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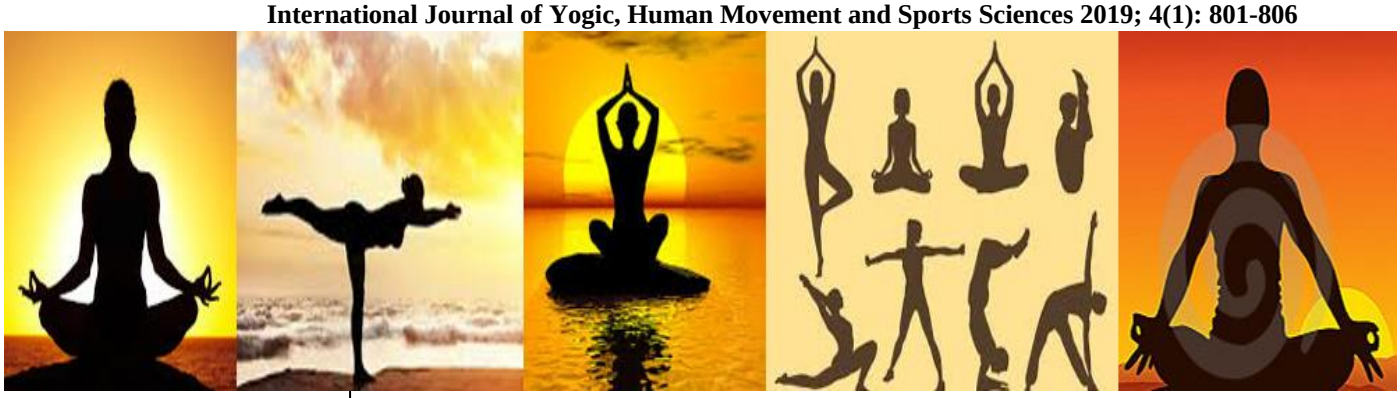

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Anthropometric and physical fitness factors of archers

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Abstract
The study is to identify those prominent Anthropometric and Physical fitness factors among national level women Archers in Kerala. The subjects selected for the study were 20 National level women Archers of Kerala selected from the senior state coaching camp held at Ernakulum in June 2017 and from thrissur district. The Physical fitness variables and the related tests were, Endurance (1200 mts), Shoulder strength (flexed arm hang), Explosive strength (cricket ball throw), Arm strength (modified push up) back strength (medicine ball throw), Abdomen strength (sit up in 1 minute), and Balance (Strok stand test). Descriptive statistics such as mean, median, mode, standard deviation, kurtosis, skweness, co-efficient of variance, minimum, maximum range, 25th percentile score, 50th percentile score and, 75th percentile score were found in order to get the basic idea of the data collected. 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 and selected physical fitness variables such as endurance, arm strength, abdomen strength, balance, explosive strength, back strength and shoulder strength.

Keywords: anthropometry, physical fitness, archery

Introduction
Sports and games is a way of maintaining physical fitness, apart from promoting recreation and showing one's upper-handiness over the other. Excelling the tactics of sport events, many legends have emerged in which led to its evaluation and development different events. Throwing some light on the reasons and circumstances would help us in better understanding the field of sports. Even before doing so, let us recognize some of exclusive points of sport and physical fitness that has been identified by the society, sports researchers, and philosophers captured in the pertaining literature. Anthropometric provides scientific methods to help in finding out talent in sports.

Anthropometry means the measurement of man. There is propound positive relationship between performance in sports and the anthropometric aspects of an athlete's body. It has been scientifically provide that different events in same sports require the demand of different bodily characteristic. In some games, where players have to play at different positions, it has been found that the requirement of anthropometric characteristic is different. Anthropometric the measurement of man provides scientific methods and skeleton. Recently it has taken a strong bonded relationship with physical education and sports sciences. The sciences of anthropometric has developed primarily in the play fields of physical anthropometric has developed primarily in the play fields of physical anthropologists. Physical anthologist have been mainly concerned with study of human origins and human evolution as well as the various of mankind in different parts of the world.

Physical fitness and structure are important factors of all competitive sports. The high level of performance in national and international competition is increasing rapidly by developing the required abilities and qualities of sports men or women. The high level of fitness of players can be achieved through one's level of tactical, technical and physical abilities at time of high ranking competitions.

Statement of the problem
The purpose of the study is to identify those prominent Anthropometric and Physical fitness factors among national level women Archers in Kerala.

Delimitations

1) Study is delimited to 20 national level women archersin Kerala of age between 17 to 25 years.
2) The study will be delimited to nine Anthropometric variables such as Height, Weight, Sitting height, Leg length, Arm length, Thigh girth, Calf girth, Ponderal Index and Crural Index.
3) The study is delimited to seven Physical fitness variables such as Endurance, Explosive power, Back strength, Abdominal strength, Shoulder strength, Arm strength and Static balance.

Limitations

1) The heredity and environmental factors which would have influenced the performance among women archers could not be controlled and this was considered as a limitation of this study.
2) In this study certain factors like diet, daily routine habits, training, schedule might have influenced the results of this study which was not taken into consideration and this was considered as a limitation of this study.
3) No motivational techniques were used while administering the tests and this was considered as a limitation of this study.

Hypotheses

The hypothesis is formulated for the study are

1) There will not be any prominent Anthropometric factors among National level women Archers in Kerala.
2) There will not be any prominent Physical fitness factors among National level women Archers in Kerala.
3) There will not be any prominent Anthropometric factors and Physical fitness factors among National level women Archers when both Anthropometric and Physical fitness factors (combined together) among National level women Archers in Kerala.

Methodology

In this chapter the methodology adopted for this study namely the selection of subjects. Selection variables, criterion measures, administration of test, statistical techniques employed for analyzing the data are given in details.

Selection of subjects

The subjects selected for the study were 20 National level women Archers of Kerala selected from the senior state coaching camp held at Ernakulum in June 2017 and from Thrissur district.

Selection of variables and tests

Nine Anthropometric variables such as Height, Weight, Sitting height, Leg length, Armlength, Thigh girth, Calf girth, Ponderal Index and Crural Index.

Six Physical fitness variables such as Endurance, Explosive power, Back strength, Abdominal strength, Shoulder strength, Arm strength, Static balance.

The tests used to assess the variables are presented in table 1.

1) Anthropometric Variables

Table 1: The tests used to assess the variables are presented

Variables	Test Instruments	Criterion Measures
height	Wall	centimeter
Weight	Weighing machine	Kilogram
Sitting height	Measuring tape	centimeter
Leg length	Measuring tape	centimeter
Arm length	Measuring tape	centimeter
Thigh girth	Measuring tape	centimeter
Calf girth	Measuring tape	Centimeter
Ponderal index	_	_-
Crural index	_	_

2) Physical fitness variables

Table 2: Tests used to assess the variables are presented

Variables	Test Instruments	Criterion Measures
Endurance	1200 meter	Minutes
Explosive power(hand power)	Cricket ball throw	Meter
Back strength	Medicine ball throw(backward)	Meter
Abdominal strength	Sit ups 1 minutes	Maximum no:
Shoulder strength	Flexed arm hang	$1/100^{th}$ seconds
Arm strength	Modified push ups	Maximum no:
Static balance	Strok stand test	$1/100^{th}$ of a seconds

Test Administration

Height

Equipment: Wall scale and brace plane

Procedure: The subject stood erect, feet together with heels, buttock, upper back and rear of the head in contact with wall scale. As the scholar broad this square on to the subject's vertex, the subject was instructed to take a deep breath and a stretch up to his full height.

Scoring: Height was recorded to the nearest centimetre

Weight

Equipment: A standard weighing machine

Procedure: The subject was asked to stand bare foot and wearing minimum cloth in the centre of a platform exerting equal pressure on both feet without any movement.

Scoring: Weight was recorded in kilogram.

Sitting height
Purpose: To assess the sitting height of the subject.

Equipment: stadiometer
Procedure: Sitting height is the vertical distance from sitting plane to the vertex. The subject was seated on a stool, legs were hanged, and buttocks and upper back contact the scale. The zero point of the stadiometer was kept in line with the upper surface on the stool. The flat object was placed on the head. The highest point of the head was recorded to the nearest centimetres.

Scoring: The highest point of the head was recorded to the nearest centimetres.

Leg length
Equipments: Steel measuring tape

Procedure: To determine the leg length the scholar stood facing the subject place the hand approximately 4 to 6 inches below the subject's waist on each hip and asked the subject to wing the right leg back and forth slowly and to lift it to the outside. By manipulating the scholar could located the spot were greater trochanter entered the pelvic girdle. The height of the greater tributes from the floor was measured. This procedure was followed three items with each subject.

Scoring: The measurement was recorded in centimetres

Arm length
Equipments: Steel tape

Procedure: The subject stood erect in relaxed position and the arms were hanging naturally at the side. The arm length was measured from the acrominal process of shoulder to tip of the middle finger.

Thigh girth
Equipments: Steel measuring tape

Procedure: Thigh girth was measured with a steel tape placed round the thigh horizontally with its top degree just under the fold of he buttock. The subject stood with his weight equally distributed on both feet.

Scoring: Measurement was recorded in centimetre sitting height.

Calf girth
Equipments: Steel measuring tape

Procedure: Calf girth was taken with a steel tape at the maximum circumference of the calf in a plane right ankle to its long axis. The leg was held hanging over table top that the tape measure was in horizontal place. In this position the calf muscle was quite relaxed.

Scoring: The measurement was recorded in centimetres

Ponderal Index
Equipment: Scales and stadiometer for measuring weight and height.

Procedure: PI is calculated from measurement of body mass (m) and height (h), PI=the cube root of body weight divided by height, where body mass is in kilograms and height in meters. Be aware that there are variations of this formula which are also sometimes called the ponderal index. There is also the reciprocal ponderal index, which is of course the height divided by the cube root of body weight.

Ponderal index=Ht(m)/cube root of Wt(kg)

Scoring: The higher the score indicating higher levels of body fat.

Crural Index
Procedure: Crural index = fore leg length/ thigh length
The ratio was computed by dividing the score of fore leg length by corresponding score of thigh length and the obtained value was recorded correct to four decimal places. This ratio is named as crural index.

Cardiovascular endurance (1200 meter)
Purpose: The purpose of the this test was to assess the cardiovascular efficiency of the subjects.

Equipments: Whistle and stop watch
Testing procedure: For the purpose of the test a standard track was divided into 8 equal segments of 50 meters. The subject were assembled on curve starting line. At the starting signal they were asked to run, if not, walk to cover as much as distance as possible within 9 minutes time. After the expiry of 9 minutes a long whistle was blown and the subject stopped running and remained there.

Scoring: The distance covered by each subjects was recorded to the nearest meter

Explosive power hand (cricket ball throw)
Aim: This test measure power particularly the hand power.

Equipments: Standard leather cricket ball, cone, Marking tape,
Procedure: Mark a line using two cones as the line the subject has to throw from. Subjects are allowed a 10m run-up. following the run-up, subjects must throw the ball without crossing the line. If the line is crossed the throw is deemed a foul. Two practice throws are allowed and three measurements are made

Scoring: The distance from the starting line to where the ball first lands is recorded. The measurement is recorded to the nearest meter. The best result of three throws is recorded.

Back strength
Equipment: Measuring tape, medicine ball, (2kg)

Aim: This test measure the back strength
The athletes starts by standing facing away from the direction they are going to throw, with their heels at the start line. The starting position is with the ball in both hands, held above the head. With arms extended. Keeping the arms extended, string the ball down between your legs while flexing the knees. Then in one motion the ball is flung up and back over the head (optimally at about 45%). The athlete is permitted to fall backward over the line after the ball is released. Three attempts are allowed.

Scoring: The distance from the starting line to where the

Ball is first landsis recorded. The measurement is recorded. The measurement is recorded to the nearest foot. The best result in the three throws is recorded.

Abdominal strength (**Sit ups in one minutes)**
Purpose: to measure the abdomen strength

Equipment: Mat and stop watch

Procedure: The subject lies on his or here back with knees bend at right angles hand shouldbe clapped behind head. a partner holds the angle for support. On 'go' the subjects performs repeated sit-ups, doing as many as possible in one minute. After each movement, the subject is to return to the back lying position with shoulders touching the mat.

Scoring: The score is the numbers of correctly performed sit ups completed in one minute.

Shoulder strength (flexed arm hang)
Purpose: To measure arm and shoulder strength.

Equipment: Horizontal bar, stop watch.
Procedure: The height of the bar should be adjusted to approximately the standing height of the subject. The subject should grasp the bar with an over hand grasp. The subject then raises her body of the floor with the help of assistants to a position where the chin is above the bar. Two spotters one in front and one in back of the subject are recommended for assistants in getting into the hang position. The subject hold the hand position as long as possible**.** The stop watch is started as soon as the subject assumes the Starting position and is stocked when the chin touches the bar falls below the bar. Or when the subjects head is tilted back to keep the chin above the bar.

Score: This score is the elapsed time to the nearest second that the subject maintained the proper hanging position.

Arm strength (modified push up)
An excellent alternative to the traditional push up test is the modified push up test. It is ideal for individuals who lack the upper body strength to perform a traditional push up. Similar to the push ups test, the modified push up test also measures the endurance strength of the chest, shoulder, and triceps muscles. The difference comes from reducing the amount of weight you need to push by resting on your knees (as opposed to your toes). The object of the test is to perform as many full-range push ups as possible

Static balance test-(Stork balance test)
Stork balance test requires the person to stand on one leg.
Purpose: To assess the ability to balance on the ball of the foot.

Equipment required: Flat, non-slip surface, stopwatch, pencil and paper.

Procedure: Remove the shoes and place the hands on the hips, then position the non supporting foot against the inside knee of the supporting leg. The subject is given one minute to practice the balance. The subject raises the heel to balance on the ball of the foot. The stopwatch is started as the heel is raised from the floor. The stopwatch is stopped if any of the follow occur; the hands(s) come off the hips the supporting foot swivels or move (hops) in any direction the non supporting foot loses contact with the knee. The heel of the supporting foot touches the floor.

Table 3: Rateing and score

Rateing	Score (Seconds)
Excellent	more than 50
Good	40-50
Average	25-39
Fair	10- 24
Poor	less than 10

Score: The total time in seconds is recorded. The score is the best of the three attempts. The adjacent tables list general ratings for this test.

Reliability of Data
The reliability of data was censured by instrument reliability and tester's competency.

Instrument Reliability
The instrument used for the study was stadiometer, flexible steel tape, stop watch and weighing machine. They were calibrated and accepted as accurate enough for research work.

Testers Competency
To ensure that the investigator was well versed with the techniques of conducting the test, the investigator had a number of practice sessions in testing procedure (under an expert). Tester's reliability was established by the consistency of results of obtained (using the correlation among the data collected by the expert and research choler and is given in table 4.

Table 4: Correlation obtained for testing competency

Sl No:	Name of variables	Correlation
1	Height	0.96
2	Weight	0.98
3	Sitting height	0.92
4	Leg length	.97
5	Arm length	.93
6	Thigh girth	.92
7	Calf girth	.91

Statistical techniques
1. **Various Descriptive profile such as:** Mean, median, mode, standard deviation, Kurtosis, skewness, cohesion of variance, range, minimum score, maximum score, 25^{th} percentile, 50^{th} percentile and, 75^{th} percentile.
2. **Factor analysis:** Three different factor analysis are done. One exclusively for Anthropometric variables the second exclusively for Physical fitness variables and the third one by combining both Anthropometric variables and Physical fitness variables as single group.

Analysis of data and result of the study
The collected data pertaining to the study has been analyzed and presented in this chapter.

The analyses of data are presented in the following ways;
Descriptive statistics such as mean, median, mode, standard deviation, kurtosis, skweness, co-efficient of variance, minimum, maximum range, 25^{th} percentile score, 50^{th} percentile score and, 75^{th} percentile score were found in order to get the basic idea of the data collected. 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 and selected physical fitness variables such as endurance, arm strength, abdomen strength, balance, explosive strength, back strength and shoulder strength.

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, seven Physical fitness variables and all the sixteen (both anthropometric and physical fitness variables) of National level archers of Kerala were subjected to correlation analysis in the form of correlation matrices. These correlation matrices were used in the principal component analysis.

With the help of principal component analysis, all the variables (Only Anthropometric variables, only Physical fitness variables and both Anthropometric and Physical fitness variables) were divided into various factors. With the help of Kaiser's criteria suggested by Guttman, only those factors having latent rules greater than one were considered as common factor. Owing to these 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 these factors obtained from the selected groups namely Anthropometric, Physical fitness and both Anthropometric and Physical fitness were interpreted and given names. 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 and physical fitness variables were presented in the following tables 4 and 5 respectively.

Discussion of findings

Anthropometric variables

The weight factor (factor 1) comprises of weight and ponderal index were heavily loaded items, the length factor (factor 2) which comprises the Arm length, calf girth and sitting height were heavily loaded item, the another loaded factor of length factor (factor 3) which comprising of leg length, thigh girth and crural index were heavily loaded items among female archers.

In Anthropometric variables (nine variables) the most prominent factors were weight, Arm length and leg length this is because Arm length is the most important factor that help to cover more distance and increase the draw length. Weight is not most prominent factor but it may get in the result because in my subject many were not performing presently may be because of less physical activity it became prominent. Leg length is important because it help in the trajectory of arrows.

Physical fitness variables

In the case of physical fitness variables, the strength factor (factor 1) which comprises of balance, back strength and explosive strength were heavily loaded items, the strength factor (factor 2) which comprises the endurance, abdomen strength and shoulder strength was heavily loaded item, the another loaded factor Arm strength factor (factor 3) which comprises the strength was heavily loaded item among female archers.

In Physical fitness variables (seven variable) back strength, Abdominal strength and arm strength this three variables are more prominent in archery for better performance back and abdomen are important for stable stands and arm strength for holding the bow steadily and for pulling the string which is most prominent in Archery.

Both anthropometric and physical fitness variables

Height, weight, arm length, ponderal index and back strength variable was heavily loaded item in the length factor (factor 1), shoulder strength and abdomen strength were heavily loaded item in the strength factor (factor 2) and Thigh girth, balance, arm strength were heavily loaded items in the girth factor (factor 3) among female archers.

In both Anthropometric and physical fitness variables the three prominent factors extracted after factor analysis were length factor, strength factor, girth factor.

Length factor is heavily loaded with variables height, weight, ponderal index, arm length and back strength. Strength factor were heavily loaded with variables abdomen strength and shoulder strength. Girth factor were heavily loaded with variable thigh girth, balance, arm strength.

This factors identified in this study and their relative importance in determine successful performance can be used in training for optimal Archery performance world wide.

Discussions of hpothesis

1. Since, three prominent factors have been extracted after factor analysis from among the selected anthropometric variables, hypothesis No: 1, thus formulated is rejected.
2. Three prominent factors have been extracted after factor analysis from among the selected physical fitness variables, hypothesis No: 2, thus formulated is rejected.
3. A combination of both anthropometric and physical fitness variables, have been extracted after factor analysis hypothesis No: 3, thus formulated is rejected.

Summary

The purpose of the study is to identify those prominent Anthropometric and Physical fitness factors among national level women Archers in Kerala. The subjects selected for the study were 20 National level women Archers of Kerala selected from the senior state coaching camp held at Ernakulum in June 2017 and from thrissur district. The purposes of the study were to find out prominent Anthropometric and Physical fitness factors contributing to performance in female archers. The Physical fitness variables and the related tests were, Endurance (1200 mts), Shoulder strength (flexed arm hang), Explosive strength (cricket ball throw), Arm strength (modified push up) back strength (medicine ball throw), Abdomen strength (sit up in 1 minute), and Balance (strok stand test). Descriptive statistics such as mean, median, mode, standard deviation, kurtosis, skweness, co-efficient of variance, minimum, maximum range, 25^{th} percentile score, 50^{th} percentile score and, 75^{th} percentile score were found in order to get the basic idea of the data collected. 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 and selected physical fitness variables such as endurance, arm strength, abdomen strength, balance, explosive strength, back strength and shoulder strength. 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. Since there was very less study on anthropometric and physical fitness variables done on National level archers. The scholar has undertaken this study to explore the importance of Anthropometric and Physical fitness variables among Archers.

Conclusions

Within the limitations of the study the following conclusions were drawn from the present study applicable to female Archers.

Anthropometric variables

The weight factor (Factor 1) comprises of weight were heavily loaded items, the length factor (Factor 2) which comprises the Arm length were heavily loaded item, the another loaded factor of length factor (Factor 3) which comprising of leg length were heavily loaded items among female archers.

Physical fitness variables

In the case of physical fitness variables, the strength factor (factor 1) which comprises of Back strength were heavily loaded items, the strength factor (factor 2) which comprises the Abdomen strength was heavily loaded item, the another loaded factor Arm strength factor (factor 3) which comprises the strength was heavily loaded item among female archers.

Both anthropometric and physical fitness variables

Arm length variable was heavily loaded item in the length factor (factor 1), Abdomen strength were heavily loaded item in the strength factor (factor 2) and Thigh girth were heavily loaded items in the girth factor (factor 3) among female archers.

Recommendations

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

1. Since there was very less study on anthropometric and physical fitness variables done on Archers so, similar studies may be conducted using National level Archers.
2. The same study may be extended to the large no: of sample size.
3. Similar studies may be conducted using female Archers of other states.
4. It is also recommended that coaches and trainers design the training plan for actual performance.

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