THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

A Study of the Factor Structure on Selected Anthropometric Variables of Men Hockey Players

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Abstract:
Field hockey is a popular sport for men and women in many countries around the world. Field hockey has several and prestigious international tournaments for both men and women. These events include the Olympic Games, the quadrennial world Hockey Cups, the annual Champions Trophies, and world Cups for juniors. The aim of hokey is quite simple – to use sticks to dribble, pass, and shoot the ball along the pitch in an effort to score goal. The rule is very similar to those of football excepted that players use sticks instead of their feet to move the ball. A goal counts as one point and is scored when the ball, having been hit by a player inside the 'striking circle; completely crosses the opposing goal line. Performance at optimal levels requires high levels of technical, tactical and physiological skills. Identification and selection of talented Hockey players are not straightforward procedures. Forty-eight (N=48) men hockey players who belong to Calicut University, M.G University and Kerala University participant in the inter University hockey tournament was selected as the subjects for the study. They were tested on selected 7 Anthropometric variables, namely Height, Weight, sitting height, Leg Length, arm length, Calf Girth, Thigh Girth, selected men hockey players The data collected was analyzed by applying the mean, median, mode, standard deviation, coefficient correlation minimum score and maximum score. This has given in idea of the distribution of scores and features obtained from the data collected for the purpose of this study. Factor analysis was done to find out the prominent factors comprising of any one or all of the selected anthropometric variables among men hockey players the unloaded factors obtained were then rotated by very max method to the final solution

Keywords: *Hockey, anthropometry, performance, factor structure analysis*

1. Introduction

Physical fitness is a natural by product of daily living. It is a prime necessity, especially in this technological age to get the almost of the life and thereby enabling to live more and serve the world better. One should have physical fitness, quick reaction time, speedy movement accompanied by a great deal of dodging, quick turn and confidence in this his/her own ability to concentrate on correct technique. Anthropometry, simply stated, consists of making external measurement of the human body. These measurement may either objective, using special instruments such as calipers or subjective, using a list of characteristics or a description of categories of guide judgment presently, anthropometry considers individual differences apprise each subject related to structural differences and determines potentialities in light of those structural characteristics.

2. Background of the Study

A study of the relevant literature is an essential step to get a full picture of what has been done with regard to the problem under study. Such review brings about a deep and clear perspective of the overall field.

The literature is any field forms the foundation upon which all future work will be built." Now a day the educational programme of any type is characterized by forms and innovative ideas.it seems to be necessary one to formulate such as review of various scholar`s work. We can bring out a deep insight and clear perspective of the overall field in such reviews. In this chapter, literature related to the problem under study has been given. An attempt to the problem to familiarize and to provide a solid basis of for understanding the present day.

Lee jw.et.al (2015) anthropometric indices as predictors of hypertension among men and women aged 40-69 years in the Korean population: the Korean genome and epidemiology study.obesity is one of the most significant risk factors for hypertension. However, there is controversy regarding which measure is the best predictor of hypertension risk. We compared body mass index (bmi), waist circumference (wc), waist-to-hip ratio (whr), and waist-to- height ratio (whtr) in subjects as predictive indicators for development of hypertension. the data were obtained from the Korean genome and epidemiology study (koges), a large population-based prospective cohort study. a total of 4,454 subjects (2,128 men and 2,326 women) aged 40-69 years who did not have hypertension at baseline were included in this study. Incident hypertension was defined as systolic blood pressure ≥140 mmhg, diastolic blood pressure ≥90 mmhg, or anti-hypertensive medication use during the 4-year follow up. Receiver operating characteristic (roc) analysis was used to compare discrimination abilities for anthropometric indices for hypertension. hazard ratios were calculated by cox proportional hazard model with adjustment for age, smoking status, alcohol consumption, diabetes and family history of hypertension by sexes.in men, the area under the roc curve (aroc) was 0.62 for wc, whr, and whtr and 0.58 for bmi. in women, the arocs for bmi, wc, whr, and whtr were 0.57, 0.66, 0.68, and 0.68, respectively. after adjustment for risk factors, a 1 standard deviation increase in bmi, wc, whr, whtr were significantly related to incident hypertension, respectively (hazard ratio: 1.39, 1.50, 1.40 and 1.49 in men, 1.31, 1.44, 1.35 and 1.48 in women). The central obesity indices wc, whr, and whtr were better than bmi for the prediction of hypertension in middle-aged Korean people. whtr facilitates prediction of incident hypertension because of the single standard regardless of sex, ethnicity, and age group. Therefore, whtr is recommended as a screening tool for the prediction of hypertension.

Munabi et al. (2015) a cross sectional study evaluating screening using maternal anthropometric measurements for outcomes of childbirth in ugandan mothers at term.birth related newborn and maternal mortality/morbidity remains high in most of sub-saharan Africa compared to the rest of the world. In this low income region, there is a need for valid, low cost, easy to use mass screening tests. This study looked at the screening value of maternal: height, weight and pelvis height, for assessing the outcomes of parturition in ugandan mothers at term. This was a multisite cross-sectional study on mothers with singleton pregnancies in labor at various hospitals in different parts of uganda. a summary of the details of the pregnancy, maternal height, weight and the delivery record were captured and analyzed to generate descriptive and inferential (multilevel logistic regression analysis) and diagnostic (receiver operator curve analysis) statistics. We recruited 1146 mothers from all the study sites during the study period of whom 987 (86.13%) had normal deliveries and healthy babies. Mothers with adverse outcomes included 107 mothers that had caesarean section and 52 mothers who had vaginal deliveries with foetal apgar score of ≤7 at 5 min of whom 11 had fresh still births. maternal height (adj or 0.97, 95% ci 0.94-1.00) and maternal pelvis height (adj or 0.73, 95% ci 0.61-0.86) were significantly associated with adverse pregnancy outcomes. The combination of maternal: height (<150 cm), weight (>55.7 kg) and pelvis height (>8.95 cm) had the best diagnostic value with a combined area under the curve of 0.60. it was observed that an increase in either maternal pelvis height or maternal height was associated with a significant reduction in adverse pregnancy outcomes. The cutoff values of all three evaluated maternal anthropometric measurements were of low test accuracy as screening tests even when used together. further research is needed to develop low cost screening tools for use in low income settings.

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

Forty-eight (N=48) men hockey players who belong to Calicut University, M.G University and Kerala University participant in the inter University hockey tournament was selected as the subjects for the study.

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.

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	centimeters

Table 1

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

No	Variables	Co-efficient of Correlation
1	Height	0.09
2	Sitting height	0.97
3	Weight	0.98
4	Arm length	0.95
5	Leg length	0.98
6	Thigh girth	0.94
7	Calf girth	0.95

Table 2

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 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 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

3.5. Statistical Techniques

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 seven anthropometric variables namely such as Height**,** Sitting height, Weight Arm length Leg length Thigh girth Calf girth. Factor analysis was done to found out the prominent factors comprising of any one or all of the selected anthropometric variables among men hockey players the unloaded factors obtained were then rotated by very max method to the final solution.

4. Results and Analysis

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 48 men hockey players who participated in all India inter university men hockey tournament were chosen as subjects descriptive analysis was done on all the selected 7 Anthropometric variables namely Height, Weight, sitting height, Leg Length, arm length, Calf Girth, Thigh Girth, selected men hockey 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 features 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 7 Anthropometric variables of men hockey players were subject to correlation analysis, which is shown in table 5 in the form of correlation matrices.

Correlation matrices obtained for the men hockey players used in the principal component analysis. With the help of principal component analysis all the 7 Anthropometric variables were divided into various factors. The unloaded factors obtained were then rotated by varirnax 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 three factors obtained from the selected men hockey 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	No.	Mean	Median	Mode	Minimum score	Maximum score	Standard Deviation
Height	48	169.40	170.00	168.19	156.00	180.00	5.96
Sitting Height	48	83.48	85.50	79.44	63.00	113.00	9.03
Weight	48	60.98	62.50	57.94	47.00	71.00	6.56
Arm length	48	76.71	76.00	78.13	68.00	90.00	5.28
leg length	48	97.04	96.50	98.13	76.00	110.00	5.42
Calf girth	48	35.02	35.00	35.06	31.00	40.00	2.25
Thigh girth	48	54.48	55.00	53.44	45.00	61.00	3.84
Performance Rating	48	6.46	6.00	7.38	5.00	8.00	0.90

Table 3: Descriptive Profile of Selected Anthropometric Variables of Men Hockey 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, of the men hockey players

Variables	Height	Sitting Height	Weight	Arm length	leg length	Calf girth	Thigh girth	Performance Rating
Height	1.000							
Sitting Height	0.20	1.000						
Weight	0.36	-0.18	1.000					
Arm length	0.34	0.24	0.25	1.000				
leg length	0.41	0.26	0.07	0.45	1.000			
Calf girth	0.15	-0.01	0.62	-0.06	0.08	1.000		
Thigh girth	0.3114	0.1025	0.7197	0.2486	0.1638	0.7446	1.000	
Performance Rating	0.2594	0.1796	-0.002	-0.0609	0.3064	0.0585	-0.1083	1.000

Table 4: Correlation Matrix on Selected Anthropometric Variables of Men Hockey 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 of the men hockey players Leg length was significantly correlates the hockey players performance among this study.

	FACTOR-1	FACTOR-2	FACTOR-3
Eigen value	3.621617	2.369453	1.303246
Total variance. Exp	36.22	23.7	13.03
Cum. Variance. Exp	36.22	59.91	72.94
Height	0.009744	-0.85399	-0.03254
sitting height	0.266582	-0.36866	0.718135
weight	-0.89086	-0.25262	-0.08159
arm length	-0.15037	-0.52789	-0.72652
leg length	0.042067	-0.73803	-0.12168
calf girth	-0.76543	-0.21165	0.370788
Thigh girth	-0.77644	-0.41783	0.189401

Table 5: Principal Component Analysis of Men Hockey Players (Un Rotated Factor Loading)

	FACTOR-1	FACTOR-2	FACTOR-3	
Eigen value	3.621617	2.369453	1.303246	
Total variance. Exp	36.22	23.7	13.03	
Cum. Variance. Exp	36.22	59.91	72.94	
Height	0.034468	0.794749	0.312468	0.989175
sitting height	-0.17064	0.050584	0.831276	0.493327
weight	0.89048	0.25548	-0.07689	0.999019
arm length	0.104211	0.774419	-0.46747	0.608313
leg length	-0.01322	0.724855	0.188861	0.499371
calf girth	0.809986	0.036904	0.332747	0.747942
Thigh girth	0.813793	0.298578	0.248813	0.797108

Table 6: Principal Component Analysis of Men Hockey Players (Un Rotated Factor Loading)

Item No	Name of the Variables	Factor Loading
3	Weight	0.890458
6	Calf girth	0.809986
7	Thigh girth	0.813793

Table 7: Factor I Men Hockey Players After Rotated Factor Loading (Varimax Solution)

Factor 1 of men hockey players in Table 7 was characterized by 3 anthropometric variables of selected 7 variables namely weight, Calf girth, thigh girth since the girth variable such as calf girth and thigh girth are loaded items. This factor called as the girth factor this accounted for 36.22% of the total common factor accounted by all the three factors.

Item No	Name of the Variables	Factor Loading
1	Height	0.794749
4	Arm length	0.774419
5	leg length	0.724855

Table 8: Factor 2 Men Hockey Players After Rotated Factor Loading (Varimax Solution)

Factor 2 of men hockey players in Table 8 was characterized by 3 Anthropometric variables of selected 7 variables namely height, arm length leg length. Since the length variables such as Arm length and leg length are heavily loaded items. This factor could be called as length factor. This factor accounted for 23.7% of the total common factor accounted by all the three factors.

Item No	Name of the variables	Factor Loading
1	Height	0.794749

Table 9: Factor 2 Men Hockey Players After Rotated Factor Loading (Varimax Solution)

Factor-3 of men hockey players in Table 9 was characterized by 1 anthropometric variable of selected 7 variables namely sitting height. This factor could be called as sitting height factor. This factor accounted for 13.03% of the total common factor accounted by all the three factors.

4.3. Discussion of Findings

The finding of the study revealed that the girth factor comprising of calf girth and thigh girth. The calf girth and thigh girth are the contributing factors for the strength (Maximum strength and explosive strength) as the muscle mass increase then maximum strength increase and this maximum strength may transform to explosive strength. Maximum strength and explosive strength contributes here by to the performance during play. The factor two length factor comprising of the height, arm length and leg length, weight, arm length leg length are contributing heavily ton performances in men hockey players. height and leg length are very closely related to the each other and contributing factors for performance in hence Height and leg length and arm length are help to attain maximum speed it help to easy ball controlling receiving, dodging in men hockey The third factor is known as sitting height factor comprising of sitting height was contributing heavy performance in men hockey players. The important group of muscles of upper extremity namely deltoid, forearm biceps, abdominal muscles thereby might have contributing to increase the upper body strength. The shoulder, arm and abdomen strength directly might have contributed performance in men hockey players.

4.4. Discussion on Hypothesis

The result of this study enables hypothesis was formulated to be accepted as three prominent contributing factors have been extracted after rotated principle component analysis in men hockey players namely girth factor, length factor and sitting height factor. Based on the factor analysis of this study all the anthropometric variables of selected 7 variables will influence the men hockey players' performance

5. Summary, Conclusions and Recommendations

5.1. Summary

The purpose of the study was to find out the prominent contributing factors to performances in men hockey players from among the selected anthropometric variables.48 men hockey players who participated in all India interuniversity men championship were selected as the subject of the study.Each subject were measured for 7 related anthropometric measurements namely Height, Weight Sitting height, Leg length, Arm length, Thigh girth Calf girth. 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 48 men hockey 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 ± 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 men hockey players, the three prominent factors extracted after factor analysis were girth factor length factor sitting height factor. Girth factor heavily loaded with variable of calf girth and thigh girth. Length factor is heavily loaded with variable of arm length and leg length. Sitting height factor was heavily loaded the variable of sitting height.

5.3. Recommendations

The investigator makes the following recommendations for the research scholars, teachers, physical teachers, coaches and Players.

1. The result may be used by teachers and coaches in selection of hockey 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 a different level hockey team.
4. Similar study may be conducted state level and national level men hockey players.
5. Similar study may be conducted for girls
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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