Chapter III

METHODOLOGY

In this chapter, procedures and methods applied in selection of subjects, selection of variables, selection of tests, competency of the tester, reliability of the instruments, reliability of the data, orientation to the subjects, pilot study, training programme, collection of the data, administration of the tests, experimental design and statistical procedures are presented.

Selection of Subjects

For the purpose of the study only ninety male hockey players at higher secondary level were selected at random from Tirunelveli district, Tamil Nadu, India. The age of the subjects ranged from 16 to 19 years only. The subjects were assigned at random to one of the three groups (n=30), in which group I had undergone selected physical exercises programme, group II had undergone a selected yogic exercise programme, and group III had acted as control group and they had not undergone any specific training programme. The subjects were free to withdraw their consent in case they felt any discomfort during the period of their participation. But there were no dropouts in the study.
A qualified physician examined the subjects medically and declared that they were fit for the study.

**Selection of Variables**

The training of yoga and physical exercise aim to improve all the functions of the body. Such kind of different categories of training concentrate on general fitness such as endurance, muscle power, speed, strength, agility and coordination. Yoga and Physical exercise improves general fitness, which links in the transport of carrying oxygen from the air to the working muscle.

Yoga improves the functioning of respiratory, circulatory, digestive and hormonal systems. Regular practice of yoga helps to keep our body fit, controls cholesterol level, reduces weight, normalizes blood pressure and improves heart performance. Yoga can be a powerful enhancement in regular training exercises.

Basic levels of physical fitness can be excellent maintained by indulging in a selected yogic routine. Yogic exercises deal with the vital organs of the body on which health depends.

Physical exercise is also a very good way to develop musculoskeletal fitness while building strength, flexibility and
co-ordination. Physical exercise is a good way to decrease percentage of body fat and to attain the other metabolic benefits of fitness.

Physical exercise increases red blood cells count, which contains haemoglobin that is responsible for transporting oxygen in the blood, a decrease in resting blood pressure and a decrease in blood lipids. A regular aerobic exercise program will cause a reduction in blood fats such as cholesterol and triglycerides.

Training of yoga and Physical exercise builds stamina and increases the efficiency of muscles, heart and circulatory system, Yoga and Physical exercise were selected as independent variables. Since Yoga and physical exercise training cause changes in the above said variables, the following dependent variables were selected for this study as criterion variables. The scholar reviewed the available scientific literature pertaining to motor ability components and physiological variables from various journals, research papers presented by the scholars, magazines and various books, taking into consideration the feasibility criteria, availability of instruments and the relevance of variables to the present study. The following variables were selected.
Motor Ability Components
* Cardio respiratory endurance
* Flexibility
* Agility

Physiological Variables
* Resting pulse rate
* Anaerobic power
* Respiratory rate

Selection of Tests

The present study was undertaken primarily to find out the influences of selected yogic exercises and physical exercises on selected motor ability components and physiological variables of higher secondary level male hockey players. The following tests were used to collect the relevant data on the selected dependent variables and they were presented in the table I.
### TABLE I
**TESTS SELECTION**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Criterion Variable</th>
<th>Test</th>
<th>Unit of measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cardio Respiratory Endurance</td>
<td>Cooper’s 12 minutes Run</td>
<td>In metres</td>
</tr>
<tr>
<td>2</td>
<td>Flexibility</td>
<td>Sit and Reach Test</td>
<td>In inches</td>
</tr>
<tr>
<td>3</td>
<td>Agility</td>
<td>Shuttle run</td>
<td>1/10th of a second</td>
</tr>
<tr>
<td>4</td>
<td>Resting Pulse Rate</td>
<td>Radial pulse method</td>
<td>In Numbers</td>
</tr>
<tr>
<td>5</td>
<td>Anaerobic Power</td>
<td>Margaria-Kalamen Anaerobic Power Test</td>
<td>In kgms cm sec-1</td>
</tr>
<tr>
<td>6</td>
<td>Respiratory Rate</td>
<td>Expirograph</td>
<td>In numbers</td>
</tr>
</tbody>
</table>

**Competency of the Tester**

All the measurements in this study were taken by the investigator with the assistance of coaches. To ensure that the assistants of the investigator were well versed with the technique of conducting tests, they had a number of practice sessions in the correct testing procedure. The tester’s reliability was established by test and re-test method.

**Instruments Reliability**

Stopwatches, sit and reach box, expirograph and measuring tape were used for the purpose of the study. All these instruments were available in the St. Xavier’s Polytechnic College, Seydunganallur, Tamilnadu, India. The instruments...
were purchased from reliable and standardized companies and were considered accurate enough for the purpose of the study.

**Reliability of the Data**

Reliability of the test concerning motor ability components and physiological variables refers to the consistency with which these tests measure. The reliability of these tests was established through test and retest method. For this purpose, ten subjects were selected at random and all the dependent variables selected in the present study were tested twice for the subjects by the same personnel under similar conditions. The intra class co-efficient of correlation was used to find out the reliability of the data and the results are presented in Table II.
TABLE II
INTRA CLASS CO-EFFICIENT OF CORRELATION ON
SELECTED DEPENDENT VARIABLES

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Criterion Variable</th>
<th>‘r’-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cardio Respiratory Endurance</td>
<td>0.94*</td>
</tr>
<tr>
<td>2</td>
<td>Flexibility</td>
<td>0.92*</td>
</tr>
<tr>
<td>3</td>
<td>Agility</td>
<td>0.95*</td>
</tr>
<tr>
<td>4</td>
<td>Resting Pulse Rate</td>
<td>0.93*</td>
</tr>
<tr>
<td>5</td>
<td>Anaerobic Power</td>
<td>0.95*</td>
</tr>
<tr>
<td>6</td>
<td>Respiratory Rate</td>
<td>0.96*</td>
</tr>
</tbody>
</table>

*Significant at 0.01 level of confidence.
(Table value required for significance at 0.01 level of confidence is 0.77).

Since, the obtained ‘r’ values were much higher than the required value, the data were accepted as reliable in terms of instruments, tester and the subjects.

Orientation to the Subjects

The purpose of the study was explained to the subjects briefly. The subjects were motivated to attend the training session regularly and to perform well during pre and post tests. The recordings of measurements during pre and post tests were made known to the subjects with a view to familiarize them about their performance. Before commencement of the training programmes, a week was spent to teach yoga and physical exercise (various exercises, duration, techniques etc.,) for Group I and II.


**Pilot Study**

A pilot study was conducted to assess the initial motor ability and physiological level of the subjects in order to fix the repetition, intensity and duration of the training. For this, ten boys were selected at random from the selected subjects and divided into two groups of six each, in which group I underwent physical exercise training and Group II underwent yoga training under the watchful eyes of experts and the researcher. Based on the response of the subjects in the pilot study and during the training for Group I and Group II were constructed; however, the individual differences were considered. While constructing the training programmes the basic principles of training (progression, overload and specificity) were followed.

**Training Programme**

The training programme was scheduled for one session in a day. During the training period the experimental groups underwent their respective training programme three days per week (alternate days) for twelve weeks in addition to their regular programme of the course. Group I underwent physical exercise training and group II underwent yoga training for three days per week for twelve weeks. The duration of training was 45-60min approximately, which included warming up and limbering down. Group III acted as control group, who did not
participate in any specific training on par with experimental groups. However, they performed the regular programme of the course of study. All the subjects involved in this study were carefully monitored throughout the training programme, not to get any injury.

Each training session conducted only in the morning. Prior to every training session, both the groups had a ten minutes warm-up exercise involving jogging, calisthenics and stretching. All the subjects involved in the training programs were questioned about their stature throughout the training period. None of them reported any injury. However, muscle soreness and fatigue were reported in the early weeks, which subsided later. Attendance was recorded and calculated for both the training groups separately by dividing total number of training session by the number of sessions present.

The age of the experimental groups was ranged from 16 to 19 years. Treatments were given to the students for 45 to 60min daily from Monday to Saturday for Twelve weeks continuously in the evening. The training packages of yogic exercises and physical exercises were presented.
**Yoga Practice**  
**Vira Padrasana (Fig. 3.1)**

The subjects were asked to stand erect in straight line keeping the heels and toes together slowly bring the hands side wards to above the head and joining palms together. Biceps touching the ears. Split the legs fact apart, turn their body and right leg towards $90^\circ$ angle. Bend the right leg knee, keep the right knee parallel, to the ground, stretched left leg, Don’t bend their left leg knees face, chest keep in a straight line toward the right knee and foot they were instructed to raise their heads upward and facing joining palms, they were asked to stay for 30 seconds and to return slowly to starting position.

**Navasana (Fig. 3.2)**

The subjects were asked to lie on the back at full length, keeping the legs together and stretched forward, raise the both legs 45 degree level. Slowly lift the body upward, hands should be in the shoulder level. They were asked to stay for 60 seconds. Then slowly come to starting position.
Uttitha Padmasana (Fig. 3.3)

The subjects were asked to sit erect with legs stretched forward, slowly bring the right leg and place it on the left thigh. The heel of the right foot should as much as possible touch the groin. After slowly bring the left leg and place it on the right thigh. The heel of the left foot should as much as possible touch the groin. Rest the palms on the floor beside the hips raise the trunk and balance only on the hands, hands should be straight then stretching out the arms. Slowly sit on the floor, release the legs.

Viparitakarani (Fig. 3.4)

The subjects were asked to lie on their back at full length, legs together, arms by the side, to press the elbows and palms on the floor; to raise their legs to vertical position; to lean the legs towards the chest and face; to raise the trunk from the floor; to raise the legs and trunk higher upwards; to support the body at the hips with both the hands; to raise the legs then to vertical position. Breathing was normal throughout. They were asked to stay and release for 60 seconds.

To return, the subjects were directed to lower the legs toward their face; to press the arms by the sides on the floor; to
lower the trunk slowly; and to carry the legs back to the starting position.

**Matsyasana (Fig. 3.5)**

The subjects were asked to sit erect with legs stretched forward; to place the right foot gently at the left hip-joint and the left foot similarly at the right hip-joint; to keep the heels to the naval; and to keep the spine erect. The soles of the feet were turned up.

Then, they were instructed to lie on the back with the help of their hands; to press the elbows and palms down on the floor; to bend the neck and trunk backward like an arch; to fix the crown of their head on the floor; to catch hold of the right foot with left hand and left foot with right hand; and to press the elbows down by the sides. Breathing was normal. They stayed in that position for 60 seconds.

To return, they were asked to release the hands from the feet; to lie down on the floor; to get up with the help of their hands; and to release the legs one by one.

**Halasana (Fig. 3.6)**

The subjects were instructed to lie on their back at full length, length together, arms pressing down by the sides; to raise their legs to vertical position slowly; to lean the legs
towards the stomach, chest and face as they raised their trunk from the floor; to raise the trunk then still higher; to place the toes immediately beyond the head; to keep the knees unbent; to press the arms then firmly down; to push the toes away from the head as they raised their trunk higher to the vertical position; to take the arms then beyond the head, interlock the hands; to press the palms against the crown of their head; to press the elbows on the floor by the sides and to put the feet to the farthest limit. They were asked to do the asana slowly. Breathing was normal. They remained in the attainable pose for 60 seconds. The subjects were then told to return slowly in the reverse order.

**Bhujangasana (Fig. 3.7)**

The subjects were asked to lie down on their chest and stomach at full length; to put their palms below their shoulder; to keep elbows close to the body raising their face, chest and stomach from the floor; to bend the spine backwards; and to let the lower part of the body from the naval downwards right up to the toes touch the ground. Breathing was normal. The students were told to stay for 60 seconds. They were then asked to return slowly in the reverse order.
**Shalabhasana (Fig. 3.8)**

The subjects were instructed to lie on their stomach and chest at full length; to stretch arms along the sides with clenched fists; to raise slowly both the legs together backward up without bending the knees; to put the whole weight of the body on the chest and the hands; and to raise the head also slightly. Breathing was normal throughout. The students were asked to remain for 60 seconds and to return, they were told to bring the legs down slowly.

**Dhanurasana (Fig. 3.9)**

The subjects were asked to lie on their stomach; to fold the legs backward and catch hold the ankles with respective hands; to push the heels away from the buttocks and raise the knees and things from the floor to raise their chin and chest up; to look up without bending elbows; and to bring the knees together and raise their feet higher to the maximum possible limit by pushing the heels away from the back. A good convex arch was formed resembling a bow and a string. Breathing was normal students were told to stay for 60 seconds. To return, they were asked to bend the knees, lower the entire body down to the floor and release the hands.
**Vrksasana (Fig. 3.10)**

The subjects were asked to stand erect, heels and toes together, palms pressing the thighs on both the sides; to bend the right leg at the knee and place the right heel at the root of the left thigh; to rest the foot on the left leg joining the palms and raise the arms and separate the arms, straighten the right leg, and stand again erect; to repeat the post standing on the right leg. The let heel should be at the root of the right thigh. Breathing was normal. They were asked to stay for 60 seconds and to return slowly to the reverse order.

The subjects of Experimental Group III did the above on alternative days.

**Physical Exercises**

**Push-Ups (Fig. 3.11)**

The subjects were instructed to lie down, facing the floor with hands flat on the floor about shoulder–width apart. Keeping the weight on the hands, legs stretched and wide apart toes on the floor. Keeping the back straight lower the body in a controlled manner by bending at the elbows until the chest touches the floor. The subjects then raises the body back to the starting position, the back should remain straight at all times during the exercise.
**Abdominal Curl (Fig. 3.12)**

The subjects were instructed to lie flat on the floor, facing upward position. Hips bent at 90, with hands clasped and keeps behind their head raise their shoulders off the floor, curling their chest forward. Keeping their lower back in contact with the floor lower their shoulder back to the starting position.

**Back Raise (Fig. 3.13)**

The subjects were instructed to lie down, facing the floor, Inter lock fingers and place hands behind their head, legs stretched and feet together, lift the trunk up to the waist level as far as possible off the ground as possible as down again.

**Squat Jump (Fig. 3.14)**

The subjects were asked to assume a squat position (Thighs Parallel with the ground) with feet shoulder width apart. Inter lock fingers and place hands behind their head. Explosively jump up to a maximum height. Land in the squat position and immediately report the jump as many times as possible.

**Burpees (Fig. 3.15)**

The subjects were asked to start in a standing position then drop down into a crouch to make a squat thrust with both legs, press up, then standup again and so on.
**Spirals (Fig. 3.16)**

The subjects were instructed to stand with feet fairly wide apart and hands clasped together behind neck, swivel torso round sharply backwards (and slightly upwards) to the left, then back the square position. It was done in opposite direction also.

**Wide Hurdling (Fig. 3.17)**

The subjects were told to sit on floor with legs wide apart; to twist torso to the left touching big tow with right hand. They repeated in opposite direction with right foot and left hand – “hurdling style”.

**Dorsals (Fig. 3.18)**

The subjects were instructed to lie on chest, hands clasped together behind neck, feet together, lift chest as far as off the ground as possible as down again.

**Squat Thrusts (Fig. 3.19)**

The subjects were asked to crouch down with hands on the floor about shoulder – width apart. Keeping the weight on the hands, they were told to thrust both legs back, then jump one leg back at a time, bringing the other leg vigorously forward.
Side Lunges (Fig. 3.20)

The subjects were instructed to keep the feet wide apart, arms forward and palms acing the ground. They were asked to lean slightly down to the right and half lunge sideways right (without moving feet) until left knee nearby touches ground. They repeated the exercise to the left also.

Collection of Data

Cardio respiratory endurance was assessed by cooper’s 12 minutes run test, Flexibility was assessed by sit and reach test. Agility was assessed by shuttle run, Resting pulse rate was assessed by Biomonitor, Anaerobic power was assessed by Margaria Kalamen Test and Respiratory rate was assessed by Expirograph test. Pre-test data were collected two days before the training programme and post-test data were collected two days after the last session of the training programme.

Administration of Tests

1. Cardio Respiratory Endurance (Cooper's 12 Minute Run Test)

Purpose

To measure cardio respiratory endurance.

Equipments

A 400 mts track, marked at 50mts interval was used.
**Procedure**

The groups were divided into two for testing purpose. Each subject worked with a partner and while one subject was running, the other partner checked the laps. The partner was instructed to count the number of laps which were run in the allotted time. At the blast of the starter's whistle and the runner note the marking he had just passed.

**Scoring**

The number of laps covered by the subject plus the number of 50 metre zone passed on the last lap within 12 minutes were measured, counted to record the distance in metres. *(H. Harrison Clarke, 1976)*.

**2. Flexibility (Sit and Reach Test)**

**Purpose**

The sit and reach test is designed to ensure the Flexibility of the low back and posterior thigh.

**Equipments**

Sit and reach box, Scorecard and pencil.

**Procedures**

The subjects were asked to remove their shoes to test. To begin the test, the subject sits in front of the test apparatus with feet flat against the end board. The knees should be fully
extended and the feet should be wide apart. To perform the test, the subject extends the arms forward with one hand placed on top of the other. The reach was repeated 3 consecutive trials and on the fourth trial the maximum reach was held. The distance of the maximum reach was recorded as the test score.

**Scoring**

Three trials were given and the distance of the maximum reach was recorded as the test score. (James R. Marrow, et al., 1995).

3. **Agility (Shuttle Run Test)**

**Purpose**

To measure the Agility of the subjects.

**Facilities and Equipments**

Two parallel lines 10 yards apart were drawn on the ground. A stop watch with calibration of 1/10 seconds, a whistle and two wooden blocks (2"x2"x4") were used for administering the test.

**Procedure**

The two wooden blocks were kept behind one of the lines. The subject was instructed to start from behind the other line. To start the shuttle run, a whistle was blown and the subject ran to the blocks, picked one block up, ran back to the
starting line and placed the block on the ground beyond the line. Then the subject ran back and picked the other block and ran across the starting line as fast as possible. The stop watch was started on the whistle and stopped when the subject crossed the starting line.

**Scoring**

Two trails were administered, with a rest period of five minutes in between. The better of the two times was recorded as the score in seconds next longer to the 1/10th of a seconds. (Johnson and Nelson, 1988).

**4. Resting Pulse Rate**

**Objective**

The objective was to measure the resting pulse rate of each subject per minute.

**Equipment**

Heart rate monitor of the Bominator was used to measure the resting pulse rate.

**Procedure**

The resting pulse rate of the subject was monitored through the heart rate monitor of the Biomonitor. It monitored the resting pulse rate using the method of finger
Plythesmography with the help of an opto-electronic transducer on finger.

The resting pulse rate of each subject was recorded in the morning between 5.30 and 6.30. Fifteen minutes before taking the pulse rate, the subject was asked to sit and rest himself comfortably on a chair. The investigator fixed an opto–sensor unit to the thumb of the subject using Velcro-straps. It was fixed in such a way that the light on the optosensor unit was at the distal end of the finger tips and the LDR was nearer to the finger tip. The Velcro strap on the LDR side was fastened firmly while the strap on the lamp side was loosely fastened.

The PCG/pulse ON-OFF switch of the Biomonitor was kept in the pulse position. Then the heart rate monitor was switched on by pressing the pulse push button switch. After about 30 seconds the pulse LED indicator flashed and the beeps started and stabilized. After that, the flashes and beeps occurred, rhythmically with respect to the subject’s pulse. The pulse rate per minute was indicated by the three digital meter. After about a minute the digital meter showed the subject’s pulse rate. (Author’s Guide, 1984).
5. Respiratory Rate

Objective

The objective was to measure the subject’s number of breaths per minute.

Equipment

The apparatus Expirograph was used to measure the respiratory rate of the subject.

Procedure

Respiratory rate was assessed by using the apparatus Expirograph. When the subject became familiar with the room temperature and attained normal breathing, kymograph was switched on at a speed of 60mm/minute. Then the subject was asked to have breath normally for one minute. Now the recorder pen was moving up and down with marking on the graph. It was allowed to move upto 60 millimeters. There were a number of sharp edges on the graph sheet indicating the number of breaths in one minute. This reading was recorded as the respiratory rate of the subject. The investigator stood nearby, observed and recorded the readings. (Author’s Guide, 1982).
6. Anaerobic Power

Objective

To measure the subjects Anaerobic power.

Equipment

For assessing anaerobic power, Margaria-Kalamen anaerobic power test was administered. To measure the time lapse between the third and the ninth step, a digital timer (1/100 sec) was (constructed in the Department of electrical and electronics of St. Xaviers’ Polytechnic College, Seidunganallur) used. The digital timer worked on the basis of the principle that the power supplied in India for domestic purpose was 50 cycles per second. The digital timer was connected with two switch mats. One to switch ‘on’ the timer and the other to switch ‘off’. The switch-mats were constructed in such a manner that when the subject placed his foot on the mat the switch would get operated. The sensitivity of the mat was 15 kg. It means that the switches could be operated by keeping minimum 15 kg weight on the mats.

Validity of the newly constructed timer was established by correlating with a reliable digital timer which was readily available in the research laboratory of Dr. Sivanthi Aditanaar College of Physical Education, Tiruchendur. For this, with both
watches 15 time trials were taken simultaneously at different times (ie. From 0 to 100 sec) by the same person. Coefficient of correlation was calculated for obtained data. The computed coefficient of correlation 0.989 was significant at 0.01 level. Table value required for significance at 0.01 level with (df 13 is 0.641). It showed that the digital timer is accurate enough and it could be used for research purpose.

A concrete staircase of 12 steps was used for administering, Margaria Kalamen Anerobic Power test. The width and perpendicular height of the staircase were 125 cms and 210 cms respectively. The angle of the staircase with respect to the ground was approximately 45 degrees. The average perpendicular distance of consecutive steps was 17.4 cms. The perpendicular height between third and ninth step was 105 cms.

**Procedure**

The subjects stood 6 meters in front of the staircase. At their pleasure, they ran up to the stairs as rapidly as possible, taking three at a time. (The clock started as the person stepped on the first switchmat (on the third step) and stopped as he stepped on the second (on the ninth step). The time it took to traverse the distance between stair 3 and 9 was recorded in 0.01 second. The power generated in a product of
the subject’s weight and the vertical distance (D) divided by the
time. Three trials were recorded and best score of three trials
was taken. (Barry L. Johnson and Jack K. Nelson, 1988).

**Experimental Design and Statistical Procedure**

The experimental design used in this study was
random group design involving ninety subjects who were
divided at random into three groups of thirty each. The data
collected from the three groups before and after the
experimental period were statistically examined for significant
improvement by dependent 't' test. Ninety subjects were divided
at random and assigned into two groups of thirty each. No
attempt was made to equate the groups in any manner. Hence,
to make adjustments for difference in the initial means and test
the adjusted post test means for significant differences, the
analysis of covariance (ANCOVA) was used. Whenever the
obtained F-ratio value was found to be significant for adjusted
post test mean, the Scheffe’s test was applied as post hoc test to
determine the paired mean differences, if any. In all the cases
0.05 level of significance was fixed to test the hypothesis.
Fig. 3.1. VIRA PADRASANA
Fig. 3.2. NAVASANA
Fig. 3.3. UTTITHA PADMASANA
Fig. 3.4. VIPARITAKARANI
Fig. 3.5. MATSYASANA
Fig. 3.6. HALASANA
Fig. 3.7. BHUJANGASANA
Fig. 3.8. SHALABHASANA
Fig. 3.9. DHANURASANA
Fig. 3.10. VIRKSASANA
Fig. 3.11. PUSH-UPS
Fig. 3.12. ABDOMINAL CURL
Fig. 3.13. BACK RAISE
Fig. 3.15. BURPEES
Fig. 3.16. SPIRALS
Fig. 3.17. WIDE HURDLING
Fig. 3.18. DORSALS
Fig. 3.19. SQUAT THRUSTS
Fig. 3.20. SIDE LUNGES