CHAPTER III

METHODOLOGY

Hockey is a team game which demands high output of individuals in physical and technical efficiency. The wise use of the mastered skills at the required moment glitters the individual performance. When the individual talents combine each other the overall performance of the team will creatively improve and the players playing in the different field positions will function like a well-oiled machine.

In this chapter, the procedure adopted for the selection of subjects, selection of variables, reliability of data, instrument reliability, tester’s competency, subject reliability, collection of data and statistical techniques employed for analysing the data, the procedure for the construction of norms were described in this chapter.

3.1. SELECTION OF SUBJECTS

This study was designed to construct norms for the sports authority of India sports training centre hockey boys and the state sports hostel hockey boys in South India.

To achieve this purpose the students of STC, SSH and the students who attended the sports authority of India sports training centre and state sports hostel selection trials for the year 2000 - 2001 and 2001 - 2002 to get admission in the above said hostels, were selected as subjects for this study.

The age group of the subjects was between 16 and 19 years. 16 year subjects, 17 year subjects, 18 year subjects and 19 year subjects. Each age group consist of five hundred subjects. The subjects were chosen from the following sports training centres.
3.2. SELECTION OF VARIABLES

In sports authority of India sports training centre and state sports hostels, admissions of inmates are being made for hockey discipline on different age groups, on the basis of some physical fitness tests and game skill tests. So far no uniform norm is being followed. Hence it has become necessary to construct a general uniform norm for the sports authority of India sports training centre and state sports hostel on the physical and performance variables as the norms are to be followed during the admission of students every year.

The research scholar in this study selected certain physical and performance variables, which were considered as the essential components for the game of hockey. Taking into consideration of the importance of the variables for selecting the students during admission in centres, the following variables were selected for the norm construction. The variables are as follows

3.2.1. Physical Variables

(i) Speed  
(ii) Agility  
(iii) Power  
(iv) Endurance and  
(v) Abdominal Strength
3.2.1.1. Speed

Speed is the ability to move the entire body rapidly from one place to another. Speed is an essential physical ingredient for the successful performance in many sports activities. Hockey is a game which involves running with and without ball in various direction. Speedy players are always asset to every team in match winning performance. Speed in hockey refers often the one’s ability to accelerate over a short distance. Penetration in to the opponent territory with and without the ball can be achieved more easily with speed and an attack can be launched by speedy runs. It also helps the players to fall back and to defend the goal. So, speed is applicable to all the positions and it appears to be one of the most important factor in modern hockey. Hence it is relevant to analyse the speed of the subjects.

Considering the importance of speed, the investigator selected speed as one of the physical variable for this study.

3.2.1.2. Agility

Agility is the ability to change the direction of the body and its part, rapidly and accurately. Fast starts and stops and quick changes in direction are fundamental foot performance in all court games such as hockey, handball, soccer and so on.

In any physical activity or in a game situation, the controlled ability to stop, to start, and to change direction rapidly and more quickly, agility is very essential factor, and this quality decides one’s performance level and the speed of acquiring any skill. Hockey players must have the more agility while playing in different field positions, to dodge, to run and receive the ball, to tackle and to defend the ball from the attacker.

Tacking into consideration of the above importance, the agility was selected as one of the physical variable for this study.
3.2.1.3. Power

Power is an important component of physical fitness. Most of the anaerobic activities are related to the leg power. Greater the leg power, better the anaerobic performance in the field of sports and games. Leg power is associated with muscular strength, which can be developed through maximal load of weight training.

Power is an important factor for a hockey player. Since the game of hockey requires more running, player needs power in his legs. Players playing in the artificial surfaces still requires more power compare to other playing surfaces. Now a days all major tournament and competitions are to be conducted only in the artificial surfaces.

The hockey players must have sufficient power to execute all the skills at any time in any situations. Modern hockey requires highly speedy player with sufficient power. To score goal, players must have very good power so that, they can send the ball into the opponent;s goal with more speed. For a long clearance to take free hit, or 16 yard hit and hit in. Players should have optimum power to achieve their ultimate aim. Now a days many match results depending mostly on the conversion of penalty corners. Most of the European players are converting the penalty corners easily by using their power.

Hence power is playing major role for hockey players to achieve high level performance. Taking into consideration of the above importance, the power was selected as one of the physical variable for this study.

3.2.1.4. Endurance

Endurance is the capacity to work under strain for a long period of time without undue fatigue. It is the ability to persist in strenuous activity. It is one of
the basic components of general athletic ability and it is usually considered as one of the important components of physical fitness. Endurance is hockey serve times inter pretend as an aerobic capacity. A hockey player is required to have endurance throughout the playing time of the game to his technical and tactical knowledge as well as his physical capabilities in performing movements effectively without any perceptible decline in performance. Hockey is one among the activities in which endurance is of prime importance. Both muscular and cardiovascular endurance play a vital role in successful performance in the game of hockey. Hence the game of hockey requires high level of endurance. Taking into consideration of the above importance endurance was selected as one of the physical variable for this study.

3.2.1.5. Abdominal Strength

Abdominal strength is the force that an abdominal muscle or muscle group can exert against a resistance in one maximal effort. The abdominal strength helps the diaphragm to contract for the better respiration. When the abdominal strength is improved all the connected systems are also being improved. Abdominal strength is related to the aerobic activities. Most of the games and sports activities, are aerobic type of activities in the field of physical education and sports.

A hockey player needs a good abdominal strength, because most of the time he needs to bend forward to execute all the basic skills accurately in the game. For example, while hitting the ball, while pushing the ball, while scooping the ball, while receiving the ball, he bends forward his upper body and performs these skills accurately. Taking this into consideration, the abdominal strength was selected as one of the physical variables for norm construction.
3.2.2. Performance Variables

(i) Dribbling
(ii) Hitting
(iii) Pushing
(iv) Scooping
(v) Trapping

3.2.2.1. Dribbling

Dribbling is the ability to propel the ball from one place to another place without losing the control. In the game of hockey, one versus one situation occurs frequently and to overcome this, controlled dribbling is very essential. Dribbling is highly helpful in the following ways:

i. To advance to the target through the open space.
ii. When there is no other teammate to receive the pass.
iii. To maintain the ball possession and to hold the time.
iv. To beat the opponents mainly in one versus one situations.

Dribbling is one of the most important skills in the game of hockey. It is an art which will draw the attention of the spectators. During the game when the defender is in dangerous zone, completely covered by the opponents, the defender has to clear the ball in that situation, dribbling is so useful. It helps the forward at the time of scoring.

During the game situation when there is no possibility of scoring or passing the ball to the team players, dribbling helps the player to find the appropriate opportunity for the next pass. Dribbling is an important aspect of individual tactics. The great dribblers have been creative artists.

Taking into consideration of the above importance of dribbling the investigator selected dribbling as one of the performance variable for this study.
3.2.2.2. Hitting

Hitting is one of the most important fundamental skills in hockey. The hitting plays a vital role in the modern hockey. The hit in, free hit, 16 yards free hit, corner and the penalty corner are mostly taken by the hockey players by using hitting. To score the goal, to clear the ball for a longer distance from the dangerous zone, for a long pass, or diagonal pass and cross pass hitting is the prime skill to execute all these tactics. It is recognised that among the fundamentals the ability to hit the ball is needed for high level of performance. The game of hockey is nowadays has become more attractive.

Because of the above qualities hitting was chosen as one of the performance variable for this study.

3.2.2.3. Pushing

In team games like - hockey various passes are used as important means for attack and defense. These passes are depending on the perfection of the skill i.e. push. Like any other skill, push is also very important skill in the game of hockey. Pushing is one of the good skills many players use in the game. Players use this skill when they want to pass the ball to his own team or to score a goal. It is easy for the receiver to collect the ball and get possession of the ball whenever his teammate use the push. It is good for short passing game. It is good in action for clearance, in dangerous zone. For forwards, push is more accurate and is more advantage in penalty corner and in penalty stroke. Considering the above facts, pushing was selected as one of the performance variable for this study.

3.2.2.4. Scooping

Like any other skill, scooping is also one of the very important skills in the game of hockey. Player uses this skill, when he can not able to play ground level passes. Player uses this skill, when he wants to send the ball in the air for
They use this stroke for the clearance from the dangerous zone, and also when the team is under pressure. Forwards make use of the scoop to good advantage to score goals, while the goal keeper is advances. This skill is also used to a great advantage while taking the penalty stroke. Players also use this skill to pass the ball to his teammate through over head pass.

Considering the above facts, scooping was selected as one of the performance variable for this study.

### 3.2.2.5. Trapping

This is one of the most important basic skills in the game of hockey. With this skill, a player gets full control over the ball and takes an advantage to execute the next move. Through trapping, not only the player gets the possession of the ball, but also plans for the attack. The perfection of trapping not only shows the individual superiority of executing the skill, but also to the successful team tactics. It also helps to defend from the attack to stop goal scoring by the opponents, and receiving passes from own teammate. Considering the above facts trapping was selected as one of the performance variable for this study.

### 3.2.3. Total Performance

Modern hockey demands a player to be totally fit to play in all the playing positions. Due to the fast movement of the ball on the artificial surface and other playing surfaces from defense to attack and vice versa, a player has to act as a defender as well as a attacker and to cope up with the demands of playing conditions and strategies of the team. In this regard a player has to sharpen his skills in defense and attack, which would be a for bearing advantage for the team. The total performance in hockey mainly depends upon the proficiency of physical and performance variables. Considering the above facts, the investigator selected total performance as one of the variable for this study.
3.3. RELIABILITY OF DATA

The reliability of the data was ensured by establishing the instrument reliability, tester's competency, reliability of the tests and the subjects reliability.

3.4. RELIABILITY OF RATING OF GENERAL PLAYING ABILITY

A panel of three experts in the game of hockey consisting of two hockey coaches and one qualified national umpire acted as judges and rated the general playing ability of the subjects.

In as much as three experts assessed the general playing ability of the subjects. The mean score of the experts was considered reliable and true indicator of playing ability.

Further to find out significant difference between the scores awarded by the three experts the scores given by them were compared by applying 't' ratio and were presented in Table I. Judges were oriented on guidelines to assess the general playing ability so that their assessment might not differ very much.

**TABLE I**

<table>
<thead>
<tr>
<th>Rater 1 Mean</th>
<th>Rater 2 Mean</th>
<th>Rater 3 Mean</th>
<th>Mean difference</th>
<th>σ DM</th>
<th>t ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.75</td>
<td>5.2</td>
<td>5.49</td>
<td>R1 x R2 = 0.55</td>
<td>1.57</td>
<td>0.35</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R1 x R3 = 0.26</td>
<td></td>
<td>0.139</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>R2 x R3 = 0.29</td>
<td></td>
<td>0.17</td>
</tr>
</tbody>
</table>

Tabulated $t = 0.44$ at 0.05 level with $df = 8$. 
The value of the 't' ratio was insignificant which shows that the assessment by the three experts did not differ. They were consistent and their ratings were not biased. Hence these ratings were considered as reliable.

3.5. INSTRUMENT RELIABILITY

The stop watches and the measuring tapes used for tests were considered reliable as they were procured from reputed firms and were on use for research purpose. Further these instruments had been calibrated in standard units.

To determine the reliability of instruments the measurements on each of the variable were recorded five times under similar conditions using the same instrument and scores obtained were the same and also the scores were compared with other scores taken from the instruments procured from other reputed firms. Thus they were considered reliable and precise for the purpose of this study.

3.6. TESTER'S COMPETENCY

The tester competency was assessed together with the reliability of the test. To determine the reliability of the test, the performance of 10 subjects selected at random on each of the chosen variables, were recorded, twice under similar conditions by the scholar. This was done by the test and retest method on two consecutive days. The scores thus obtained for each variable by test and retest method were correlated using Pearson's product moment correlation method as suggested by Garrett.\(^1\) The co-efficient of correlation were prescribed in table II.

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### TABLE II

**CO-EFFICIENT OF CORRELATION OF TEST AND RETEST SCORES**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Variable</th>
<th>Co-efficient of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Speed</td>
<td>0.98</td>
</tr>
<tr>
<td>2.</td>
<td>Agility</td>
<td>0.97</td>
</tr>
<tr>
<td>3.</td>
<td>Power</td>
<td>0.98</td>
</tr>
<tr>
<td>4.</td>
<td>Endurance</td>
<td>0.97</td>
</tr>
<tr>
<td>5.</td>
<td>Abdominal Strength / B.K.S.</td>
<td>0.96</td>
</tr>
<tr>
<td>6.</td>
<td>Dribbling</td>
<td>0.93</td>
</tr>
<tr>
<td>7.</td>
<td>Hitting</td>
<td>0.96</td>
</tr>
<tr>
<td>8.</td>
<td>Pushing</td>
<td>0.94</td>
</tr>
<tr>
<td>9.</td>
<td>Scooping</td>
<td>0.95</td>
</tr>
<tr>
<td>10.</td>
<td>Trapping</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Tabulated $r = 0.835$ at 0.05 level of confidence

df = 8

Since the obtained 'r's were more than the table value, the reliability of the tests were considered reliable at 0.05 level of confidence.

#### 3.7. SUBJECTS RELIABILITY

The test and retest co-efficients of correlation also indicated subject reliability as the same subjects were used under similar conditions by the same tester. No motivational techniques were used at the time of testing.

#### 3.8. ORIENTATION OF SUBJECTS

In order to get full co-operation from the subjects the investigator very clearly explained about the purpose of the study.
Prior to the administration of test, it was very clearly explained to the subjects in detail about the procedure to be followed in the test. This explanation helped very much to ensure the effectiveness co-operation from the subjects to obtain the reliable data. Model performance by some of the subjects were also done to make the subjects clearly understand the tests related to the study.

3.9. COLLECTION OF DATA

The administration of test and method of collection of data are explained here.

3.9.1. Speed

Test

30 mts (Standing Start)

Purpose

The purpose of the test was to measure the speed of an individual.

Equipments

Measuring tape, stopwatch, flags whistle and lime powder.

Description

The subject took a position behind the starting line. The starter used the command "ready" and "Go". The latter was accompanied by a downward sweep of the arm as a signal to the timer. The subjects ran across the finishing line.
Scoring

The score was the elapsed time to the nearest one tenth of the seconds between the starting signal and the instant the subject crossed the finish line. The least time of the two trials was recorded as the individual score.²

SPEED

(30 meter Run)
3.9.2. Agility Test

Shuttle Run (6 x 10 mts)

Purpose

The purpose of the test was to measure the agility of the subjects.

 Equipments

Measuring tape, stop watches, flags, whistle and lime powder.

Description

Two parallel lines were marked at the distance of 10mt. The subject stood behind the starting line. On signal, he ran to the other line and touched with hand, returned to starting line. And again he touched with the hand and turns to the another line and he repeated it for a total of 6 times. Two trials were given and the best trial was taken in to account.

Scoring

The score was the elapsed time recorded in seconds and one tenths of seconds for the better of 2 trials.\(^3\)

AGILITY

(6 x 10 meter Shuttle Run)
3.9.3. Power Test

Standing Broad Jump

Purpose

The purpose of the test was to find out the explosive power of the individuals.

Equipments

measuring tape and lime powder.

Description

The subject stood behind a take off line with his feet several inches apart. Before jumping, the subject dips at the knees and swung the arms backward. The subject then jumped forward by simultaneously extending the knees and swung the arms forward. Three trials were given and the best one was taken into account. Measurement was from the closest heel mark to the take off line.

Scoring

The score was the distance between the take off line and the nearest point where any part of the subject body touched the floor. The best of the three trials was recorded\(^4\) as the score of an individuals.

POWER

(Standing Broad Jump)
3.9.4. Endurance Test

2.4 kms Run.

Purpose

The purpose of this test was to find out the cardio vascular endurance of the subjects.

Equipments

Measuring tape, stop watches, whistle and lime powder.

Description

The subject took a position behind the starting line in a 400 mts standard track. The starter used the command “ready” and “Go”. The latter was accompanied by a downward sweep of the arm as a signal to the timer. The subject has to complete the distance of 2.4 km (6 laps) in as limited time as possible, by crossing the finish line.

Scoring

The score was the elapsed time in minutes and seconds between the starting signal and the subject crossed the finish line.5

ENDURANCE

(2.4 km Run)
3.9.5. Abdominal Strength Test

Sit-ups (Bend Knee in 1 minute).

Purpose

To measure abdominal strength.

Facilities and Equipments

Mats and stop watch.

Procedure

The student lies flat on the back with knees bent and feet on the floor with the heels no more than 1 foot from the buttocks. The knees angle should be no less than 90 degrees. The fingers are inter locked and placed behind the neck with the elbows touching the floor. The feet are held securely by a partner. The students then curls up to a sitting position and touches the elbows to the knees. This exercise is repeated as many times as possible in the time requirement.

Instructions

Fingers must remain inter locked and in contact with the back of neck at all times. He curl up from the starting position, but he may not push off the floor with an elbow. When he returns to the starting position, his elbows must be flat on the floor or mat.
ABDOMINAL STRENGTH

(Bend Knee Sit-ups)
3.10. DESCRIPTION OF PERFORMANCE VARIABLES TEST

3.10.1. “W” Form Dribbling

Objective

The purpose of “W” form dribbling was to measure the subject ball control ability.

Equipments

Hockey balls, hockey sticks, measuring tape, whistle, 5 flag posts, stop watch and lime powder.

Marking

Three flag posts A, C and E are placed in a straight line at a distance of 5 mts from one another. An area of 5 mt is drawn from point A and C, and C and E and flag posts are placed at the intersecting points namely B and D.

Description

On the signal “Go” the subject moved with the ball dribbling from flag A and then to B and then to C and then to D and then to E and returned back to the starting line by covering flag post D, C, B and A respectively. The subject covered 40 mts totally.

Scoring

The watch was operated on the signal “Go” and was stopped when the subject returned back to the starting line. Two trials were given. The least time taken was recorded in one tenth of a second as the score of the subject.\footnote{Battery of Tests, “Scientific Journal”, Sports Authority of India, New Delhi, p.70.}
"W" FORM DRIBBLING
3.10.2. Hitting

Accuracy Test

Objective

The purpose of hitting was to find out the subject accuracy ability in hitting.

Equipments

Hockey balls, hockey stick, 2 flag posts, goal post, lime powder.

Marking

A shooting circle is marked with goal post. On either side of the goal post that flag posts are fixed inside the goal post at one meter from each goal post.

Description

10 balls are placed at the top of the shooting circle (16 yards). The subject takes the hit at stationary ball one by one alternatively to the corners of the goals marked on the left side and on the right side.

Scoring

The total number of goals scored was recorded as the score of the subject.\(^8\)

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\(^8\) *Ibid.*, p.66
HITTING
3.10.3. Pushing

Purpose

The purpose of the test was to find out the pushing accuracy, of the subject.

Equipments

Hockey balls, hockey stick, 8 flag post, lime powder.

Marking

Five yards from the centre of the field, a rectangular is marked with 3 yards side. To the sides of the rectangular a goal post of 2 yards width is placed at 20 yards away from the centre of the rectangular parallel towards the side lines, and to the goal line. Totally three goal posts are fixed.

Description

Ten balls are placed on the centre line. On the signal, the subject moves with the ball and enters the rectangular. As soon as he entered the rectangular, pushed the ball towards left of the goal post, and returned to centre line to collect the ball. And again moved to the rectangular area, and pushed the ball to centre goal post, and next to the right goal post. Like this he continued to complete the ten attempts, one by one.

Scoring

The number of goals with the accurate pushes counted and recorded as the scores of the subjects.9

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9 Ibid., p.69.
PUSHING
3.10.4. Scooping

Purpose

The purpose of the test is to find out the scooping ability of the subject.

Equipments

Hockey sticks, hockey balls, 10 cones, whistle measuring tape and lime powder.

Marking

Short marking were done on the hockey field from back line in meters with the help of cones.

Description

Five balls are placed on the starting line. On the signal, the subject scoops the ball and sends the ball in the air to cover maximum distance. Totally he completes five attempts.

Scoring

The longest distance covered in scooping by the subject out of 5 attempts, was recorded as his scores.\textsuperscript{10}

\textsuperscript{10} Ibid., p. 71.
SCOOPING
3.10.5. Trapping

Objective

The purpose of trapping test to measure the subjects trapping ability.

Equipments

Hockey sticks, hockey balls, measuring tape and lime powder.

Description

The subjects were asked to stand on the goal line in the goal post, and were asked to stop the ball with the stick using any type of stopping technique. Other subjects should stand on the shooting circle (16 yards), with 10 balls and were asked to hit the ball in to the goal post one by one.

Scoring

Three experts assessed the trapping ability of the subjects using five point rating scale with subjective rating. The modern score of the experts was the subject score.

Trapping

The trapping ability of the player was determined individually by subjective rating in the following areas namely. Nature of trapping, position of stick, perfection of the trapping, player position while receiving, position of the ball. This was done on a 5 point rating scale (Appendix - III) for each of the above factors by three experts. The rating scale had five categories with each category scored from a minimum of one point to a maximum of five points. The total score was the sum of the scores of all the five categories. The total scores were divided by 5 to get each experts rater's individual score on the rating scale. The average score of all the three experts was the score of each subject in trapping ability.
TRAPPING
3.11. TOTAL PERFORMANCE

The total performance was the general playing ability. The playing ability of the player was determined individually by subjective rating in the following areas namely dribbling, hitting, pushing, scooping, trapping, positional play attack, defense, tactics and general behaviour like respecting rules and officials etcetera. This was done on a 10 point rating scale (Appendix - IV) for each of the above factors by three experts. The rating scale had ten categories with each category scored from a minimum of one point to a maximum of ten points. The total score was the sum of the scores of all the ten categories. The total score divided by 10 to get each rater's individual score of three experts was the measure of total performance for each subject. The purpose for dividing the total score into ten categories was to make the experts rating of hockey playing ability reliable and accurate.

3.12. STATISTICAL TECHNIQUES EMPLOYED

To construct the norm for the selected variables, the following statistical procedure was followed. After collecting the raw scores, mean and standard deviation were computed by the formula suggested by Donald Mathews.

\[
\text{Mean} = \frac{\sum fd}{N} = AM + \frac{i}{N}
\]

Where
- \( M \) = Mean
- AM = Assumed Mean
- \( \Sigma \) = Summation
- \( f \) = Frequency
- \( d \) = deviation
- \( i \) = Size of the class interval
- \( N \) = Number of scores
Standard Deviation = \( i \sqrt{\frac{(\Sigma fd^2 / N)}{(\Sigma fd / N)^2}} \)

After calculating the mean and standard deviation (s), the scores were converted into hull scale. The hull scale was computed by using the following formula

\[ \sigma \]

Hull scale = \( 3.5 \times \frac{\sigma}{50} \)

Where \( \sigma \) = standard deviation multiply the standard deviation by 3.5 and divide by 50 and serially add and subtract from the mean.

Hull scale is made up to 3.5 standard deviation on either side of the mean.

Consecutively add the hull scale value to the mean for determining points 51 to 100 on the 0 to 100 scale and consecutively subtract the hull scale value from the mean for determining assigned value from 49 to 0 point. Thus 0 to 100 norm scale was compiled.\(^1\)