

Chapter III

METHODOLOGY

In this chapter the methodology adopted for the selection of subjects, selection of variables, justification of the variables selected, selection of tests, reliability of tests, orientation of testers, orientation of subjects, design of the study, collection of data, training interventions, administration of tests and statistical techniques have been elucidated.

3.1 Selection of Subjects

A total of thirty (30) male inter collegiate male handball players were selected from Alpha college of Engineering, Thirumazhisai, Chennai. These subjects were randomly distributed into three groups namely moderate intensity game specific circuit training (MIGSCTG: n = 10), high intensity game specific circuit training group (HIGSCTG: n = 10) and control group (CG: n = 10). The mean age of the selected players was 20.85 ± 1.67 . The selected players had 3.8 ± 3.1 years of playing experience and regularly participate in training prior to the commencement of this study. All subjects were subjected to medical examination by a general medical practitioner before participation in the study to ensure that there was of sufficient standard to be able to take part in fitness testing and training. A written consent was obtained prior to initial data collection, which is given in Appendix A. This clearly explains the nature of the study, the training program for the training group and variables in which they will be tested.

3.2 Selection of Variables

The investigator referred to various relevant literatures, consulted with experienced experts in sports to identify ideal variables. In addition to this by using the investigator's personal knowledge and professional experience the following most appropriate variables were selected in the present investigation.

3.2.1 Dependent Variables

The dependent variables selected in this study were physical variables – speed, agility, power, arm strength, abdominal strength endurance; physiological variables – aerobic capacity, anaerobic capacity, fatigue index, resting heart rate; skill variables – dribble test and jump shot throw for accuracy.

3.2.2 Independent variables

The independent variable selected in the present study was moderate and high intensity of game specific circuit training administered three sessions per week for eight weeks and control group remained passive.

3.3 Justification of the Variables Selected

Competitive team handball is an intermittent high intensity body contact team sport that requires a combination of aerobic and anaerobic fitness to perform a sequence of well-coordinated activities (Chelly *et al.*,2011). Performance in a variety of intermittent team sports has been linked to the participant's speed, power, strength, agility, and a sustained ability to repeat short high intensity bursts of activity throughout a match, rather than the capacity to sustain a steady submaximal work rate (Chelly *et al.*, 2011). Team handball places a heavy emphasis on sprinting, running, jumping, and

throwing (Chelly *et al.*, 2011). The capability to perform skills is a prominent feature of human exercise (Schmidt & Wrisberg, 2000). So keeping these ideas in mind above mentioned variables are selected.

Though, several training interventions employed by coaches to train and condition handball players, the effectiveness of moderate and high intensity game specific circuits training on physical, physiological and skill variables of handball players are yet to be evaluated. Hence it was considered as independent variables of the study.

3.4 Selection of Tests

In the current exploration, the ultimate and consistent tests were used to assess the selected physical, physiological and skill variables as presented in Table I.

Table I

Tests used for criterion variables

SL .No	Variables	Methods / Tests /Equipment
I	Physical	
1	Speed	30 m sprint
2	Agility	T – test
3	Power	Vertical jump test
4	Arm strength	Handball throw for distance
5	Abdominal strength endurance	Sit ups
II	Physiological	
1	Aerobic capacity	Coopers 12 minutes run and walk test
2	Anaerobic capacity	Running based anaerobic sprint test
3	Fatigue index	(RAST)
4	Resting heart rate	Omron Heart rate Monitor
III	Skills	
1	Dribble test	
2	Jump shot throw for accuracy	Brian Bergemann (2008)

3.5 Reliability of Tests

The tester's competency for test administration was evolved with the reliability of tests. To establish the reliability of tests, test and retest method was followed. For this purpose, 10 handball players as subjects were selected at random. All the criterion variables selected in the present investigation were tested twice for same subjects under similar condition. Pearson product moment correlation was computed separately for each criterion variable. The obtained coefficient of correlation is given in Table II.

Table II

Reliability coefficients for test and retest on criterion variables

SL .No	Variables	Coefficient of Correlation	Sig
I	Physical		<i>p</i> < 0.05
1	Speed	0.71*	
2	Agility	0.67*	
3	Power	0.95*	
4	Arm strength	0.68*	
5	Abdominal strength endurance	0.67*	
II	Physiological		
1	Aerobic capacity	0.71*	
2	Anaerobic capacity	0.67*	
3	Fatigue index	0.95*	
4	Resting heart rate	0.68*	
III	Skills		
1	Dribble test	0.74*	
2	Jump shot throw for accuracy	0.79*	

The entire criterion variables were acceptable at 0.05 level and this reveals that all the test items are reliable. Hence, these tests were used in this study.

3.6 Orientation of Testers

The purpose of the study, testing procedures and method of scoring were briefly explained and demonstrated to the helping testers. The investigator had overall supervision on the subjects and the testers. All the testers performed their duty to the utmost gratification.

3.7 Orientation of Subjects

Prior to exploration, the investigator informed the rationale of the study and brief introduction about sports specific circuit training and highlighted its impact on selected physiological variables. The way of doing each test was

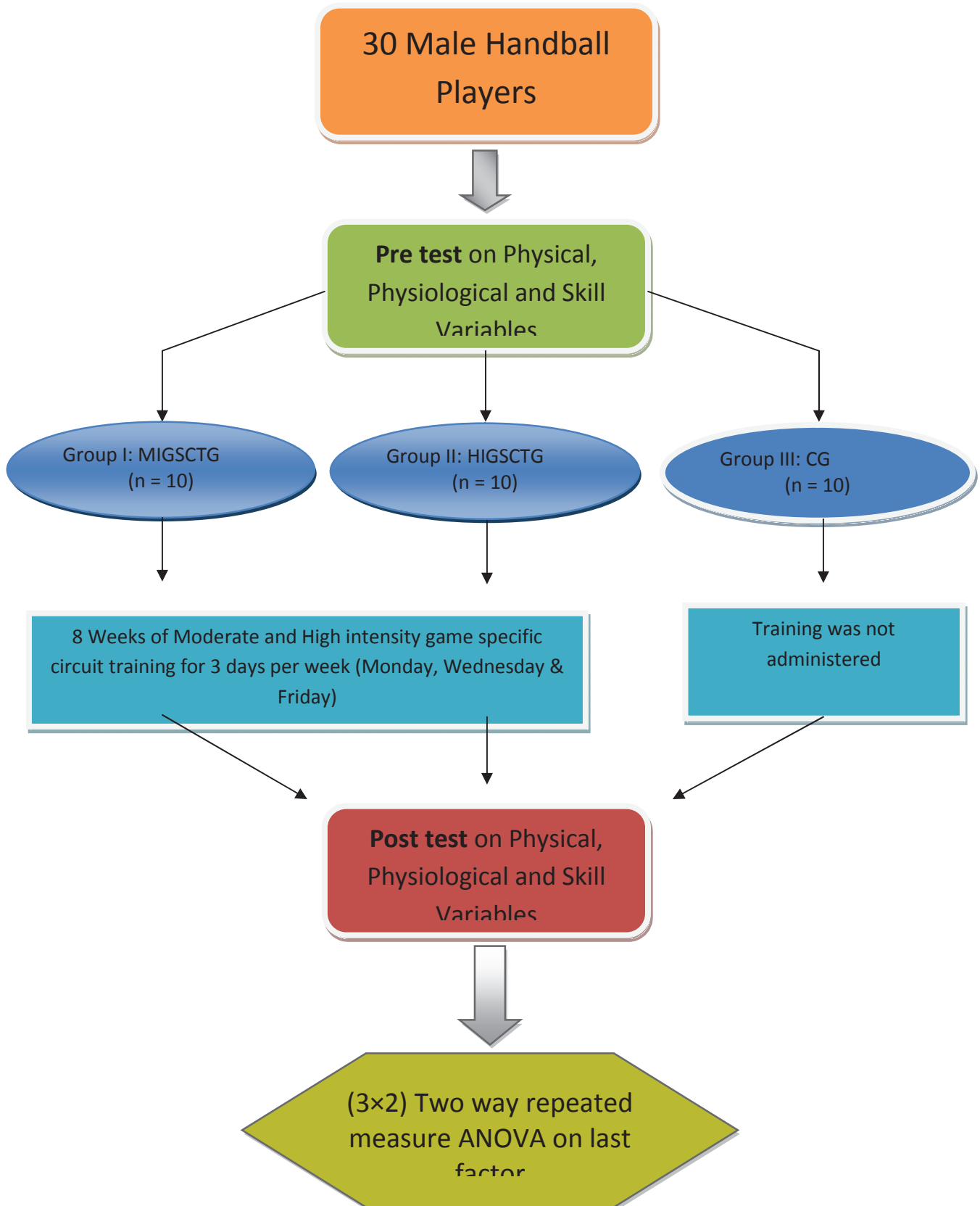
demonstrated and explained to subjects by the researcher. Subjects were motivated to exhibit their maximum performance in selected test. All the subjects cooperated to their best during the course of experimentation.

3.8 Design of the study

For the present study pretest – posttest randomized group design (Thomas, Nelson & Silverman, 2005) which consists of a control group and two experimental group that was used to find out effect game specific circuit training on the selected physical, physiological and skill variables. Equal numbers (ten) of subjects were assigned randomly to all the groups. Training was administered based on the intensity as moderate and high intensity selected for specific purpose. The training was administered three days a week (i.e. Monday, Wednesday, and Friday) for eight weeks. Measurement of physical, physiological and skill variables was taken for the three groups which is presented in Table II a.

Figure- I

Flow chart depicting the methodology adopted in the study



3.9 Collection of Data

All the subjects were tested on physical, physiological and skill variables prior to training and after eight weeks of training. The testing session consists of warm-up and test interspersed with rest. All tests were explained and demonstrated. Before testing, subjects were given practice trials to become familiar with the testing procedures. All tests were counterbalanced pre and post testing to ensure that testing effects were minimized. Subjects performed each test as per test procedure and the scores of best trials were taken for this study.

In the morning of the first day of testing measurements like resting heart rate, speed, agility, power, handball throw for distance, abdominal strength endurance and running based anaerobic sprint test were measured, however in the evening aerobic capacity was evaluated. Next day evening these subjects were tested for their dribbling and jump shot throw for accuracy.

3.10 Training Interventions

The training intensity of sport specific aerobic circuit training was appraised for each subject based on the time taken to perform one circuit at their cent percent effort. The training schedule adopted in this study was as given in Table III.

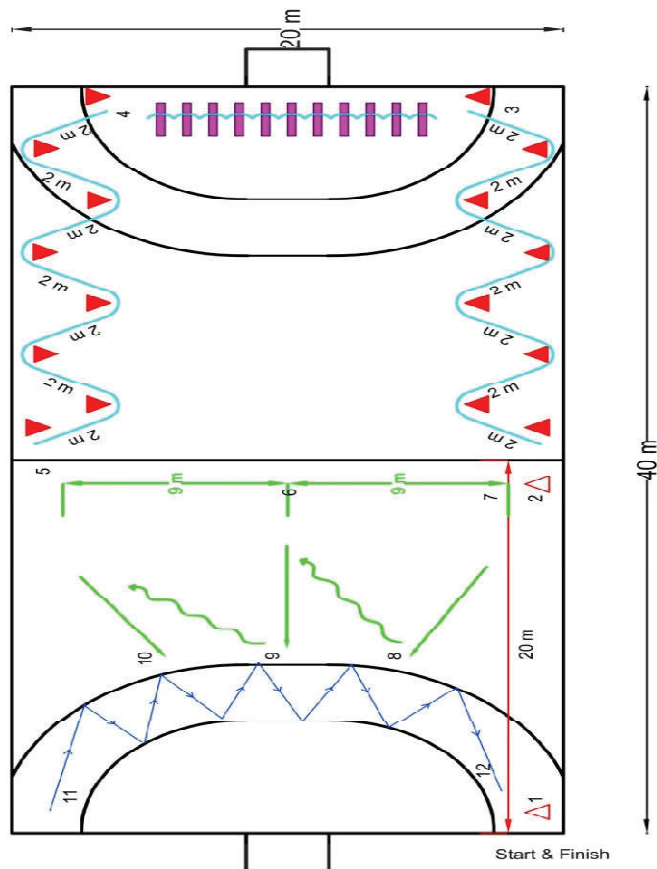
Table III**Training load adopted**

Groups	Weeks	Days	Intensity	Duration of work	Repetition	Duration of active rest	Total duration of work	Total duration of active rest
MIGSC TG	1 - 4	Monday	60 to 65 %	4 min	4	4 min	16 min	16 min
		Wednesday						
		Friday						
	5 - 8	Monday	66 to 70%	4 min	4	4 min	16 min	16 min
		Wednesday						
		Friday						
HIGSC TG	1 - 4	Monday	80 to 85%	4 min	4	4 min	16 min	16 min
		Wednesday						
		Friday						
	5 - 8	Monday	86 to 90%	4 min	4	4 min	16 min	16 min
		Wednesday						
		Friday						

The training was carried out in outdoor handball court. This type of circuit training was based on a previous design (Smith, 2004) and adapted to mimic as closely as possible the movement patterns of handball match play as reported by McInnes *et al.*, (1995). The subjects performed handball sports specific circuit training for four minutes at a given intensity of respective groups, and repeated the circuit three more times with a ample active recovery for four minutes. In this study 1:1 work rest ratio was followed. This training protocol was adapted from Helgerud *et al.*, (2001). The one repeat of the handball circuit administered was presented in figure 1.

Figure 2

Handball specific circuit training diagram



The description of the circuit:Figure 1: Handball movement specific training circuit: 1-2 forward sprint, 2-3 zig-zag run, 3-4 jump across the hurdle, 4-5 Dribbling the ball, 5-6 side step, 5-7 side step opposite side, 7-10 Jumpshot high, 11-12 shuffling forward and backward.

3.11 Administration of Tests

3.11.1 30metres sprint

Purpose

The purpose of the test is to determine the subject's maximum sprint speed and the ability to accelerate from a stationary position.

Equipment

Electronic stop watch, marking cones and tape measure.

Procedure

The test involves running a single maximum sprint over 30 metres, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary standing position, with one foot in front of the other. The front foot must be on or behind the starting line. This starting position should be held for 2 seconds prior to starting, and no rocking movements are allowed. The tester should provide hints for maximizing speed (*such as keeping low, driving hard with the arms and legs*) and encouraged to continue running hard through the finish line.

Scoring

Time taken to complete the given task was recorded as score.

3.11.2 T-test

Purpose

The T-Test is a test of agility for subjects, and includes forward, lateral, and backward running.

Equipments

Measuring tape, marking cones and stopwatch.

Procedure

Set out four cones (5 yards = 4.57 m, 10 yards = 9.14 m). The subject starts at cone A. On the command of the timer, the subject sprints to cone B and touches the base of the cone with their right hand. They then turn left and shuffle sideways to cone C, and also touch its base, this time with their left hand. Then shuffling sideways to the right to cone D and touching the base with the right hand. Then they shuffle back to cone B touching with the left hand, and run backwards to cone A. The stopwatch is stopped as they pass cone A.

Scoring

The trial will not be counted if the subject crosses one foot in front of the other while shuffling, fails to touch the base of the cones, or fails to face forward throughout the test. The best time of three successful trials to the nearest one-tenth of a second was recorded as score.

3.11.3 Vertical jump test

Purpose

Test to measure vertical leg power of the subjects.

Equipments

Vertical jump board, chalk, a metre ruler

Procedure

The subjects stand side on to a wall and reach up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. The subjects then stand away from the wall, and jump vertically as high as possible using both arms and legs to assist in projecting the body upwards, and attempt to touch the wall at the highest point of the jump.

Scoring

The difference in distance between the reach height and the jump height was recorded as score in centimetre.

3.11.4 Handball throw for distance

Purpose

This test measures arm explosive strength of the subjects.

Equipment

Handball and measuring tape

Procedures

The subjects were directed to stand with a handball in their dominant hand (right). They were permitted to take three steps and execute over hand throw.

Scoring

The distance from the restraining line to where the handball ball landed was recorded. The measurement is recorded to the nearest centimetre (10 cm). The best result of the three throws was recorded.

3.11.5 Sit and reach test

Purpose

To measure the abdominal strength endurance of the subjects.

Equipments

Stopwatch.

Procedure

The subject down in the floor facing the sun fold the leg in sit up position hand close back side of the neck partner catch the Knee and ready for the count On the command of the timersubject come up chest touch the knee and go back continue for one minutes.

Scoring

Measured as number of successful lift.

3.11.6 Cooper's 12 minute run and walk test

Objective

To monitor the development of the athlete's VO₂max.

Equipments required

To undertake this test 400 metre track, stopwatch whistle or sound horn and an assistant

Procedure

Initially the athletes were provided with warm up for 10 minutes. When the athlete is ready the assistant gives the command “GO” and starts the stop watch and the athlete commences the test. The athlete has to run and walk for around the track to aid in measuring the completed distance. Participants run for 12 minutes, and the total distance covered is recorded. Walking is allowed, though the participants must be encouraged to push themselves as hard as they can to maximize the distance covered.

Assessment

The equation that can be used to estimate VO_{2max} (in ml/kg/min) from the distance score is:

$$VO_2 \text{ max} = (22.35 \times \text{kilometers}) - 11.29$$

3.11.7 Running based anaerobic sprint test

Purpose

The Running-based Anaerobic Sprint Test (*RAST*) provides measurements of anaerobic capacity and fatigue index.

Facilities and equipment used

The test was administered in 400 meters track - with a 35 meter marked section on the straight. Two cones to mark the 35 meter section and stopwatches were used to administer the test.

Procedure

The subjects were weighed prior to the test. Undertakes a 10-minute warm session and has a 5-minute recovery. Then completes six 35 meter runs at maximum pace with 10 seconds between each sprint for turnaround. The

testers records the time taken for each 35 meter sprint to the nearest hundredth of a second.

Scoring

By using following equation anaerobic capacity and fatigue index was found.

Power output for each sprint is found using the following equations:

$$\text{Anaerobic capacity} = \text{Weight} \times \text{Distance}^2 \div \text{Time}^3$$

From the six times calculate the power for each run and then determine:

$$\text{Average power} = \text{Total time for the 6 sprints} \div 6$$

$\text{Fatigue Index} = (\text{Maximum power} - \text{Minimum power}) \div \text{Total time for the 6 sprints}$

3.11.8 Resting heart rate

Purpose

To record the resting heart rate of the subjects.

Equipment used

Omron heart rate monitor

Description

The subject was made to lie down for 10 minutes comfortably without crossing their legs. Omron heart rate monitor measures the resting heart rate automatically and displayed in the screen. Keep the body still and relaxed during measurement.

Scoring

The number of heart beat per minute was recorded as shown in the Omron heart rate monitor.

3.11.9 Dribbling Test

Purpose

To assess the dribbling ability of the subjects.

Equipment used

Handball, Measuring tape, Cone stopwatch.

Procedure

The test was administered in Hand ball court - with a 25 meter marked section on the straight. Each cone to mark the 5 meter section and stopwatches were used to administer the test. The subject dribbling the ball run in zig-zag and finish to the starting cone best of trials will be recorded.

Scoring

The time elapsed to complete is recorded as score and the best trial was selected from three trials.

3.11.10 Jump shot high for accuracy

Purpose

To measure the shooting accuracy while jumping

Equipment

Handball, small size tyre

Procedure

The test was administered in handball court by planting a post at 8 metre and volleyball net was tied to it at 8 feet high. In the handball post TVS Scooty tyre was fixed at four corners. The subject dribbling the ball and

perform jump shoot high above the tied net towards the goal post. They were provided with five trials for each spot.

Scoring

When the ball enter the post through tyre 3 point was awarded, when it hits the tyre they were awarded with 2 point and without touching tyre and enters goal mouth 1 point will be awarded. Total scoring for four corner point will be the individual score.

3.12 Statistical techniques

The collected data was evaluated using two way repeated measures ANOVA on last factor. When the interaction was significant simple effect was applied and Scheffé S post hoc test was applied to know the pair wise comparison. The proposed hypotheses was tested at 0.05 level of confidence. Beside this mean and standard deviation were also calculated. SPSS statistic software package (SPSS Company, America, version 16.0) was used.