Wellness. 2009; 8(1).

6. Reilly T, Bangsho J, Franks A. Anthropometric and physiological predispositions for elite soccer. Journal of Sports Science. 2000; 18(9):669-683.

7. Sedano S, Vaeyens R, Philippaerts R, Redondo JC, Cuardo G. Anthropometric and anaerobic fitness profile of elite and non- elite female soccer players. Journal of Sports Medicine and Physical fitness. 2009; 49(4):387-394.

8. Strudwick A, Reilly T, Doran D. Anthropometric and physical fitness profiles of elite players in two football codes. The Journal of Sports Medicine and Physical fitness. 2002; 42(2):239-242.