Chapter - III

PROCEDURE

In this chapter the procedure adopted for the selection of subjects, selection of physical and physiological variables, criterion measures, reliability of data, procedure for administering the tests and measurements and statistical technique employed for the analysis of the data have been presented.

Selection of Subjects

For the purpose of this study twenty male and twenty female archers those who have participated in the National Archery Championship in the year 1994-95 from various part of India were selected at random as subjects for this study.

All the subjects belong to average socioeconomic status families but exceptions apart as revealed by individual archers after discussion with the research scholar. The requirements of the study was explained to them in the presence of their coaches.
They agreed voluntarily to undergo tests and measurements. The procedure of the testing was explained to them so that there were no ambiguity regarding the efforts required on their part and the hardships might have to endure. In fact most of the subjects were very enthusiastic to take part in their project and took part in all experiment with whole hearted cooperation.

**Selection of Variables**

The selection of Physical and Physiological variables was done by using the following criteria:

(1) Through review of all the available Scientific literature pertaining to the physical and physiological variables which are related and likely to contribute for better archery performance.

(2) After finding the initial criteria it was reviewed again while keeping about the availability of equipments, facilities, time
factor and exceptability of subjects that could be devoted for individual subject, while testing and also to keep the entire study unitary. Selection of variables were finally made in consultation with experts and Guide.

Based on above mentioned criteria the following Physical Physiological variables were selected:

**Physical Variables**

1. Age
2. Height (Standing height)
3. Weight (Total body weight)
4. Arm length
5. Leg length

**Physiological Variables**

1. Positive breath holding time
2. Resting Pulse rate
3. Resting respiratory rate
4. Resting blood pressure:
   (a) Systolic blood pressure
   (b) Diastolic blood pressure
5. Body composition:
   (a) Lean body weight
   (b) Fat percentage

6. Arm-and-shoulder strength

7. Grip strength
   (a) Right hand grip strength
   (b) Left hand grip strength

8. Shoulder-and-wrist flexibility

**Criterion Measures**

The individual performance score of male archers (who have participated in 90 mts, 70 mts, 50 mts and 30 mts events) and female archers (who have participated in 70 mts, 60 mts, 50 mts and 30 mts events) who have participated in the National Archery Championship in the year 1994-95 was considered as the criterion measures.

**Reliability of Data**

Prior to the actual collection of data the reliability of the data was ensured by establishing the
instrument's reliability and tester's reliability.

**Instrument Reliability**

Instruments used for the study were available at the human performance laboratory of Lakshmibai National Institute of Physical Education, Gwalior and Sports Authority of India, Netaji Subash Eastern Centre, Salt Lake City, Calcutta. Instruments were calibrated and tested prior to the collection of data. Thus, these were considered accurate enough for the purpose of this study.

**Tester's Reliability**

The reliability of the tester in taking Physical and Physiological variables was established and with the help of test retest method of performance of ten subjects were selected at random on the selected variables were recorded several times under identical conditions by the research scholar. A pearson's product moment correlation was computed between the two measures of each variable, the reliability coefficient
have shown higher values. The values of coefficients is given in Table .1.

**TABLE .1.**

RELIABILITY COEFFICIENTS OF TEST, RETEST SCORES  
(N = 10)

<table>
<thead>
<tr>
<th>Tests/Measurements</th>
<th>Coefficient of Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>.992</td>
</tr>
<tr>
<td>Arm length</td>
<td>.902</td>
</tr>
<tr>
<td>Leg length</td>
<td>.968</td>
</tr>
<tr>
<td>Positive breath holding time</td>
<td>.922</td>
</tr>
<tr>
<td>Resting pulse rate</td>
<td>.953</td>
</tr>
<tr>
<td>Resting respiratory rate</td>
<td>.967</td>
</tr>
<tr>
<td>Resting blood pressure</td>
<td>.970</td>
</tr>
<tr>
<td>Biceps skinfold</td>
<td>.912</td>
</tr>
<tr>
<td>Triceps skinfold</td>
<td>.905</td>
</tr>
<tr>
<td>Sub-Scapularis region skinfold</td>
<td>.917</td>
</tr>
<tr>
<td>Supra-illiac region skinfold</td>
<td>.921</td>
</tr>
<tr>
<td>Push-ups</td>
<td>.913</td>
</tr>
<tr>
<td>Modified push-ups</td>
<td>.901</td>
</tr>
<tr>
<td>Grip strength</td>
<td>.981</td>
</tr>
<tr>
<td>Shoulder-and-wrist flexibility</td>
<td>.908</td>
</tr>
</tbody>
</table>
Collection of Data

The data pertaining to Physical and Physiological variables were collected by administering standard tests and measurements procedure available in the literature.

Physical Variables

Age:

The age of each subjects were taken from the subject's actual date of birth with reference to the official recording available with SAI and National Association. But for the purpose of the study only the completed years were taken into consideration.

Standing Height:

The standing height was taken with the subject standing erect without shoes against a wall with a marked scale. The subject was instructed to keep the heels together, touching the wall with heels, buttock and back, head erect without tilt and to take and hold a full breath while hard board was held vertically on
his head. Slightly pressing his head and touching the scales marked on the wall at a right angle. The subject was asked to step out by lowering the head and the reading indicated by the hard board's lower edge was read on the scale. Height was recorded correct to the nearest half of a centimetre.  

Weight:

The weight of each subjects were taken on a weighing machine. The subjects were wearing a minimum possible dress, stood on the weighting machine and the weight was recorded to its nearest half a kilogram.

Arm Length:

The arm length was measured with a steel tape. The subject was asked to stand erect and the measurement was taken from the acromion process at the top centre of the shoulder to the tip of middle finger. Arm length was recorded correct to the nearest half of a centimetre.

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Leg Length:

The leg length was measured with a steel tape. The subject was asked to stand erect with feet together. The measurement was taken from the outside edge of the foot to the upper edge of greater trochanter. Leg length was recorded correct to the nearest half of a centimetre.³

Physiological Variables

Positive breath holding time:

A suitable chair was provided to the subject to sit comfortably, the subject was asked to take maximum inhalation and to hold it for whatever it was possible for him to do so. As soon as his chest movement was stopped, after taking full inspiration, his nose was pinched with a nose clip and simultaneously a stop watch was started. The subject was asked to prevent any sort of air leakage through mouth. The stop watch was stopped as soon as the subject opened his/her mouth. The time of holding the breath was recorded to the nearest second.

³ Ibid.
Resting pulse rate:

Resting pulse rate was recorded while the subject was in supine position. The subject were instructed to be in supine position for at least 15 to 20 minutes before recording to resting pulse rate. Then the research scholar kept his finger tips on the radial artery of the subject and the pulse beats were palpated for 15 seconds for each subject and finally it was converted in minute's form (B/M). The resting pulse rate was recorded in terms of number of pulse per minute.

Resting respiratory rate:

Resting respiratory rate was recorded while the subject was in supine position. The subjects were instructed to be in supine position for 15 to 20 minutes before recording the resting respiratory rate. Then the research scholar kept his palm just below the thoracic cavity that is on the diaphragm of the subject and was pelpated for 60 seconds for each subject. The resting respiratory rate was recorded in term of the total number of inhalation and exhalation per minute.
Resting Blood Pressure:

A sphygmomanometer (dial type) and a stethoscope were used to measure blood pressure (systolic and diastolic). The subject was placed in a supine lying position for 15 to 20 minutes for recovery from any unusual tension.

The left upper arm of the subject was encircled by an inflatable rubber bag containing in cuff was connected to pressure pump and manometer. By pumping air to pressure in the bag was rapidly raised to 180 mm Hg, which was sufficient to obliterate completely the brachial artery so that no blood comes through, the radial pulse disappeared. The pressure was then lowered to a point where the pulse could be felt by using a stethoscope, the pulsation of the brachial artery at the bend of the elbow could be distinctly heard. At this point the pressure shown on the deal was recorded as systolic pressure.

The pressure on the brachial artery was then gradually reduced until the arterial pulse beats could
by distinctly heard and the point at which the sound disappeared was recorded as diastolic pressure.

**Body composition:**

The body composition was represented by the percentage of fat of the subjects. To obtain the percentage of body fat of each subject skinfold measurement on right side of the body were taken at four selected sites. Skinfold caliper was used for the purpose of the thickness of the skinfolds were recorded in milimeters. 4

The following were the sites used for taking skinfold measurements:
1. Biceps skinfold
2. Triceps skinfold
3. Subscapular region skinfold
4. Supra-iliac region skinfold

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Biceps skinfolds:

The subject standing erect with arm hanging loosely, a double layered fold of skin was picked up on the anterior of the mid part of biceps and the skinfold thickness was measured using lahe's skinfold caliper. The position of the fold was vertical and reading to the nearest half milimetre was recorded.

Triceps skinfold:

The skinfold thickness was taken over the triceps muscle at a point-half way between the tip of the shoulder (acromial process) and the tip of the elbow (olecranon process). The point was located with forearm flexed to 90° and while taking the measurement the arm was kept hanging free. The double layered fold of skin was lifted parallel to the Long axis of the arm and the caliper was gently placed and the reading to the nearest half milimetre was recorded.

Subscapular region skinfold:

The skinfold thickness was taken at the tip of the scapula with the subject in a relaxed standing
position. The fold was lifted to the diagonal plane at about 45° from the vertical and horizontal planes and the langer caliper was gently placed and the reading to the nearest half milimetre was recorded.

Supra-iliac region skinfold:

The skinfold thickness was taken three to five centimetres above the anterior-superior iliac spine on a diagonal line giving downward and inward and the double langered skinfold was gently grasped by lange's caliper. The reading to the nearest half milimetre was recorded.

The sum of the skinfold thickness of four sites of the body was used in order to obtain percentage of body fat with the help of standard conversion table suggested by durnin and rehman.  

The research scholar himself has taken the skinfold measurement of the male archers and in case of female archers the research scholar has been assisted by Lady Medical Officer and J.S.O.

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Lean body weight:

The total body weight minus the weight of body's fat give the lean body weight. The weight of the fat was substracted from each subject's total body weight recorded. The weight of fat was calculated by using the following formula:

$$\text{Fat weight} = \frac{\text{Body weight} \times \% \text{ Value of fat}}{100}$$

Lean body weight and fat percentage of the subject will represent the body composition.

Arm and Shoulder Strength:

Push-ups (Male)

The push-up test was administered on plane surface. Each subject had taken a dip's position that is arm shoulder apart, feet apart and the body was in a straight line resting on the limb. From this position, he dipped his body down until the angle of the upper arm and the fore arm was less than 90° then push-up to the front support position. Maximum number of correctly executed push-ups was recorded as the subject's score.
Modified Push-ups (Female):

The subject's were asked to keep the knee bent at the right angles and the hands on the floor (directly under the shoulders), the performer lowers her body to the floor until the chest touches and then she pushes back to the starting position. Maximum number of correctly executed push-ups was recorded as the subject's score.  

Grip strength:

Grip strength of the subject was measured with the help of grip dynamometer. The concave edge of the dynamometer was placed between the first and the second joint of the fingers of each hand with the dial towards the palm of the hand and both the needles were kept on zero. The subjects were allowed any type of movement while squeezing the handle of the instrument, provided that they did not hit any object with their fist and the grip strength of each hand was tested. The score of the grip strength was recorded to the nearest kilogram from the

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indicating needle of the dynamometer dial.  

**Shoulder-and-wrist flexibility:**

The subject was asked to lie down on the floor in prone position with arms straight upward and grasp one yard stick about shoulder width apart. Then the subject was asked to raise the yard stick upward as high as possible while keeping the chin on the floor and elbows straight. The best lift of three trails was subtracted from one's own arm length, which was considered as shoulder-and-wrist flexibility score.

**Statistical Analysis of Data**

To determine the physical and physiological profiles of Indian National level archers, the data obtained were analysed by employing the following statistical techniques: