Factor Structure Of Male And Female Long Jumpers And Tripple Jumpers On Selected Anthropometric And Physical Fitness Variables in school children of Nilgiri District

Sariul Varghese

Director Of Physical Education, Nilgiri college of Arts and Science Thaloor. Ph.D. Research scholar, Department of physical Education University of Calicut, India

Abstract

1. The purpose of the study was to find out prominent contributing factors to performances in different jumping events in athletics from the among selected anthropometric and physical fitness variablesThe study was delimited to two jumping events in athletics namely, long jump and triple jump. The study was delimited to the male and female athletes of Nilgiri. who have either represented Tamil Nadu state or any of the schools in Tamilnadu states. The study was delimited to the age group of 15 – 18 years.Non-availability of sophisticated instruments to measure the anthropometric and physical fitness variables was considered as a limitation of this study.No motivational technique was used while administering the tests and this was considered as another limitation of this study. The difference that exist among the subject due to varied social, cultural and religious factors cannot be controlled and this might have affected the result of this study, hence this is considered an another limitation of this study. The general mood and environmental factors at the time of performing the various tests by the selected subject's might be different from the actual and might have affected the results of this study and this is considered as another limitation of this study. The results of this study will high light the importance of anthropometric measurements and physical fitness variables to performances in different jumping events in athletics. The study will help coaches athletes and physical education teachers, to identify the prominent factors comprising of anthropometric measurements and physical fitness variables which is to be given more importance, for improving performances in different jumping events in athletics. The result of this study will help the Physical Education teachers to identify athletes for different jumping events in athletics.The results of this study will also help the coaches and Physical Education teachers to prepare specific training programme for different type of jumpers in athletics. The result of this study will help coaches and Physical Education teachers in identifying talent in different jumping events in athletics by highlighting prominent factors comprising of any or all of the selected anthropometric and physical fitness variables.

INTRODUCTION

The nature of sports performance has been insufficiently explored because sports performance in a complicated multi-dimensional process of tackling a given sports task. It's further exploration and determination needs an integral effort

involving various training sciences, disciplines and theory and methods of specific sports. Sports performance in its real nature is a process, of tackling a given motor task. The degree of extend to which this task has been fulfilled in the result of the process of tackling the motor task.[1]The track and field events, which include walking running, jumping and throwing, were the main attraction of the Olympic games since its origin. From the basic human movements, the track and field events have now developed to greater dimension. The number and types of events and the intensity of competition are very high. Due to the influence of science and technology in selection of athletes, training and competition, the performance in track and field athletics have attained new levels in international competition.The modern track and field competition consists of a variety of events, which include jumping, sprinting, middle and long distance running, apart from walking and throwing. . Each event has its own specific characteristics and the qualities required for each one are distinct in nature. Performance in an event is determined and influenced by various factor, such as physical structure of the athlete, the physiological qualities, physical fitness qualities, psychological aspects, social factors etc are same of them.Now a days, mostly the improvement in performance is due the athletes themselves. Perhaps they are more gifted now than previously. In jumps, sprints and the throwing events at least, it is hard to resist the conclusion that the modern athlete is actually better endowed physically and better suited to his/her particular task. Human motor performance is composite of many variables one which is the structure of the body. The specific measurements of the limp lengths, circumference breath and body built indexes can reveal the relationship between the anthropometry of the athlete and his/her motor performance. Further it would be worthwhile to review the factors affecting jumping in order to identify areas of research in developing the function for further improvement in jumping performance. The important factors thus identified are the structure of the body of the athlete, age, temperament, technique of jumping, conditions of track, jumping surface equipment, jumping shoes etc. The profile of jumpers seems to be that of a man of average height with good musculature. Apart from that there are certain factors, which play important roles in determining the success of jumping such as explosive power, strength, speed, co-ordination etc., along with the physique of the athlete.The term anthropometry refers to the investigation of variation in body structures. This topic has been of particular interest to Physical Education because of the effect of body structure on performance and the effect of physical activity on body structure. Certain other persons, including psychologists and medical doctors, have also an interest in this area because of the possible relationship between body types and personality and between physical health.The body structure of an individual plays an important role on his/her motor performance. Hence Physical Education teachers and coaches while selecting their teams for participation apart from giving due consideration to the skill possessed by the player they at the same time shall give due to weightage to various anthropometric measurements also, as these measurements are objective measurements of the body. Cureton[3] studied track and field champion athletes of the Unites States and reported typical track men to be slight in skeletal framework with longer forelegs relative to thighs and longer leg relative to the length of the trunk, but with exceeding well muscles. The jumpers, hurdler's and vaulter's were relatively slim in skeletal built and were typically taller with longer legs and shorter trunks.

.

In order to train a champion jumper the physical education teachers and coaches have to make a right choice in the selection of the talents and then train them employing the best method of training and coaching, so that increase in performance capacity can be guaranteed. These dual efforts of channeling potential talents to the most suitable games and sports, selecting suitable players are helped to a great event by the recent development in anthropometry it is applied to sports and games and construction of objective and valid tests of fitness and skill thereafter, a number of research studies have listed the essential pre-requisites of potential champions in various games and sports.

REVIEW OF RELATED LITERATURE

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."

Clark[1] (1957) conducted a study to find out the relationship of strength and anthropometric measures to physical performance of 53 unselected, not disabled male students at the University of Oregon, involve trunk and leg. He concluded that inter correlation among some of the anthropometric variables were especially high; 91 standing height with leg length, 0.88 foot length with leg length, 0.87 body weight with both hip width and thigh girth. The highest strength test inter correlation was 0.65 between trunk flexion and extension. Significant multiple correlations obtained were 0.74 for leg lift with body weight, ankle dorsal flexion strength and trunk flexion strength; 0.71 for back lift with knee extension strength, and knee flexion strength 0.66 for standing broad jump with adipose tissue over one abdomen (negative) and hip extension strength (positive).

Reid[2] (1978) in his examined the relationship of flexibility strength and anthropometric measurements of lower link to the skating speed of hockey player. Seventeen university hockey players were assessed for; leg and grip strength using cable tension methods, lower limb, flexibility by using Legthton'sFlexometer technique, anthropometry of the legs and sloating speed under standing and flying start conditions with and without a stick over two feet distance, 40 feet.

Sabol[3] (1963) conducted a study of the relationship among anthropometric, strength and performance measure of college women bowlers. The purpose of this study was to determine the validity of a subjective satiny of the ability to handle a given weight ball as a criterion measure of bowling ability and to investigate the relationship among anthropometric strength and performance variables for each subjects on height weight arm length, grip, pull, push three finger bowling grip, velocity, first ball averaged and game score. All groups were significantly different in all variables out the ten as five percent levels when on analysis of variance was computed. The Duncan multiple range test was used to determine significant different between pair of means.

.
.

STATEMENT OF THE PROBLEM

The purpose of the study was to find out prominent contributing factors to performances in different jumping events in athletics from the among selected anthropometric and physical fitness variables.

DELIMITATIONS

1. The study was delimited to two jumping events in athletics namely, long jump and tripple jump.

2. The study was delimited to the male and female athletes of Nilgiri who have either represented state or any of the Schools in Tamil Nadu states.

3. The study was delimited to the age group of 15 – 18years.

4. The study was delimited to total of 48 subjects, comprising of 12 female long jumpers, 12 male long jumpers, 12 male tripple jumpers ad 12 female tripple jumpers.

5. The study was further delimited to the selected anthropometric such as height, weight, leg length, calf girth, thigh girth and physical fitness variable such as speed, agility, explosive power 1, explosive power 2, abdominal strength

LIMITATIONS

1. Non-availability of sophisticated instruments to measure the anthropometric and physical fitness variables was considered as a limitation of this study.

2. No motivational technique was used while administering the tests and this was considered as another limitation of this study.

3. The difference that exist among the subject due to varied social, cultural and religious factors cannot be controlled and this might have affected the result of this study, hence this is considered an another limitation of this study.

4. The general mood and environmental factors at the time of performing the various tests by the selected subject's might be different from the actual and might have affected the results of this study and this is considered as another limitation of this study.

HYPOTHESIS

1. It is hypothesized that there will contributing prominent factors in male long jumpers comprising of any or all of the selected anthropometric and or physical fitness variables.
2. It is hypothesized that there will contributing prominent factors in female long jumpers comprising of any or all of the selected anthropometric and or physical fitness variables.

3. It is hypothesized that there will contributing prominent factors in male tripple jumpers comprising of any or all of the selected anthropometric and or physical fitness variables.

It is hypothesized that there will contributing prominent factors in female tripple jumpers comprising of any or all of the selected anthropometric and or physical fitness variables

DEFINITION AND EXPLANATION OF TERMS

Physical Fitness

Physical fitness is restricted to the capacity of the individual for prolonged heavy work.[6]

Height

The height of the subject is measured in centimeters in standing position. A high scale in centimeters may be fastened to the wall or blackboard. The subject stands erect with the heel, buttock and upper back containing the scale. The chin is tucked in slightly and the heel erect. It is measured from heal to heel in standing position.[7]

Body Weight

It is the most useful anthropometric measurement, which relates to the body mass as its potential value is not only appreciated by the health personal, but after by parents for who its is a useful score of health education. Weight of the individual in standing erect position.[8]

Leg length

The leg length is the vertical distance from the bottom outside edge of the centre of the foot to the most protuberant part of Patella bulge.[9]

Calf girth

Subject, stands erect with his feet slightly apart using the tape, measure the horizontal circumference of the right lower leg. At the level of the great bulge of the calf muscles.[10]

Thigh girth

Subject stands erect with his legs slightly apart to allow the passage of the tape between them. The circumference of the thigh is taken in a plane at right angles to the long axis of the femur through gluteal fold.[11]

Speed

Speed is the ability of the individual to make successive movements of the same kind in the shortest period of time.[12]

Agility

Agility is to change direction quickly and to control body movements.[13]

Abdominal strength

To measure the ability of the abdominal muscle.[14]

Explosive strength

Explosive strength is a combination of strength and speed abilities and can be defined as the ability to overcome a resistance with high speed.[15]

SIGNIFICANCE OF THE STUDY

The results of the present study will contribute is the following ways.

2. The results of this study will high light the importance of anthropometric measurements and physical fitness variables to performances in different jumping events in athletics.

3. The study will help coaches athletes and physical education teachers, to identify the prominent factors comprising of anthropometric measurements and physical fitness variables which is to be given more importance, for improving performances in different jumping events in athletics.

4. The result of this study will help the Physical Education teachers to identify athletes for different jumping events in athletics.

5. The results of this study will also help the coaches and Physical Education teachers to prepare specific training programme for different type of jumpers in athletics.

6. The result of this study will help coaches and Physical Education teachers in identifying talent in different jumping events in athletics by highlighting prominent factors comprising of any or all of the selected anthropometric and physical fitness variables.

PROCEDURE AND METHODOLOGY

In this chapter the methodology adopted for this study namely the selection of subjects selection of variables reliability of data, tester's competency, criterion

measures, collection of data, administration of test item, and the statistical techniques employed for analyzing the data are given in detail.

SELECTION OF SUBJECTS

Male and female jumpers who have represented Gudaloor,Pandaloor, and Ooty were selected as the subject for this study. The age of this subject was between 15 and 18 years.

SELECTION OF VARIABLES

Comprising of twelve male long jumpers twelve female long jumpers, twelve male tripple jumpers and twelve female tripple jumpers.

RELIABILITY OF DATA

The reliability of data was ensured by instrument reliability and tester's competency.

a) Instrument reliability

All the instrument used for the collection of data was collected from standard research laboratories.

b) Tester's competency

The tester's competency was established by test retest method were by consistency of result is obtained by product moment correlation. In the test retest method, the correlation thus obtained is presented in table 1.

TABLE 1

CORRELATION ON TEST RETEST SCORES OF SELECTED PHYSICAL FITNESS VARIABLES AND ANTHROPOMETRIC VARIABLES TO TEST THE TESTER'S COMPETENCY

SL.No	Variables	Coefficient of Correlation
1	Height	0.93
2	Weight	0.94
3	Leg length	0.96
4	Calf girth	0.98
5	Thigh girth	0.92
6	Explosive power 1	0.97
7	Abdominal strength	0.96
8	Explosive power 2	0.97

9	Agility	0.98
10	Speed	0.95

CRITERION MEASURES

The criterion measures chosen to test hypothesis were

1. Standing height: Recorded in centimeters
2. Leg length: Recorded in centimeters
3. Thigh girth: Recorded in centimeters
4. Calf girth: Recorded in centimeters
5. Body weight was in kilograms
6. 40 meters speed was recorded to 1/100 of a second
7. Abdominal strength was recorded in number.
8. Explosive power 1 and 2 were recorded in centimeters
9. Agility was recorded in 1/100 of a second.

COLLECTION OF DATA

The data pertaining to selected anthropometric measurements such as height, weight, leg length, thigh girth, calf girth and physical fitness variables like explosive power 1, explosive power 2, agility and speed were collected by administrating appropriate standard tests using correct measurement procedures.

The purpose of the tests were explained to the subjects and after the investigator has requested for the full support and co-operation of the subjects, for the conduct of the test, the data were collected.

STATISTICAL TECHNIQUE

Descriptive analysis mean, median, mode, standard error, standard deviation, kurtosis, standard error of kurtosis, skewness, standard error of skewness, range, minimum score and maximum score. This have given an idea of the distribution of scores and features obtained from the data collected for the purpose of this study was done on all the selected ten variables namely Height, Weight, Leg Length, Calf Girth, thigh Girth, Explosive power 1, Abdominal strength, Explosive power 2, Agility and Speed of the selected four groups such as male and female long jumpers and tripple jumpers.

Factor analysis (principal component analysis) was done to find out prominent factors comprising of anyone or all of the selected anthropometric and or physical fitness variables among selected four groups separately. The unloaded factors obtained were then rotated by varimax method to find the final solution.

ANALYSIS OF DATA AND RESULT OF THE STUDY

Descriptive analysis was done on all the selected ten variables namely Height, Weight, Leg Length, Calf Girth, Thigh Girth, Explosive power 1, Abdominal strength, Explosive power 2, Agility and Speed of the selected four groups such as male and female long jumpers and tripple jumpers to find out the mean, median, mode, standard error, standard deviation, kurtosis, standard error of kurtosis, skeweness, standard error of skewness, range, 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

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 ten variables of the four groups, namely male long jumper, female long jumpers, male tripple jumpers and female tripple jumpers were subjected to correlation analysis, which are shown in Table 6, 12, 18 and 24 in the form of correlation matrices.

Correlation matrices obtained for the four groups namely male long jumpers, female long jumpers and male tripple jumpers and female tripple jumpers were used in the principal component analysis. With the help of principal component analysis, all the ten variables were divided into various factors. With the help of Kaiser's[1] criteria suggested by Guttman[2], only those factor having latent rules greater than one were considered as common factors. Owing to this criteria three factors were retained in each group. 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 the three factors obtained from the selected groups namely male long jumpers, female long jumpers, male tripple jumper and female tripple jumpers were interpreted and given names. Items with loading greater than or equal to ± 0.60 of varimax solution were selected for discussing each factor.

Findings

The findings of the study are detailed below:

TABLE 7

PRINCIPAL COMPONENT ANALYSIS OF MALE LONG JUMPERS (UN-ROTATED FACTOR LOADINGS)

	Factor 1	Factor 2	Factor 3
Eigen value	5.32280	1.89655	1.03610
Total Variance. Exp.	53.2	19.00	10.4
Cum.Variance.Exp	53.2	72.2	82.6
Height	0.87277	0.5627	0.1274
Weight	0.90938	0.11437	0.11411
Leg length	087436	-0.25867	-.12297
Calf girth	0.75949	-0.40588	0.40205
Thigh girth	0.86005	0.14754	43.005
Explosive power1	0.47313	0.65466	0.17214
Abdominal Strength	0.68384	-0.4200	-0.23652
Explosive Power 2	0.51818	0.74368	-0.36271
Agility	-.42843	0.51592	0.63612
Speed	0.71382	-0.45020	0.19862

TABLE 8

ROTATED FACTOR LOADING OF MALE LONG JUMPERS (VARIMAX SOLUTION)

	Factor 1	Factor 2	Factor 3	Communalities
Eigen value	5.32280	1.89655	1.03610	-
Total Variance. Exp.	53.2	19.0	10.4	-
%Variance.Exp	53.2	72.2	82.6	-
Height	0.64591	0.50513	0.30446	0.76505
Weight	0.71535	0.54457	0.21164	0.85307

Leg length	0.66264	0.28820	0.56954	0.84653
Calf girth	0.92909	-0.03003	0.19773	0.90322
Thigh girth	0.94294	0.22399	0.08408	0.946337
Explosive power 1	0.25847	073282	-0.27969	0.68206
Abdominal Strength	0.50168	0.08718	0.66386	0.69999
Explosive Power 2	-0.04859	0.96973	0.10189	0.95312
Agility	-0.10427	0.02004	-0.91820	0.85437
Speed	-0.28338	-0.79387	-0.20286	0.75168

TABLE 9

FACTOR ONE OF MALE LONG JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
1	Height	0.64591
2	Weight	0.71535
3	Leg Length	0.66264
4	Calf girth	0.92909
5	Thigh girth	0.94294

Factor 1 of male long jumpers in Table 9 was characterized by all the five anthropometric variables of the selected ten variables namely Height, Weight, leg length, Calf girth and Thigh girth. Since the girth variables such as Calf girth and Thigh girth are the heavily loaded items, this factor could be called as the Girth Factor. This factor account for 53.2% of the total common factor accounted by all the three factors.

TABLE 10

FACTOR TWO OF MALE LONG JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	**Name of the variables**	**Factor loadings**
6	Explosive Power 1	0.73282
8	Explosive Power 2	0.96973
10	Speed	-0.79387

Factor two of male long jumpers in table 10 was characterized by the three physical variables of the selected ten variables namely explosive power 1, explosive power 2 and speed. Since, explosive power 2 and the speed are the heavily loaded items, this factor could be called as the Speed Power Factor. This factor accounted for 19.0% of the total common factor accounted by all the 3 factors.

TABLE 11

FACTOR THREE OF MALE LONG JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
7	Abdominal strength	0.66386
9	Agility	-0.91820

Factor three of male long jumpers in table 11 was characterized by two physical variables of the selected ten variables namely abdominal strength and agility. Since, agility is the heavily, loaded item, this factor could be called as the Agile Factors. This factors accounted for 10.4% of the total common factor accounted by all the 3 fact

TABLE 12
PRINCIPAL COMPONENT ANALYSIS OF FEMALE LONG JUMPERS (UN-ROTATED FACTOR LOADINGS)

	Factor 1	Factor 2	Factor 3
Eigen Value	4.50644	2.55616	1.15125
Total Variance. Exp.	45.1	25.6	11.5
Cum.Variance.Exp	45.1	70.6	82.1
Height	0.12690	0.75493	-0.03309
Weight	0.68454	0.44202	0.39018
Leg Length	-0.08077	0.72334	0.27605
Calf Girth	0.93527	-0.11904	0.12182
Thigh Girth	0.81719	-0.15874	0.23056
Explosive Power 1	0.77524	0.28971	-0.49861
Abdominal Strength	0.82132	0.39436	0.27963
Explosive Power 2	0.61752	0.32292	-0.70135
Agility	-0.61407	0.69213	0.09639
Speed	-0.66236	0.63679	-0.16036

TABLE 13

ROTATED FACTOR LOADING OF FEMALE LONG JUMPERS (VARIMAX SOLUTION)

	Factor 1	Factor 2	Factor 3	Communalities
Eigen Value	4.50644	2.55616	1.15125	--
Total Variance. Exp.	45.1	25.6	11.5	--
%Variance.Exp	45.1	70.6	82.1	--
Height	0.19680	0.67167	0.31184	0.58712
Weight	0.84201	0.28689	0.15793	0.81622
Leg Length	0.19593	0.75148	-0.05329	0.60595
Calf Girth	0.81297	-0.35834	0.33824	0.90374
Thigh Girth	0.77172	0.34448	0.17871	0.74616
Explosive Power 1	0.39564	-0.02832	0.88100	0.93354
Abdominal Strength	0.88454	0.18488	0.30281	0.90828
Explosive Power 2	0.15852	0.01469	0.97578	0.97750
Agility	-0.34402	0.84415	-0.18565	0.86541
Speed	-0.53535	0.76356	-0.01770	0.86993

TABLE 14

FACTOR ONE OF FEMALE LONG JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	**Name of the variables**	**Factor loadings**
2	Weight	0.84201
4	Calf girth	0.81297
5	Thigh girth	0.77172
7	Abdominal strength	0.88454

Factor 1 of female long jumpers in Table 15 was characterized by three anthropometric variables and one physical variable namely weight, calf girth, thigh

girth and abdominal strength. Since abdominal variable is the heavily loaded item, this factor could be called as the Strength Factor. This factor accounted for 45.1% of the total common factor accounted by all the three factors.

TABLE 15

FACTOR TWO OF FEMALE LONG JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
1	Height	0.67167
3	Leg length	0.75148
9	Agility	0.84415
10	Speed	0.76356

Factor 2 of female long jumpers in Table 16 was characterized by two anthropometric and two physical variables namely height, leg length, agility and speed. Since height and leg length are important factors for performance in speed, this factor could be called as the Speed Factor. This factor accounted for 25.6% of the total common factor accounted by all the three factors.

TABLE 16

FACTOR THREE OF FEMALE LONG JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
6	Explosive power 1	0.88100
8	Explosive power 2	0.975785

Factor 3 of female long jumpers in Table 16 was characterized by two physical variables of the selected ten variables namely explosive power 1 and explosive power 2. Since Explosive Power 1 and 2 are the two heavily loaded item, this factor could be called as the Power Factor. This factor accounted for 11.5% of the total common factor accounted by all the three factors.

TABLE 17

PRINCIPAL COMPONENT ANALYSIS OF MALE TRIPPLE JUMPERS (UN-ROTATED FACTOR LOADINGS)

	Factor 1	Factor 2	Factor 3
Eigen value	5.33387	1.61961	1.32750
Total Variance. Exp.	53.3	16.2	13.3
Cum.Variance.Exp	53.3	69.5	82.8.
Height	0.82400	0.19076	0.15609
Weight	0.95616	-0.09278	-0.04107
Leg length	0.65666	0.60000	-0.13543
Calf girth	0.65560	0.53149	0.26427
Thigh girth	0.84889	-0.10430	0.25289
Explosive power 1	0.60715	-0.65785	0.35686
Abdominal Strength	0.74253	0.29741	0.20511
Explosive Power 2	0.58065	-0.59617	0.15581
Agility	-0.50876	0.14214	0.81461
Speed	-0.80191	0.15626	0.54040

TABLE 18

ROTATED FACTOR LOADING OF MALE TRIPPLE JUMPERS (VARIMAX SOLUTION)

	Factor 1	Factor 2	Factor 3	Communalities
Eigen value	5.33387	1.61961	1.32750	--
Total Variance. Exp.	53.3	16.2	13.3	--
%Variance.Exp	53.3	69.5	82.8	--
Height	0.75305	0.36304	-0.20210	0.73972
Weight	0.61225	0.56964	-0.47454	0.92453
Leg Length	0.82457	-0.41611	-0.32903	0.80953
Calf Girth	0.88224	0.05962	0.01564	0.78214
Thigh Girth	0.60385	0.63441	-0.16831	0.79544
Explosive Power 1	0.09785	0.95767	-0.04528	0.92875
Abdominal Strength	0.77684	0.25842	-0.10774	0.68187
Explosive Power 2	0.06724	0.81925	-0.20286	0.71684
Agility	-0.06119	-0.6468	0.96680	0.94264
Speed	-0.33211	-0.33994	0.85653	0.95951

TABLE 19
FACTOR ONE OF MALE TRIPPLE JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
1	Height	0.75305
2	Weight	0.61225
3	Leg Length	0.82457
4	Calf Girth	0.88224
5	Thigh Girth	0.60385
7	Abdominal Strength	0.77684

Factor one of male tripple jumpers in Table 21 was characterized by all the five anthropometric variables of the selected ten variables namely height, weight, leg length, calf girth, thigh girth are the heavily loaded item, this factor could be called as the Anthropometric Factor. This factor accounted for 53.3% of the total common factor accounted by all the three factors.

TABLE 20

FACTOR TWO OF MALE TRIPPLE JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
5	Thigh girth	0.63441
6	Explosive power 1	0.95767
8	Explosive power 2	0.81925

Factor two of male tripple jumpers in Table 22 was characterized by two physical variables of the selected ten variables namely explosive power 1 and explosive power 2. Since explosive power 1 and 2 are the two heavily loaded item, this factor could be called as the Power Factor accounted for 16.2% of the total common factor accounted by all the three factors.

TABLE 21

FACTOR THREE OF MALE TRIPPLE JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
9	Agility	0.96680
10	Speed	0.85653

Factor three of male tripple jumper in Table 22 was characterized by two physical variables of the selected ten variables namely agility and speed. Since agility and speed are the two heavily loaded item, this factor could be called as the Agile Factor. This factor accounted for 13.3% of the total common factor accounted by all the three factors.

TABLE 22

PRINCIPAL COMPONENT ANALYSIS OF FEMALE TRIPPLE JUMPERS (UN-ROTATED FACTOR LOADINGS)

	Factor 1	Factor 2	Factor 3
Eigen value	4.51174	1.78898	1.37259
Total Variance. Exp.	45.1	17.9	13.7
Cum.Variance.Exp	45.1	63.0	76.7
Height	0.41943	0.80740	0.10318
Weight	0.69916	0.52018	0.16732
Leg length	0.76887	0.44975	0.18218
Calf girth	-0.37375	0.25155	0.53830
Thigh girth	0.46667	0.02284	-0.65804
Explosive power 1	0.86332	-0.24721	-0.04158
Abdominal Strength	0.86982	0.11866	-0.32040
Explosive Power 2	0.42346	-0.30329	0.64882
Agility	-0.74333	0.44850	-0.18586
Speed	-0.81523	0.48176	-0.13447

TABLE 23

ROTATED FACTOR LOADING OF FEMALE TRIPPLE JUMPERS (VARIMAX SOLUTION)

	Factor 1	Factor 2	Factor 3	Communalities
Eigen value	4.51174	1.78898	1.37259	-
Total Variance. Exp.	45.1	17.9	13.7	_
%Variance.Exp	45.1	63.0	76.7	_

Height	-0.13818	0.90514	-0.00872	0.83845
Weight	0.24700	0.84578	0.10516	0.78741
Leg length	0.34182	0.83171	0.13435	0.82662
Calf girth	-0.15581	0.08223	-0.67348	0.49274
Thigh girth	0.00527	0.17001	0.78891	0.65131
Explosive power 1	0.70933	0.28762	0.47148	0.80817
Abdominal Strength	0.37524	0.53609	0.66718	0.87333
Explosive Power 2	0.75613	0.11191	-0.32864	0.69227
Agility	-0.84777	-0.09735	-0.24504	0.78824
Speed	-0.89253	-0.10277	-0.32801	0.91477

TABLE 24

FACTOR ONE OF FEMALE TRIPPLE JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
6	Explosive power 1	0.70933
8	Explosive power 2	0.75613
9	Agility	-0.84777
10	Speed	-0.89253

Factor 1 of female tripple jumpers in Table 27 was characterized by four physical variables of the selected ten variables namely explosive power 1 and explosive power 2, agility and speed. Since a physical variables are the heavily loaded item, this factor could be called as the Physical Factor. This factor accounted for 45.1% of the total common factor accounted by all the three factors.

TABLE 25

FACTOR TWO OF FEMALE TRIPPLE JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
1	Height	0.90514
2	Weight	0.84578
3	Leg length	0.83171

Factor two of female tripple jumpers in Table 28 was characterized by three anthropometric variables of the selected ten variables namely height, weight and leg length. Since anthropometric variables are the heavily loaded items, this factor could be called as the Anthropometric Factor. This factor accounted for 17.9% of the total common factor accounted by the three factors.

TABLE 26

FACTOR THREE OF FEMALE TRIPPLE JUMPERS AFTER ROTATED FACTOR LOADINGS (VARIMAX SOLUTION)

Item No.	Name of the variables	Factor loadings
4	Calf girth	-0.67348
5	Thigh girth	0.78891
7	Abdominal strength	0.66718

Factor 3 of female tripple jumpers in Table 29 was characterized by two anthropometric variables and one physical variable of the selected ten variables namely calf girth, thigh girth, abdominal strength. Since calf girth and thigh girth are the heavily loaded items, this factor could be called as the Girth Factor. This factor accounted for 13.7% of the total common factor accounted by all the three factors.

DISCUSSION OF FINDINGS

The girth factor comprising of the calf girth and thigh girth are contributing heavily to performances in long jump of male athletes. This might have been due to the fact that muscle mass increases maximum strength proportionately, which ultimately might have been transformed to explosive strength. The three important groups of muscles of the lower extremities namely hamstring groups and quadriceps groups, forms the thigh muscles and gastronimous groups forms the calf muscles, thereby might have contributed to increases in thigh and calf girth and indirectly might have contributed to performances in long jump of male athletes.

The speed power factor which comprises of explosive power 1 (standing board jump) , explosive power 2 (vertical jump) and speed are very important factors for elite performances in male long jumpers. This factor is very closely related to the girth factor as the maximum strength embedded in increased muscles mass (thigh girth and calf girth) have certainly been transformed to explosive power of the thigh and calf muscles. This which might certainly have improved performances in long jump.

The third factor agile factor is heavily loaded with the variable agility. This also is an important factor for better performances in male long jumpers, as agility can be said to be the ability to transform the horizontal speed to a better jumping distance by coordinating all factors at take off and during flight.

The extraction of the strength factor, which comprises of the abdominal strength female long jumpers, indicates the importance of abdominal strength for long jump performances in female athletes. This might be due to the fact that better abdominal strength is said to improve potential energy at the time of take off in long jumpers. This increased potential energy might have enabled the female athletes to get better flight during long jump thereby improving the performances in long jump by increased distances.

Another heavily loaded factor of female long jumpers is the speed factor. Which comprises mainly of speed and agility. This factor is closely related with strength factor of female long jumpers. The extraction of the factor shows the importance of speed in long jump performances of male athletes, as increased performances in speed is said to certainly improve long jump performance as increased kinetic energy attained through increases in speed is transformed into potential energy from the point of take off, which might have ultimately improved long jump performance.

Another heavily loaded factor of female long jumpers is the power factor which comprises mainly of explosive power 1 (standing broad jump) and explosive power 2 (vertical jump) are very important factor for elite performances in female long jumpers. This factor is very closely related to the girth factor as the maximum strength embedded in increased muscle mass (thigh girth and calf girth) have certainly been transformed to explosive power of the thigh and calf muscles. This might have certainly improved performances in long jumpers.

The anthropometric factor comprising of the height, leg length, thigh girth and calf girth are contributing heavily to performances in male tripple jumpers. This might have been due to the fact that thigh girth and calf girth increases muscle mass, which is directly proportional for increases in maximum strength, which have been ultimately transformed to explosive strength. The three important groups of muscles of the lower extremities namely hamstring group and quadriceps groups, forms the thigh muscles and gastronimous groups forms the calf muscles, thereby might have contributed to increases in thigh and calf girth and indirectly might have contributed to performances in tripple jump of male athletes. Height and leg length are very closely related to each other and are contributing factors for performances in on speed, by longer stride length, which along with stride frequency is contributing to speed performances. Hence, this increase in kinetic energy through increased speed will enable male tripple jumpers to transform to potential energy at the time of take off.

The second factor known as power factor is heavily loaded with the variable explosive power 1 (standing broad jump) and explosive power 2 (vertical jump). This is an important factor for better performances in male tripple jumpers this factor is very closely related to the anthropometric factor as the maximum strength embedded in increased muscle mass have certainly been transformed to explosive power of the thigh and calf muscles. The explosive power performance depends largely on the muscle cross-section, contraction, speed and intra and inter muscular coordination. This might have certainly paved way for as harmoniously combined better training for maximum and explosive strength.

The third factor agile factor is heavily loaded with variable agility. This also is an important factor for better performances in male tripple jumpers, as agility in tripple jumpers enables them to have a better take off on one leg, then to hop into the same leg and a step to the other leg for a final jump to the pit. This complex technique involving both the legs performed in a very short time, thereby transforming the horizontal speed to a better hope, step and jump distance by coordinating all factors at run up, take off and during flight.

Physical factor comprising of the explosive power 1, explosive power 2, agility and speed are contributing heavily to performances in female tripple jumpers. This factor is very closely related to with factor (third factor), as the maximum strength embedded in increased muscle mass (thigh girth and calf girth) might have certainly have been transformed to explosive power of the thigh and calf muscles. This might have certainly improved performances in female tripple jumpers besides explosive power performances depends largely on the muscle cross sectional, contractions, and speed and inter and intra muscular coordination. This might have certainly paved way for as harmoniously combined better training for maximum strength and explosive strength, thereby resulting the better performances in female tripple jumpers. This physical factor of female tripple jumpers has been extracted on the second factor (power factor in male tripple jumpers).

The anthropometric factor comprising of the height, leg length and weight are contributing heavily to performances in female tripple jumpers. Height and leg length are very closely related to each other and are contributing factors for performances in speed, as longer stride length, along with stride frequency is contributing to speed performances. Hence, this increase in kinetic energy through increased speed will enable female tripple jumpers to transform to potential energy at the time of take off.

The third factor known as the girth factor comprising of the calf girth and thigh girth are contributing heavily to performances in female tripple jumpers. This might have been due to the fact that muscle mass increases maximum strength proportionately, which ultimately might have been transformed to explosive strength. The three important groups of muscles of the lower extremities namely hamstring groups and quadriceps groups, forms the thigh muscles and gastronimous groups forms the calf muscles, thereby might have contributed to increases in thigh and calf girth and indirectly might have contributed to performances in female tripple jumpers.

DISCUSSION OF HYPOTHESIS

1. The result of this study enables hypothesis one thus formulated to be accepted as three prominent contributing factors have been extracted after rotated principle

component analysis in male long jumpers namely girth factor, speed power factor and agile factor.

2. The result of this study enables hypothesis two thus formulated to be accepted as three prominent contributing factors have been extracted after rotated principle component analysis in female long jumpers namely strength factor, speed factor and power factor.
3. The result of this study enables hypothesis three thus formulated to be accepted as three prominent contributing factors have been extracted after rotated principle component analysis in male tripple jumpers namely anthropometric factor, power factor and agile factor.
4. The result of this study enables hypothesis four thus formulated to be accepted as three prominent contributing factors have been extracted after rotated principle component analysis in female tripple jumpers namely physical factor, anthropometric factor and girth fact

BIBLIOGRAPHY

Barrow, Harold M. and McGee, Rose Mary A Practical Approach to Measurement in Physical Education. 3rd ed. (Philadelphia: Lea and Febiger, 1979), p.111.

Burley, Llyod R., Dobell, Helenc and Farrele, Belty J. "Relationship of Power, speed, flexibility and certain Anthropometric measures of Junior High School Girls, *Research Quarterly* 323 (December 1961): 443

Burley, Lyod R. and Anderson, Lenard, Roy "The Relationship of Jumps and Reach Measure of Power to Intelligent Scores of Athletic Performance", *Research Quarterly* 26 (March 1995): 28 – 35.

California, L. "A Physical Fitness Profiles of High School Age Students, Completed Rese3arch 28 – 121 (1985).

Cawely, C.M. "Comparison of Fitness Level of V Grade Boys and Girls in a Continuous Physical Education Programme, a One Year Physical Education Program" Completed Research in Health Physical Education and Recreation, 27: 121 (1983).

Chetia, Kamal , Uday "Relationship of leg-length, thigh-girth, calf-girth and AdbominalStrengh to Standing Broad Jump", (Unpublished Master's Thesis, JewajiUniverstiy, 1982).

Clarke , Harrison, H. and Clarke, David H. Application of Measurement to Physical Education, (New Jersey, Englewood Cliffs, Prentice Hall, Inc., 1976), p.194.

Clarke, Harrison, H. and Clarke, David H. Application to Physical Education, p.63.

Clarke, Harrison, H. "Relationship of selected and anthropometric Measures to Physical Performances Involving Trunk and Legs", *Research Quarterly,* 28(October 1957): 223.

Cureton T.K. Jr., Physical Fitness of Champion Athletes (Urbana: The University of Illionosis Press, 1961) Ited by Sodhi and Sidhu, Physique and Selection of

Sports Men (Patiala: Pubjab Publishing House, 1984), p. 10.

Cureton, Thomas Krik, Physical Fitness of Champion Athletes (Urbana: The University of Illinosis Press, 1961), p. 28.

Gooden, Keith "The Relationship of Selected Anthropometric Measurements of the Leg and Foot to Speed and Vertical Jump of Male Collegiate Track and Field Athletes", *Complted Research in Health, Physical Education and Recreation,* 21 (1979): 307.

Guttman, L. "Some Necessary Condition for Common Factor Anslysis", *Psychometrika* 19 (1954): 154 – 161.

H.Harrison Clarke and David H. Clarke, Appication to Physical Education, p.160.

Hastad, Douglas, N. Measurement and Education, (Gorsuch Scarisbric Publishers, 1994), p.198.

Johnson, Barry L. and Welson, Jack. K Practical Measurement for Evaluation in Physical Education, 3rd ed. (Delhi, Surjeet Publications, 1988), p.180.

Kaiser, H.F "Computer Programme for Variance Rotation in Factor Analysis", Educational Psychological Measures in (1959): 413 – 420.

Kruczalak, Eugeniusz "Strength Training for Sprinters" Track Technique. 35 (March 1969), 1106.

Kunttgen, Howard G. "Comparison of Physical Fitness of Danish and American School Children Research Quarterly vol 32 (1991).

Lewis, Barbara Irene "The Relationship of Selected Factors to the Vertical Jump", *Completed Research is Health,* Physical Education and Recreation 2(1960): 45.

Low, L. "A Description of Physical Fitness Components and Body Composition of 5-Year-Old Children", Completed Research in Health, Physical Education and Recreation 30: 280 (1987).

Mayer, Carlton R. Measurement in Physical Education, (New York, The Ronald Press Co., 1974), p.357.

Nath, Surinder Anthropometry the Measurement of Bodysize, Shape and Form, (New Delhi, Friend Publication, 1993), p.134.

Nath, Surinder Anthropometry the Measurement of Bodysize, Shape and Form, (New Delhi, Friend Publication, 1993), p.135.

Nath, Surinder Anthropometry the Measurement of Bodysize, Shape and Form, (New Delhi, Friend Publication, 1993), p.32.

Rasch, Philip J. "Relation of Arm Strength, Weight and Length to Speed of Arm Movement", *Research Quarterly* 25 (October 1954): 328.

Reid, Randall W. "The Relationship of Lower Limb Flexibility, Strength and Anthropometric Measures to Skating Speed in Varsity Hockey Players", *Completed Research in Health, Physical Education and Recreation,* 20 (1978): 114.

Sabol, Beatic "A Study of the Relationship among Anthropometric, Strength and PerrforamceMasures of College Women Bowlers", *Completed Research in Health, Physical Education and Recreation,* 5 (1963): 96.

Sanward, K.W The relation ship of age, weight, height, menstrual status and percent body fat to performance on the AAHPER youth fitness test in junior High School Girls Completed research (1987): 29, 39.

Singh, Hardayal Science of Sports Training, (New Delhi, D.V.S. Publication, 1991), p.80.

Singh, Hardayal, Sports Training General Theory and Methods (Patiala: Phulkian, Press 1984), p. 14.

Smith, Leon E. "Relationship betweenm Explosive Leg Strength and Performance in Vertical Jump", *Research Quarterly* 32 (October 1961): 405.

Wells, Russel F. "The Relationship of Leg Strength/Body Weight Ratio and Length of the Lower Limb Segments to Vertical Jump", *Completed Research in Health Physical Education and Recreation,* 5 (1963): 78.