CHAPTER III

METHODOLOGY
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The present study has been mainly designed to find out the effect of selected yogic practices and physical exercises on health-related physical fitness and psychological variables of school boys. To accomplish the purpose of this study, the experimental design, the subjects, the criterion variables and test of measuring them and their variables and methods of applying them have been systematically presented and explained in this chapter.

THE SUBJECTS

Ninety subjects were selected at random from the schools in Madras for this study. The average age of the subjects was sixteen, ranging from fifteen to seventeen years, the standard deviation being ±1. The selected students were further divided at random into three groups namely yogic practices, physical exercises and control groups. All the subjects were normal and healthy male students. The sample was considered as the true representative of population. The number of each group was thirty.

EXPERIMENTAL DESIGN

Random group design with three groups with testing in criterion variables before and after the experimental period of twelve weeks were adopted.
ORGANISATION OF THE PROJECT

At the commencement of the project all the subjects were oriented, in an assembly on the objectives of the study, testing procedures for measuring criterion variables and treatment procedures. The test techniques were demonstrated. The subjects were motivated to give their best performance by explaining the importance of the scores made by them in the various tests, interpreting the scores and the possible improvement they could make by proposed treatments to be given to them.

CRITERION VARIABLES

The health related variables chosen for the study were taken from the Manual of Urofit prescribed by Risto Telema. The anxiety and the self-concept were the psychological variables, which were considered to be highly co-related with performance level. So these variables were selected along with health-related physical fitness, which was taken as an indicator of physical performance.

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Speed and Agility - Shuttle Run (10 x 5 meters) Test
Cardiorespiratory Endurance - Harvard Step Test
Estimated Body Fat Percentage - Skin-folds Measurement
Body Composition - Taylor's Manifest Anxiety Scale Questionnaire
Anxiety - Muktha Rani Rastogi Questionnaire
Self-concept -

FLEXIBILITY

The term general flexibility is used to denote the level of flexibility of all the important joints of the body.\footnote{Hardayal Singh, \textit{Science of Sports Training} (New Delhi: D.V.S. Publications, 1991) p.156.} The shoulder joints, hip joints and trunk joints are examples. Sit and Reach Test was used to measure the low back-hamstring area.\footnote{Margaret J. Safrit, \textit{Introduction to measurement in Physical Education and Exercise Science} (Saint Louis: Times Mirror/ Mosby College Publishing, 1986), pp. 241-242.} Verducci observed that the purpose is to test the flexibility of the low back and posterior thigh.\footnote{Frank M. Verducci, \textit{Measurement Concepts in Physical Education} (St. Louis, Toronto, London: The C.V. Mosby company, 1980), p. 282.}
Testing

Flexibility measurements include flexion exercises and extension exercises since the degree of flexibility in various joints of the same individual may differ greatly, it is considered as a specific ability of the joint involved. By the proper use of the standard instruments of test, it is possible to determine which individuals have the greater flexibility.

Hardayal Singh stated that flexibility is measured by determining the range of movement possible at the joint. Greater range of movement enables the muscles to develop more force and speed.\(^{145}\)

A test box was chosen with the following dimensions: length 35 cm, width 45 cm, height 32 cm. The measurements of the top plate comprised length 55 cm. and width 45 cm. This top plate extended 15 cm. over the side supporting the feet. A scale running from 0 to 50 cm was marked in the middle of the top plate.\(^{146}\)

To begin the test, the subject sat in front of the test apparatus with feet flat against the end board. The knees should be fully extended and the feet, shoulder-width apart. To perform the test, the subject extended the arms forward with one hand placed on top


\(^{146}\)Verducci, *Loc. cit.*, p. 282
of the other. The test was done twice, with the better result taken as the scores. The
distance of the maximum reach was noted as the score.

**TRUNK STRENGTH** – Abdominal muscular endurance

Strength endurance is the ability to overcome high resistance or to act against
high resistance under conditions of fatigue. Martin and Matweyew have used the
concept of 'ability to resist fatigue' for defining endurance. The Modified Sit - ups
Test was used to measure abdominal strength and endurance.

**Testing**

The starting position of the test was a back lying position with knees flexed, feet
on the floor, and heels between twelve and eighteen inches from the buttocks. The arms
were crossed on the chest with the hand on opposite shoulders. An assistant held the
subject's feet to keep them in contact with the surface. The subject curled to a sitting
position, maintaining arm contact with the chest. The chin touched on the chest and
remained in the position until the completion of the sit-up. When the elbows touched the
thighs, the sit-up was completed. The subject then curled back down to the floor until the
mid-back contacted the testing surface. Sit-up was then attempted.

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147 Hardayal Singh, *op.cit.*, p.87.


SIT-UPS TEST
The subject was asked to repeat the sit-ups as rapidly as possible for sixty seconds. The total number of correctly performed complete sit-ups in sixty seconds was the score.

**FUNCTIONAL STRENGTH - (Arm and Shoulder Muscular Endurance)**

Strength is a physical fitness component, it must be related to each individual and it should be measured in relation to the individual's body weight.

**Testing**

The Bent Arm Hang Test was used to measure the muscular strength. (Arm and shoulder muscular endurance). A round horizontal bar, diameter 2.5 cm was preferred. The subjects stood under the bar with hands in a forward grip on the bar at shoulder width. The height of the bar was adjusted to the height of the subject. The subject was taking by thighs and placed into the correct position. The watch was started as soon as the subject took the hanging position. The watch was stopped when the subject could not hold the required position any longer as described above. The time in tenths of a second was the score.
BENT ARM HANG TEST
SPEED AND AGILITY

The maximum speed at which an individual was able to move his entire body or part of the body over a specified distance was considered to be the speed of movement. Theiss and Schnabel define speed as the performance pre-requisite to do motor actions under given conditions (Movement task, external factor, individual pre requisite) in minimum of time.

Testing

The shuttle run (10 x 5 meters) Test was used to measure speed and agility. For the shuttle run test two parallel lines were marked on the floor ten meters apart. The subject stood just behind the line. Position was got ready when one foot was just behind the line. When the start was given, the subject ran as fast as possible to the other line and returned to the starting line, crossing both lines with both feet. This was one cycle and was completed five times. The time needed to complete the civic cycles was the score and written in tenths of a second.


SHUTTLE - RUN TEST

Diagram 4
CARDORESPIRATORY ENDURANCE

It is characterised by moderate contractions of large muscle groups for relatively long periods of time, during which maximal adjustments of the circulatory-respiratory systems to the activity are necessary. Verducci uses the Harvard Step Test to measure recovery heart rate to indicate physiological assessment of maximum performance.\(^{153}\)

**Testing**

The subject exercised on a 20 inches high platform for as long a period as possible upto five minutes. The stepping pattern was up with the left foot, up with right foot, down with the left foot and down with the right foot. Both the legs of subject were straight, when standing on the bench. The steps were taken at a cadence of 30 steps per minute. The stepping exercises would continue for five minutes unless he felt that he must stop before exhaustion set in. As soon as he stopped exercising, he sat down and remained seated and quiet throughout the pulse counts. The pulse count was taken one to one and half minute, two to two and half, three to three and half minutes after the exercise ceases.

To measure cardiorespiratory endurance and ability to perform and recover from muscular work, a Physical Efficiency Index was computed with the following formula.

\[
\text{PEI} = \frac{\text{Duration of exercises in seconds} \times 100}{2 \times \text{sum of 3 recovery pulse counts}}
\]

ESTIMATED BODY FAT PERCENTAGE - Body composition

Fats are the components of carbon, hydrogen and oxygen, mainly three fatty acid molecules attached to one glycerol molecule. Neutral fats are better sources of energy giving around nine calories for each gram of fat taken.\(^{154}\)

Testing

The skin-folds measurement was used to assess estimated body fat percentage or more specifically the level of fatness in an individual.\(^{155}\) The skin-folds in the present investigation were measured with "Slim Guide skin-fold Caliper" and the instruction manual for this purpose by Wallace C. Donoghue\(^{156}\) was followed.

Biceps:

The subject was asked to let the arm hang freely and the skin-folds were lifted over the biceps muscles.


SKINFOLD MEASUREMENTS
Triceps:

The subject was asked to flex the arm at the elbow to 90°. The skin-fold measurement was taken over the triceps muscles.

Subscapular:

Measurement was made at the fold diagonally from the vertebral column upward the inferior angle of the right scapula, approximately 2 cm below the inferior angle and slightly towards the midline of the body.

Suprailiac:

The site was located immediate above the crest of the left ileum. The thumb was placed over the iliac and the fold lifted medial to the midline at a slight angle to the vertical along the normal fold line.

Estimated Body Fat Percentage:

Once density has been estimated, the percentage of fat is calculated, based on the known differences in density of fat and lean tissue. Siri's\textsuperscript{157} equation is used for converting body density to percentage of fat:

\textsuperscript{157}Siri, W.E., "The Gross Composition of the Body", \textit{Advance in Biological and Medical Physics}, 4 (1956), p.239
Estimated Body Density: \(1.1620 - 0.630 \text{ Kg} \times \log \text{ of the sum of the four skin-folds (Biceps + Triceps + Supra-iliac + Sub-scapular)}\)

Estimated body fat percentage\(^{158}\) = \(\{(4.950/\text{Density}) - 4.500\} \times 100\)

Durin and Rahaman\(^{159}\) also suggested the same.

**ANXIETY**

Anxiety is most often stimulated by qualities of a person himself rather than by any external events.\(^{160}\) Anxiety is the tendency to view competitive situations as treating and to react to them with feelings of apprehension.

**Testing**

The level of anxiety is measured by administering Taylor's Manifest Anxiety Scale.\(^{161}\) This is a self-reporting paper and pencil test widely used in research in psychology and education.

The subjects were assembled and briefed on the objectives of the test and mode of answering. They were asked to be fairly quick in answering without much deliberation on any time. All the items were to be answered. The copies of the test were distributed. The subjects were to tick with pencil 'yes' or 'no' against each item as


\(^{161}\)A.Janet, *Loc. cit.*
reflective of their feelings and behavioural pattern. The test papers were manually scored with the 'key' of the test. The score was recorded in numbers as evaluated from the scoring key of the test.

**SELF-CONCEPT**

Self-concept is relatively a stable and more or less conscious phenomenon and unique system of the individual's ideas about himself, image of his own qualities, abilities, appearance, social significance bearing on which he interacts with other people and develops an attitude towards himself.\(^{162}\)

**Testing**

Mukta Rani Rastogi's\(^{163}\) questionnaire, which consists of fifty-one statements used to measure self-concept. It includes both positive and negative statements. It is a Likert method and each statement consist of five responses:- Strongly Agree, Agree, Undecided, Disagree, Strongly Disagree. The respondents were asked to put a tick mark (✓) against any one of the responses that was found most suitable.

This scale was scored with the help of a scoring key. A separate scoring method was followed for positive and negative statements. The scores obtained for both positive


\(^{163}\)Mukta Rani Rastogi, *Loc. cit.*
and negative statements were added and it was treated as individual score. The total score constituted the self-concept score.

**RELIABILITY OF DATA**

Reliability of data was ensured by establishing the instrument reliability, tester competency, reliability of tests and subject reliability. Instrument reliability was ensured through measuring tapes, stop watches. Skin-fold callipers were obtained from reputed suppliers of standard equipment. All the instruments were in good condition and workable.

The investigator was well versed in the techniques of conducting the test. The investigator took all the measurements for all the subjects. By co-efficient of correlation the subject reliability was checked by the investigator of this study.

**TREATMENT PROCEDURE**

**Yogic Practices Group**

The group of thirty students was randomly assigned to the treatment of yogic practices. They performed some loosening and stretching exercises for five minutes. Then for the next thirty minutes they practiced yogasanas. The schedule of progression in the practice of yogasanas were taught and trained by experts. The yogic practices programme consisted of the following selected yogic exercises.\(^{164}\)

Yogic practices programme

The yogic practices programme consisted of the following selected yogic exercises

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General Short course for Half an hour daily practice
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Sithilikarana Vyayama

Forward - Backward bending 10 times

ASANAS

Suryanamaskar 3 times

Standing:
1. Ardhakati Cakrasana
2. Ardhacakrasana
3. Padahastasana

Sitting:
1. Sasankasana
2. Supta-Vajrasana
3. Ardhamatsyendrasana

Lying Posture:
1. Bhujangasana
2. Sarvangasana
3. Matsyasana
4. Savasana

PRANAYAYAMA
1. Kapalabhati 60 strokes
2. Nadisuddhi 9 round

Silence

Prayer
Suryanamaskar

In this asana, the subject stood erect with the legs together, palms together, the hands above the head and bent the trunk backwards then inhaling fully. Bent the body to the front, touched the knees by the forehead, kept the palms on the floor on either side of the legs and then exhaling fully. The subject was asked to kick the right leg back, took the left knee forward, looked up and inhaled touching the thigh with the heel. Took the left leg also back resting only on palms and toes. Kept the body straight from head to toes inclined to the ground at about 30 degree and then exhaling completely. Bent at the knee and rest the knees on the floor without altering the positions of the palms and toes. Rest the forehead on the ground while moving backwards and exhaling completely.

Without moving the hands and toes came forward on the chest and rest the forehead. In that position Sastanganamaskar, forehead, chest, hands, knees and legs all the eight organs would be touching the ground. The buttocks would be raised up while inhaling. Raised the head and trunk making the spine concave upwards without changing the position of the hands and feet, kept the knees on the ground. While exhaling raised the buttocks pushed the head down and had a complete arch with the heels touching the ground and palms on the floor. Now bent at the knee and rest the knees on the floor without altering the positions of the palms and toes. Rest the forehead on the ground. In that position inhaled while moving backwards and then exhaling completely.
While inhaling brought the right leg in between the two hands and in line with them. Arch the back concave upwards. Making the subject to exhale and brought the left foot forward next to the right foot and touching the knees with forehead. While inhaling, the subject stood erect relaxed with hands along the body.

**Ardhakati Cakrasana**

In this asana the subject stood erect with feet close together, hands along with thigh, fingers stretched out. While inhaling, the subject slowly raised the right arm sideways up, above the head, bent slowly, on the left side and placed the left palm down, exhaling as he bent. The subject raised his head without bending the elbow. He held his knees straight. He breathed normally. He maintained his posture for about a minute. After that returned to normal position completely. He repeated on the left side, by bending towards the right.

**Ardha Cakrasana**

In the above posture the subject assumed sitting position. He supported the back at the waist with the palms. The subject then exhaled. He bent back- wards from the lumbar region and then bent his head backwards stretching the muscles of the neck. He inhaled while bending, retained the position for about a minute and resumed normal breathing and returned to starting position.
Pada Hastasana

In the above posture, the subject stood erect with legs together, raised the arms, parallel to ground and inhaled while going up. He stretched up the body from the coccyx. Making the body concave, he bent forward till the body came to horizontal position. He attempted to push the bottom of the spine, forward while bending. He breathed out while going down. He then inhaled. While inhaling he bent down, till the palms rested on the ground and forehead touched the knees, he retained the position for about two minutes without bending knees and returned to starting position.

Sasankasana

In this position, the subject started in sitting position. Slowly he bent the right leg and kept the heel tight under the buttock. He brought the left leg under the left buttock. He kept the knees close to each other, spine erect, head, shoulders and buttocks in a vertical line. He rested the palms on the upper part of the thighs or covering the knees. He closed the eyes and meditated. He caught the right hand with left behind the back. He bent forward from the waist. He rested the forehead on the ground in front of the knees. He returned to starting position.
PADAHASTASANA
Supta-Vajrasana

In this position, the subject slowly bent the right leg and kept the heel tight under the buttock. He brought the left leg under the left buttock. He kept the knees close to each other, spine erect, the head, shoulders and buttocks in a vertical line. He rested the palm on the upper part of the thighs or covering the knees. He closed the eyes and meditated. He re-climbed slowly back-wards taking the body weight on the right elbow first and then the left. He lay flat on the back. He kept the hands crossed above the head. He kept the knees close together, touching the ground. He returned to starting position.

Ardha Matsyendrasana

In this posture, the subject bent the right leg at the knee and placed the heel tight against the perineum. The subject kept the foot on the left leg by the side of the right thigh near the knee. He brought the right hand round the outside of the left knee passing between the chest and the knee and caught hold on the left big toe. The right shoulder blade rested on the other side of the left knee. After that he took the left hand round the back and tried to catch the right thigh. He looked back over the left shoulder (the erect knee acts as a fulcrum for getting maximum twist of the spine). He kept the trunk vertical. He did not sit on the heels. He maintained it for some time. He came back to starting position. He repeated the same on the other side.
ARDHAMATSYENDRASANA
Bhujangasana

In this posture, the subject lay prone and touched the ground with forehead. He let the palms rest on the ground by the side of the chest. He raised the head slowly but fully, then raised the chest and abdomen only up to the umbilicus. He maintained the position for a few seconds and gradually returned to the original position, first touching the abdomen, then chest and ultimately the forehead.

Sarvangasana

In this posture the subject by supine he raised both the legs up to 90 degree, slowly through 30 and 60 degrees. He raised the buttocks and gave support with both the hands, by pressing chest. He kept trunk and legs in a straight line as far as possible. He removed the support of the hands and lower the legs slowly to the ground.

Matsyasana

In this posture, the subject sat with legs extended. He bent one of the legs in the knee and arranged the foot on the opposite thigh. He bent the other leg similarly and arranged the foot on the opposite thigh. This formed a foot lock. Taking help of the elbows, the subject leg on the back and turned the head backward making an arch of the back. He held the big toes with the hands and maintained the position comfortably. He returned to the starting position in the reverse order.
SARVANGASANA
MATSYASANA
Savasana

In this posture, the subject lay on the back with heads extended along the body. He kept the feet 40 to 50 cms apart, allowing the toes to point outside. He placed both the hands on the side at about 15 to 20 cms distance from the body. The fingers were in a semi-flexed condition. He kept the head in the most convenient position. He closed the eyes. He started moderately deep abdominal breathing. He attended to the flow of breath at the nose.

Kapalabhatti

In this posture the subject sat in a comfortable asana, preferably Padmasana. He placed the hands comfortably on the knees. He raised the chest and sat erect. He exhaled suddenly and forcibly giving an inward stroke at the navel region. He released the abdomen and inhaled. He repeated the forceful exhalation and inhalations a number of times. He lowered the chest. He released the legs from Padmasana position. The session concluded with five minutes of quite silence, prayer and consciousness with no thinking of any sort.

Nadi Suddhi

In this posture, the subject was asked to sit erect in Padmasana and exhale completely. He closed the right nostril with the thumb of the right hand and inhaled slowly, steadily and deeply as long as possible. He released the right nostril and closed the left nostril with the little and ring fingers of the right hand and breathed out the right
SAVASANA
KAPALABHATI
NADISUDDHI
nostril. Again he breathed in through the right nostril and breathed out through the left nostril.

**PHYSICAL EXERCISE GROUP**

A group of thirty students randomly was assigned to the treatment of physical exercises. Each exercise session lasted for thirty minutes excluding warming up on alternate days for a period of twelve weeks. The curricular programme of physical education, common for all students, warming up exercise of loosening, jogging, and stretching were given before the physical exercises. The exercises were not only relaxing but also refreshing. Singh observed, a proper warm up including general and specific warm up, is perhaps the most important means for preventing injuries. For starters, one should exercise daily or at least three times a week, dressed in comfortable clothes. The subject should warm up for five minutes before the exercises and should cool down for five minutes after the exercises.

According to Francis and William, young by ageing successfully - the befitting statement emphasises the importance of physical exercises on the health-related physical fitness of the individual. Hence this variable had attracted the researcher to study its

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166 M. Bhasin, "Looking good", *The Indian Express* (December, 1993).

impact on the health-related physical fitness. The following selected physical exercises were considered as the experimental variables.

**Forward Bends**

In this exercise, the subject stood with feet 12" apart. He bent forward and touched the floor between feet. He did not try to keep knees straight. He returned to starting position. He repeated it 10 times.

**Knee Raising**

In this exercise the subject stood erect with feet together and hands at sides. He raised left knees as high as possible and grasped knee and chin with hands, taking care to keep back straight. He lowered left foot to floor. He repeated with right leg. Each repetition was counted as one. He did it ten times with each leg.

**Side Bends**

In this exercise the subject stood with feet 12" apart arms at sides. He kept back straight and bend to left sliding left hand down, left leg as far as possible. He got back to starting position and repeated the bend to right. He bent to the left and right and counted one. He repeated it ten times.
Arms Circling

In this exercise, the subject stood with feet 12" apart, arms at sides. He made large forward circles with left arm ten times. He then made large backward circles with left arm ten times. He repeated the same exercise with right arm, forwards and backwards, ten times.

Partial Sit-Ups

In this posture the subject lay on back. He kept legs straight and arms at side. He raised head and shoulders from the floor till he could see heels. He lowered head to the floor. Each sit up was counted as one.

Chest and Leg Raising

In this exercise the subject lay face down. He kept arms along sides, with hands under thighs, so that palms were pressing against thighs. He raised his head and shoulders and lifted them as high as can from the floor. He kept the leg straight and lowered it slowly to the floor. He repeated raising head, shoulders and right leg. Each leg and chest raise was counted as one.
FORWARD BENDS

KNEE RAISING
SIDE BENDS

ARMS CIRCLING
PARTIAL SIT UPS
CHEST AND LEG RAISING
Side Leg Raise

In this exercise, the subject lay side with legs straight, lower arm over head, along the floor and top arm used for balance. He raised the upper leg about 18" to 24". He lowered to starting position. Each leg raising was counted as one. He did this exercise ten times on each side.

Leg Lifting

He lay on back, kept legs straight and together with his arms at your side palms facing down. He raised left leg till it was perpendicular to the floor. He lowered them and repeated with right leg. Both left and right lifts were counted as one. He repeated 10 times.

Run and Hop

In this exercise the subject ran in one place. While doing this he lifted his knee forward. He did not merely kick his legs backward. Hopping was done so that both feet leave floor together. He tried to hop at least four times off the floor each time. After 50 counts of running the subject did at least ten hops. The session was concluded by slow jogging exercises.
SIDE LEG RAISE

LEG LIFTING
RUN AND HOP
CONTROL GROUP

The control group attended the curricular programme in physical education without participating in the experimental programme of yoga and exercises.

STATISTICAL PROCEDURES

The groups' mean gain or loss in the criterion variables was tested for significance by analysis of co-variance, at five percent or 0.05 level of significance.