CHAPTER - III

METHODOLOGY
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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

To achieve the purpose of the study, forty students from K. Ramasamy Arts College and National Engineering College, Tamil Nadu, India were selected randomly as subjects. Only male students were selected as subjects for this study. The age of the subjects ranged from 18 to 25 years. The students participated in the inter collegiate tournaments without undergoing any specific and systematic training.

The selected subjects were randomly assigned to four groups of ten each such as four experimental groups. The first experimental group underwent circuit training package A (interval method) for 2 days per week, second experimental group underwent circuit training package A (interval method) for 3 days per week, third experimental group underwent circuit training package B (continuous method) for 2 days per week and fourth experimental group underwent circuit training package B (continuous method) for 3 days per week. 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**

**Dependent Variables**

When a sports or game training is introduced, it is likely to improve physical and biomotor abilities. Performance in sports depends largely on physical fitness.

Speed, power and endurance are critical to many sports. Running speed is an athletic event itself and at the same time it is important for numerous other sports. Speed is mostly considered in the form of acceleration. Speed is an important factor in almost all games, and it can make the difference in whether a performer is able to gain an advantage over his opponent.

In all sports, speed and power are important qualities. Generally it requires developing performance in sports and games. Speed is a magic work in sports. The person who can run faster, throw harder and more quickly is likely to be a better player and win more contests. Power is an essential quality in many sports, for it represents the effective combination of strength and speed. Increase in strength or speed will increase power, and when power increases, more work can be done in less time.
A Flow Chart Depicting Variables in this Study

Subjects
40 Male Inter-collegiate Hockey Players

Independent Variables
Circuit Training

Circuit Training Package A
Interval Method

Group - I
10 Subjects
Underwent
2 days per week

Circuit Training Package B
Continuous Method

Group - III
10 Subjects
Underwent
2 days per week

Group - IV
10 Subjects
Underwent
3 days per week

Group - II
10 Subjects
Underwent
3 days per week

Dependent Variables

Bio-Motor Variables

1. Speed
2. Agility
3. Power
4. Cardio Respiratory Endurance

Hockey Skill Performance Variables

1. Dribbling
2. Hitting
3. Pushing
4. Goal Shooting
Agility is an athlete's ability to accelerate, decelerate and quickly change direction while maintaining balance, body control and speed. It's very similar to balance in that it forces the athlete to regulate shifts in the body's center of gravity while constantly changing posture. Circuit-training program, in addition to developing quickness of the hands and feet, enhances agility by improving body control and full control of the feet. Greater agility also boosts speed and quickness of the hands and feet and it enables the athlete to instantly assess situations and make accurate changes in direction while moving at high speed.

Hence, speed, power, agility and cardio respiratory endurance were selected as biomotor variables for this study, which play important role in determining the skill performance of hockey.

Hockey is a game of strength, speed, and skill. It is among the most difficult to master, the costliest to equip, the fastest to watch, and the most dangerous to play. It requires a combination of power, endurance, and flexibility applied within a confined space over a cold, hard, and slippery surface.

There are many fundamental skills involved in Hockey such as dribbling, passing, scooping, flicking, pushing, hitting, stopping and goal shooting which play a major role in playing hockey. Among these skills, hitting, dribbling pushing and goal shooting only were selected as performance variables for this study.
Independent Variables

Sports training is conscious human activity. Also, it is a goal oriented activity. Therefore, it is obligatory for sports training to include in its subject matter the study of sports performance and performance capacity. Without an understanding of sports performance and performance capacity no effective and meaningful theories and methods of training are possible. As a consequence, sports training gives high weight-age to study the nature and genesis of sports performance in training and competition. Similarly, a large portion of sports training is devoted to the study of performance capacity which further comprises of physical condition (physical fitness), technique and co-ordinative abilities, tactics, physique and psychic factors.

Circuit training can be done according to any of the two methods of conditioning but continuous and interval methods are used more commonly. When continuous method is followed then all the exercises are done one after the other without break or the required number of circuits completed without any pause. In interval method, incomplete rest is given after each station or exercise. In between the rounds three to five minutes recovery is normally given (Hardayal Singh, 1991).

In the present study, two packages of circuit training were designed. Circuit training package A was followed by using the interval method and Circuit training package B was followed by using the continuous method.
The present study was undertaken primarily to assess the effect of varied circuit training packages on speed, power, cardio respiratory endurance, agility, and hockey skill performance such as dribbling, hitting, pushing and goal shooting. 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>S. No</th>
<th>Criterion Variable</th>
<th>Test</th>
<th>Unit of Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed</td>
<td>50metres Run</td>
<td>1/10th of a second</td>
</tr>
<tr>
<td>2.</td>
<td>Power</td>
<td>Bunny Hops test</td>
<td>In metres</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>Cardio Respiratory Endurance</td>
<td>12 minutes Run</td>
<td>In metres</td>
</tr>
<tr>
<td>5.</td>
<td>Dribbling</td>
<td>Stewart Pither's Hockey test</td>
<td>In numbers</td>
</tr>
<tr>
<td>6.</td>
<td>Hitting</td>
<td>Stewart Pither's Hockey test</td>
<td>In numbers</td>
</tr>
<tr>
<td>7.</td>
<td>Pushing</td>
<td>Stewart Pither's Hockey test</td>
<td>In numbers</td>
</tr>
<tr>
<td>8.</td>
<td>Goal shooting</td>
<td>Stewart Pither's Hockey test</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 physical directors of K. Ramasamy College and National Engineering College. 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 testers' reliability was established by test and re-test method.

INSTRUMENTS RELIABILITY

Stopwatches and measuring tape were used for the purpose of the study. All these instruments were available in the Department of Physical Education, Arulmigu Kumara Gurubara Swamigal arts college, Srivaikumndam, 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 Bio-motor and performance 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>S. No</th>
<th>Criterion Variable</th>
<th>'r'-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed</td>
<td>0.87*</td>
</tr>
<tr>
<td>2.</td>
<td>Power</td>
<td>0.92*</td>
</tr>
<tr>
<td>3.</td>
<td>Agility</td>
<td>0.95*</td>
</tr>
<tr>
<td>4.</td>
<td>Cardio Respiratory Endurance</td>
<td>0.86*</td>
</tr>
<tr>
<td>5.</td>
<td>Dribbling</td>
<td>0.87*</td>
</tr>
<tr>
<td>6.</td>
<td>Hitting</td>
<td>0.89*</td>
</tr>
<tr>
<td>7.</td>
<td>Pushing</td>
<td>0.92*</td>
</tr>
<tr>
<td>8.</td>
<td>Goal Shooting</td>
<td>0.88*</td>
</tr>
</tbody>
</table>

*Significant at 0.01 level of confidence.

(Table value required for significance at .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 circuit training (various exercises, duration, techniques etc.,) for Group I, II, III and IV.

PILOT STUDY

A pilot study was conducted to assess the initial motor fitness level and skill performance of the subjects in order to fix the repetition, intensity and duration of the circuit training. For this, twelve boys were selected at random from the selected subjects and divided into two groups of six each, in which group I underwent circuit training package A and Group II underwent circuit training package B under the watchful eyes of experts and the researcher. Based on the response of the subjects in the pilot study and during the training, the training schedule (presented in appendices) for Group I, II, III and Group IV were constructed; however, the individual differences were considered. While constructing the training programmes, the basic principles of training (progression, over load and specificity) were followed.
TRAINING PROGRAMME

During the training period, two varied packages of circuit training as package A for two days per week and three days per week (interval Method) and circuit training package B for two days per week and three days per week (Continuous Method) were given to the subjects. The groups followed the training schedule mentioned in the appendix with unaccountable individual differences. Everyday the workout lasted for one and half an hour approximately. The subjects underwent their respective programmes under strict supervision. Prior to every training session, the subjects underwent a 10 minute warm-up exercise, which included jogging, stretching, striding and loosening exercise.

All the subjects involved in the training programmes were questioned about their stature throughout the training period. None of them reported any injuries. However, muscular soreness was reported in the early weeks, but it subsided later.

COLLECTION OF DATA

The data on speed, power, agility and cardio respiratory endurance, were collected by administering 50 metres run, bunny hops, shuttle run and 12 minutes run tests respectively. The data on hockey skill performance variables like Dribbling, Hitting, Pushing and Goal shooting were collected by administering Stewart Pither's hockey skill tests. Pre test data were collected two days before the training
programme and post test data were collected two days after the final training session. In both the cases, the data were collected in two consecutive days. On the first day, 50 metre run (speed) shuttle run (agility), bunny hops (power) and 12 minute run (cardio respiratory endurance) tests were conducted whereas the Steward Pither's hockey skill tests were conducted on the second day.

ADMINISTRATION OF TESTS

50 METRES RUN

Purpose

To assess speed

Equipments used

Measuring tape, starting clapper and stopwatch

Procedure

The standing start method was adopted for this purpose. The time elapsed from the 'clap' to the runner crossing the finish line was taken as the test score. The fractions were rounded to the next largest one tenth of a second. For this purpose, a digital electronic watch was used.

Scoring

Two trials were conducted with sufficient rest in between and the better of the two trials were recorded (Baumgartner and Jackson, 1991).
BUNNY HOPS TEST

Purpose

To measure the elastic power

Equipment

Measuring tape

Procedure

The procedure prescribed by (Loren Seagrave Loren Seagrave, 1996) was employed to measure the elastic power. The subject took position on the take off line. When he completed the five stride bounding (Bunny Hops), the performance was measured from the nearest break to the takeoff line. Three trials were given. The five stride bounding test (Bunny hops) for distance will provide the best assessment of an individual’s power capacity.

Scoring

The best of the three trials was recorded in metres.
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" x 2" x 4") 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 (Baumgartner and Jackson, 1991).
COOPER'S 12 MINUTE RUN TEST

Purpose

To measure cardio respiratory endurance.

Equipmnets

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

Procedure

This test was conducted in the standard 400 meter track.

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. All the subjects were given instruction regarding the procedure and asked to run the maximum distance in twelve minutes. On the command 'go', all the subjects started running. The partner assigned to each subjects kept track of their progress and instructed them about the time left and verbally motivated them to continue. At the end of twelve minutes, the distance covered by each individual is noted in metres.

Scoring

The score is the distance in metres covered in twelve minutes (Bosco, 1983).
The skill testing for Hockey performance had been designed by Stewart Pithers (2002). The purpose of these tests were to help young Hockey players improve their skills and prepare them for their future in the game. This was done by isolating and testing the technical and physical ability of players in terms of accuracy and speed, and by providing them with the challenge and motivation to practice and improve. These tests also provide young players with the opportunity to check their progress, by comparing their performance against other players. Hence, these tests were used to collect the pre and post test data on Hockey skill performance variables for the present study.

Dribbling, hitting, pushing and goal shooting are the major skills of the game of hockey which have been the test skills chosen by Stewart Pither. Hence, face validity was established by the investigator.

STEWARD PITHER'S Dribbling Test

Purpose

To measure the dribbling skill performance of hockey.

Equipments

Cones, hockey sticks, hockey balls and stopwatch.
Floor Marking

Cones 5 metres apart

Procedure

On the command 'start' the subject start dribbling the ball through the starting gate and dribble to the left of the central cone then to the right and through the second cone on the circuit. The subjects were directed to use the open stick only at all times.

Scoring

Two points were awarded, for each gate successfully and correctly negotiated. The highest score possible from starting to finishing (16 points) was recorded.

STEWART PITHER'S HITTING TEST

Purpose

To measure the hitting skill performance of hockey.

Equipments

Hockey sticks, hockey balls and cones.
Floor Marking

<table>
<thead>
<tr>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 1 2</td>
</tr>
</tbody>
</table>

60 Yards

5 m

Procedure

The subjects were asked to hit the ball across the width of the pitch at the targets, kept as shown in the diagram. Two options were given to the subjects in hitting the ball. One is to put the ball on the side line and hit the stationary ball and the second is to move from the spot and hit the rolling ball.

Scoring

The highest score possible from six balls (24 points) was recorded. Points were allocated as in the diagram with one point being scored if the ball travels through the furthest cones. Two points were scored if the ball passes through the cones close to the middle cones and 4 points were scored for pushing the ball straight.
STEWART PITHER’s PUSHING TEST

Purpose

To measure the pushing ability in hockey

Equipments

Hockey sticks, hockey balls, cones and floor marking.

Floor Marking

![Diagram showing floor marking with points allocated for different areas.]

Points

1  2  4  2  1

Procedure

The aim of this test was for the subjects to direct the ball at the target, dragging, slapping or pushing the ball. The subjects were not permitted to run with the ball before pushing. A maximum of six balls were used.

Scoring

The highest score possible from six balls (24 points) was recorded as the test score. Points were allocated as in the diagram. One
point being scored if the ball travels through the furthest cones and two points were scored if the ball passes through the cones close to the middle cones, and 4 points are scored for pushing the ball straight.

**STEWARD PITHER'S GOAL SHOOTING TEST**

**Purpose**

To measure the hockey goal shooting ability

**Equipments**

Hockey sticks, hockey balls,

**Floor Marking**

The subject was asked to start by rolling the ball in to the circle to the forehand (open stick) side and hitting the ball at the goal. The next ball was pushed to the left and hit with the reverse stick side
only, then the next ball to the right and so on. Six balls were rolled in which 3 balls were rolled from right side and 3 balls were rolled from left alternatively.

**Scoring**

If the ball hit the back board 1 point was awarded, two points were awarded if the ball hit the middle third, three points were awarded if the ball hit the top third and no point was given if the ball missed to enter the goal cage. In order to see the difference between the middle third and top third of the goal, a coloured rope was placed in the goal net. Maximum score after six shots (18 points) was recorded as test scores.

**EXPERIMENTAL DESIGN AND STATISTICAL PROCEDURE**

The design selected for this study was 2x2 factorial designs. The investigator selected 40 Hockey players as subjects on random basis from K. Ramasamy College of Arts and Science and National Engineering College, Kovilpatti, TamilNadu, India. They were divided in to four equal groups and each group consisted of ten subjects. On random basis, they were designated as group I, group II, group III and group IV.

The collected data were analysed by using dependent 't' test and two way (2x2) analysis of covariance (ANCOVA). Whenever F ratio was to be found significant for adjusted post test scheffe's test was used as a post hoc test. In all the cases 0.05 level of significance was fixed.