

Chapter – III

METHODOLOGY

This Chapter describes of the procedures adopted for selection of subjects, selection of variables, experimental design, selection of test, competency of the tester, instruments reliability, subject's reliability, reliability of data, orientations to the subjects, pilot study, assessment of training intensity, training programme, administration of the test, collection of the data and statistical technique adopted were explained in detail.

3.1 SELECTION OF SUBJECTS

The purpose of the study was to find out the effect of high intensity plyometric training, anaerobic training and cross training on selected motor fitness, physiological and skill variables of volleyball players. To execute this investigation the research scholar employed random sample of one hundred men volleyball players who have participated in state and inter-collegiate volleyball tournament during the year 2012-2013 were selected as subjects from Madurai, Tamil Nadu . Their age ranged between 19 and 23 years. The subjects were divided at random into four groups of twenty five each (n=25). The experimental group-I underwent high intensity plyometric training, experimental group-II underwent anaerobic training, experimental group-III underwent cross training and the group IV acted as control. The experimental groups were subjected to their respective training programmes for a period of twelve weeks and three sessions in a week in addition to their regular academic

schedule. However, control group was not exposed to any specific training but they took part in their regular schedule. The subjects were free to withdraw their consent in case of feeling any discomfort during the period of their participation but there was no drop out in this study.

3.2 SELECTION OF VARIABLES

The investigator reviewed all the available scientific literatures pertaining to the problem under study from books, research papers, websites and also consideration of the feasibility and availability of instrument relevant to the present study the following motor fitness, physiological and volleyball skill variables were selected.

I. Dependent Variables

The following motor fitness, physiological and volleyball skill variable were selected as dependant variables.

a. Motor Fitness Variables

- i. Agility
- ii. Speed
- iii. Explosive Power
- iv. Flexibility
- v. Co-ordination

b. Physiological Variables

- i. Resting Pulse Rate
- ii. Respiratory Rate
- iii. VO_{2max}

iv. Breath Holding Time

v. Anaerobic Power

c. Volleyball Skill Variables

i. Set

ii. Attack

iii. Block

iv. Pass

v. Serve

II. Independent Variables:

The following were selected as independent variables.

i. High Intensity Plyometric Training

ii. Anaerobic Training

iii. Cross Training

iv. Control group

3.3 EXPERIMENTAL DESIGN

The experimental design used in this study was random group design involving one hundred subjects who were divided at random into four groups of twenty each. This study consisted of four independent variables such as high intensity plyometric training, anaerobic training, cross training and control group, the four selected groups, experimental group-I underwent high intensity plyometric training, experimental group-II underwent anaerobic training, experimental group-III underwent cross training and the group IV acted as control. All the subjects were tested prior to, and after the training period on agility, speed, explosive power, flexibility, co-ordination, resting pulse rate, respiratory rate, VO_{2max} , breath holding time, anaerobic power, set, attack, block, pass and serve. The study was aimed at finding out the influence of high

intensity plyometric training, anaerobic training and cross training on selected motor fitness, physiological and skill variables of volleyball players.

3.4 PILOT STUDY

A pilot study was conducted to assess the initial capacity of the subjects to fix the training load and also to design the training programme. For that purpose, ten Inter - collegiate level men volleyball players at Madurai Kamaraj University, Madurai, Tamilnadu, India were selected at random and they were given various high intensity plyometric training , anaerobic training and cross training separately under the watchful eyes of the investigator. Finally, selected specific exercises, which were closely related to develop the dependent variables, were chosen to design the training programme. The initial load of the subjects were fixed based on the results of the pilot study and the directions given by *Dan Wathen(1994)*. The training schedule with respective intensities was fixed for high intensity plyometric training, anaerobic training and cross training. While constructing the training programme considering the basic principles of sports training i.e., progression of overload and specificity were followed and the individual differences were also taken into consideration.

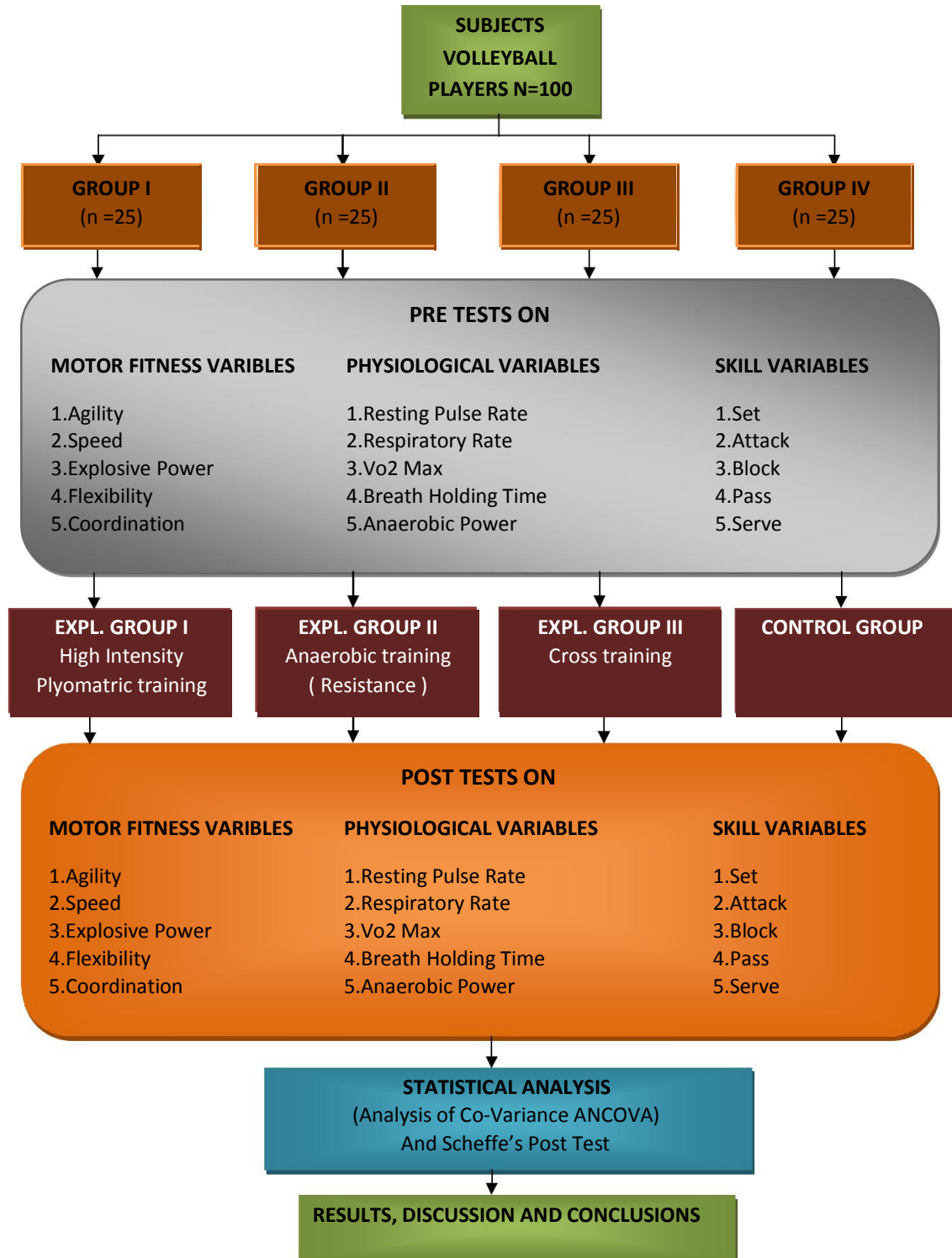


Fig 1 : Diagrammatic representation of the research study

3.5 SELECTION OF TEST

The present study was undertaken primarily to assess the effect of high intensity plyometric training, anaerobic training and cross training on selected motor fitness, physiological and skill variables of volleyball players such as agility, speed, explosive power, flexibility, co-ordination, resting pulse rate, respiratory rate, VO_{2max} , breath holding time, anaerobic power, set, attack, block, pass and serve among men volleyball players. As per the available literatures, the following tests were used to collect relevant data on the selected dependent variables and they were presented in Table - I.

TABLE - I
TESTS SELECTION

S. No.	Criterion Variables	Test Items	Unit of Measurement
1.	Agility	Shuttle Run	In Seconds
2.	Speed	50 Meters Run	In Seconds
3.	Explosive Power	Standing Broad Jump	In Meters
4.	Flexibility	Sit and Reach Test	In Centimeters
5.	Co-ordination	Ball Transfer Test	In Seconds
6.	Resting Pulse Rate	Radial Pulse Test	In Numbers
7.	Respiratory Rate	Stop watch (Manual Method)	In Seconds
8.	VO_{2max}	Astrand Nomogram	In Milliliters per kilogram per minute
9.	Breath Holding Time	Stop watch (Manual)	In Seconds
10.	Anaerobic Power	Margaria-Kalamen Power Test	In Kg. M/Sec
11.	Set	Subjective Rating	In Points
12.	Attack	Subjective Rating	In Points
13.	Block	Subjective Rating	In Points
14.	Pass	Subjective Rating	In Points
15.	Serve	Subjective Rating	In Points

3.6 COMPETENCY OF THE TESTER

To ensure that the investigator was well versed with the technique of conducting tests, tester had a number of practice sessions in the correct testing procedure. All the measurements in this study were taken by the investigator with the assistance of experts in the field of Physical Education and Sports who were also well known about the testing procedure. The tester's reliability was established by test and re-test method.

3.7 INSTRUMENTS RELIABILITY

To conduct the tests on selected criterion variables, instruments such as stop watches, measuring steel tape, cone, plyometric box, medicine ball and volleyball available at sports development authority of Tamilnadu, Dr. MGR Stadium, Madurai were used for the study. They were purchased from reliable companies and their calibrations were accepted and found to be accurate enough to serve the purpose of the study.

3.8 RELIABILITY OF DATA

Test and retest method was followed in order to establish the reliability of data by using ten subjects. All the dependant variables selected in the present study were tested twice for the subjects by the same personals under similar conditions. The intra-class co efficient of correlation was used to find out the reliability of the data as suggested by Johnson and Nelson and the results were presented in Table II.

3.9 SUBJECT RELIABILITY

The intra class correlation value of the below test and retest also indicated subject reliability as the same subjects were used under similar conditions by the same tester.

TABLE – II
INTRA CLASS COEFFICIENT OF CORRELATION ON SELECTED
DEPENDENT VARIABLE

S. No.	Criterion Variables	'r' value
1.	Agility	0.93*
2.	Speed	0.95*
3.	Explosive Power	0.94*
4.	Flexibility	0.89*
5.	Co-ordination	0.96*
6.	Resting Pulse Rate	0.97*
7.	Respiratory Rate	0.97*
8.	VO _{2max}	0.95*
9.	Breath Holding Time	0.97*
10.	Anaerobic Power	0.94*
11.	Set	0.89*
12.	Attack	0.96*
13.	Block	0.97*
14.	Pass	0.94*
15.	Serve	0.89*

** 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 had been accepted as reliable in terms of instrument, tester and the subjects.

3.10 ORIENTATION TO THE SUBJECTS

Prior to the administration of the tests, the subjects were oriented with the purpose of the study and the importance of training programme. For the collection of data, the investigator had explained the procedure of testing on selected dependent variables. Five sessions were spent to familiarize the subjects with the techniques involved in undergoing high intensity plyometric Training, anaerobic training and cross training. It helped them to perform their respective training perfectly without any injuries. The subjects of all the groups were sufficiently motivated to perform their assigned tasks during the testing periods.

3.11 ASSESSMENT OF TRAINING INTENSITY

High Intensity Plyometric Training

Intensity is the effort involved in performing a given task. In plyometric, intensity is controlled by the type of exercise performed. Plyometric ranges from simple tasks to highly complex tasks and stressful exercises. The Intensity of plyometric exercise can be increased by adding light weight in certain cases, by raising the platform height for depth jumps or simply by aiming at covering a greater distance in longitudinal jumps.

Anaerobic Training (Resistance Training)

After selecting the resistance training, 1 RM was found for each subject of resistance training group for each exercise separately by increasing and

decreasing the weight. 1 RM is the maximum amount of weight a person can successfully lift one time only through the full range of motion.

3.12 TRAINING PROGRAMME

With the help of the experts in sports training and coaches and based on the results of the pilot study, a package of training programme was designed separately for high intensity plyometric training, anaerobic training and cross training that tend to enhance the performance level of the selected motor fitness, physiological and skill variables.

During the training period, experimental group-I underwent high intensity plyometric training, experimental group-II underwent anaerobic training, experimental group-III underwent cross training and the group IV acted as control which was not given any special treatment, except of their routine.

The duration of training session in all three days were approximately between one hour to one and a half hour thirty minutes which included warming up and limbering down. All the subjects involved in this study were carefully monitored throughout the training programme to keep them away from any injuries. They were questioned about their health status throughout the training programme. None of them reported any injuries. However, muscle soreness appeared in the earlier period of the training programme and was reduced in due course. The detailed training scheduled for each group was

given in the form of tables by indicating the intensity, repetitions, set, rest and duration.

All the three treatment groups were treated with their respective treatment for weekly three days with duration of one hour to one and a half hour for a period of 12 weeks.

WARMING- UP AND WARMING – DOWN

Singh (1991) has recommended that the physical preparation for the training session is achieved through optimum warm up of the six exercises in a definite manner for the purpose of warming of the physical and physiological systems of the organism. It leads to a) increase in muscle and body temperature, b) Raising the functional level of the heart and lungs, c) loosening of muscles, ligaments and joints, d) Facilitation of motor co-ordination, e) increase in readiness for training activity. General warm-up aims at general preparedness for the training activity. It consists of jogging and stretching exercises.

TRAINING PROGRAMME FOR HIGH INTENSITY PLYOMETRIC TRAINING

The subjects of group-I were treated with high intensity plyometric training for one hour to one and a half hour in the same session. In the plyometric training session the subjects were actively involved in plyometric training only. Each exercise was 3-5 repetitions for 3 sets. The load progression technique was adapted in the training to maintain the training load and training principles.

The training programme design and training programme were presented in Table III & IV respectively.

**TABLE -III : PLYOMETRIC TRAINING PROGRAMME DESIGN
HIGH INTENSITY PLYOMETRIC TRAINING**

S. No	Details	Duration
1.	Number of weeks	12 weeks
2.	Number of sessions per week	3
3.	Duration of each session	1 hour to 30 minutes
4.	Rest Interval between repetition	3 to 5 minutes
5.	Rest Interval between exercise	3 to 3 minutes
6.	Warm up and warm down	20 minutes

TABLE-IV : HIGH INTENSITYPLYOMETRIC TRAINING PROGRAMME

Weeks	Exercises	Repetitions	Contacts
I & II weeks	1.Double leg vertical power jump	2	8
	2.Multiple box to box squat jump	2	8
	3. Stadium hops	2	8
	4.Power drop	2	8
	5.Low post drills	2	8
III & IV weeks	1.Double leg vertical power jump	2	10
	2.Multiple box to box squat jump	2	10
	3. Stadium hops	2	10
	4.Power drop	2	10
	5.Low post drills	2	10
V & VI weeks	1.Double leg vertical power jump	3	8
	2.Multiple box to box squat jump	3	8
	3. Stadium hops	3	8
	4.Power drop	3	8
	5.Low post drills	3	8
VII & VIII weeks	1.Double leg vertical power jump	3	10
	2.Multiple box to box squat jump	3	10
	3. Stadium hops	3	10
	4.Power drop	3	10
	5.Low post drills	3	10
IX & X weeks	1.Double leg vertical power jump	4	8
	2.Multiple box to box squat jump	4	8
	3. Stadium hops	4	8
	4.Power drop	4	8
	5.Low post drills	4	8
XI & XII weeks	1.Double leg vertical power jump	4	10
	2.Multiple box to box squat jump	4	10
	3. Stadium hops	4	10
	4.Power drop	4	10
	5.Low post drills	4	10

Number of the Contacts = Number set x Repetition

TRAINING PROGRAMME FOR ANAEROBIC TRAINING GROUP (RESISTANCE TRAINING)

The subjects in the group - II were treated with resistance training for 12 weeks. The subjects were starts with resistance training with the intensity of 55% (1RM) with 10-12 repetitions of 3 sets for one-hour and finished 70% (1RM) with 10-12 repetitions of 3 sets for one-hour. The load progression technique was adapted in the training to maintain the training load and training principles. Resistance training intensity was raised by 5% for every three weeks (55%, 60%, 65% and 70% respectively).

The training programmes for anaerobic training (resistance training) were presented in Table-V.

TABLE-V
ANAEROBIC TRAINING (RESISTANCE TRAINING) PROGRAMME

S. No	Resistance Training	Intensity				Repetitions	Sets
		1-3 Weeks	4-6 Weeks	7-9 Weeks	10-12 Weeks		
1.	Arm Curl	55%	60%	65%	70%	10-12	3
2.	Triceps Extension	55%	60%	65%	70%	10-12	3
3.	Bench Press	55%	60%	65%	70%	10-12	3
4.	Lat pull down	55%	60%	65%	70%	10-12	3
5.	Military press	55%	60%	65%	70%	10-12	3
6.	Leg press	55%	60%	65%	70%	10-12	3
7.	Half squat	55%	60%	65%	70%	10-12	3
8.	Leg curl	55%	60%	65%	70%	10-12	3
9.	Heel raise	55%	60%	65%	70%	10-12	3
10.	Abdominal crunches	55%	60%	65%	70%	10-12	3

TRAINING PROGRAMME FOR CROSS TRAINING GROUP

The subjects of experimental group-III were treated with resistance training for the first 30 minutes, after completion of resistance training for another 30 minutes of Plyometric training in the same session. The intensity for the resistance training for first three weeks was 55% (1RM) with 4-6 repetitions of 3 sets. The rest in between the exercise was 60 seconds and rest in between sets was 2 to 3 minutes. In the plyometric session the subjects were actively involved in plyometric training. Each exercise was had 4-6 repetitions for 3 sets. The intensity for plyometric training for the first three weeks were 3 kg Medicine ball, 1 feet plyometric Box and body weight as intensity for all jumping exercises. The load progression technique was adapted in the training to maintain the training load and training principles. Resistance training intensity was raised by 5% for every three weeks (55%, 60%, 65% and 70% respectively).

The training programmes for cross training (plyometric and resistance training) were presented in Table-VI.

TABLE-VI
CROSS TRAINING PROGRAMME

Sl No	Plyometric Training	Intensity					sets	Resistance Training
		1 st to 3 th Week	4 th to 6 th Week	7 th to 9 th Week	10 th to 12 th Week			
1.	Vertical Jump	55%	60%	65%	70%	4-6	3	Arm Curl
2.	Medicine ball chest pass	55%	60%	65%	70%	4-6	3	Triceps Extension
3.	Box Jump	55%	60%	65%	70%	4-6	3	Bench Press
4.	Medicine ball over head pass	55%	60%	65%	70%	4-6	3	Lat Pull down
5.	Medicine ball sit up throw	55%	60%	65%	70%	4-6	3	Military Press
6.	Hop (single leg)	55%	60%	65%	70%	4-6	3	Leg Press
7.	Plyometric Sit-Up	55%	60%	65%	70%	4-6	3	Squat
8.	Front obstacle jump	55%	60%	65%	70%	4-6	3	Leg curl
9.	Over head throw	55%	60%	65%	70%	4-6	3	Heel raise
10.	Burpee	55%	60%	65%	70%	15-20	3	Abdominal crunches

CONTROL GROUP

The control group was engaged in practicing the volleyball skills on weekly three days in the evening. They practiced the volleyball skills in a traditional way without and special coaching or training by any instructor. They were allowed to play whenever they liked.

3.13 ADMINISTRATION OF THE TESTS**AGILITY****(10 YARDS SHUTTLE RUN)****Purpose:**

To assess agility

Equipments:

Stop Watch, Measuring tape, lime powder, flag post, paper and pen.

Description:

A distance of ten yards was marked by two parallel lines. The subject stood behind the starting line. On starting signal "Go" she ran fast as possible towards the other line and touched it with one hand and runs back to the starting line. After touching it, he repeated the course shuttle.

Scoring:

The time taken by the performer to complete the course of 4x10 yards to the nearest $1/10^{\text{th}}$ of the seconds is recorded as score in the test. (Rose Magi, 1967)

SPEED**(50 METERS RUN)****Purpose**

To assess Speed

Equipments Used

Measuring tape, starting clapper and digital stopwatch

Procedure

The standing start was adopted. The time 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. Two trials were given with sufficient rest in between and the better of the two trials was recorded.

Scoring

Speed was recorded in 1/10 second. (*Rose Magi, 1967*)

EXPLOSIVE POWER
(Standing Broad Jump Test)

Purpose:

To measure the explosive power in terms of horizontal distance of the subject.

Facilities and equipment:

Long jump pit and measuring tape.

Description

The subject was asked to stand on the take off board with his feet parallel to each other. From this position the subject took a preliminary

movement by flexing his knees and swinging his arms back and jumped forward as far as possible.

Scoring:

Three trials were permitted in succession, best performance was recorded. The horizontal distance of all the jumps were measured to the nearest centimetres. (*Rose Magi, 1967*)

FLEXIBILITY**(Sit & Reach Test)****Purpose**

The purpose of this test is to monitor the development of the athlete's lower back and hamstring flexibility.

Equipment Used

A 'sit & reach table' or a bench with a ruler

An assistant

Procedure

The starting position is sitting on the floor with shoes removed, feet flat against the table, and legs straight

Reach forward and push the fingers along the table as far as possible

The distance from the finger tips to the edge of the table represents the score for that person

As the 'sit and reach' table has an overhang of 15 cm, a person who reaches 10 cm past their toes scores 25 cm

It is important to have several warm-up attempts first, and to record the best score

Scoring

Maximum of reading taken by the students was recorded in centimeters.

(Canadian Fitness Manual, 1985)

CO-ORDINATION**Eye & Hand Coordination:** (Ball Transfer Test)

Purpose: To measure the Eye & Hand Coordination of the subjects.

Equipments:

1. Two Boxes of large enough to hold at least 10 inch play ground balls.
2. 10 Basket Ball

Procedure:

At a signal the subjects quickly take a basketball from left box and place it to right box. (One at a time). The manner in which they deposited the ball in the box depended on the nature and level of skill desired. The scholar asked the subject to a) Simply place the balls in the basket, b) toss it from a specified distance, c) toss it over a basket, d) bounce it in, e) bank it in. The size and number of balls were altered accordingly as seen in the fig. I.

Scoring:

The elapsed time for a certain number of trials was recorded. (***Teacher made test***)

RESTING PULSE RATE**(Radial Pulse Test)****Purpose**

The purpose of the test was to measure the heart beat per minute.

Equipment used

Stopwatch with calibration of $1/10^{\text{th}}$ of a second was used for the test.

Procedure

Subjects were asked to relax before taking the pulse rate and the pulse rate was recorded in a sitting position in the morning. In order to record the pulse rate the finger tips were placed on the radial artery at the thumb side of the wrist about an inch from the base of the thumb. The beat felt at the time was considered as the signal to start counting and the number of pulse were counted for one full minute.

Scoring

The number of pulse beats per minute was recorded as the score.

(Medical Instrument)

**BREATH HOLDING TIME
(Manual Method)****Purpose**

To measure the ability of the subject to hold the breathe for longer time

Equipment and materials

Stop watch with calibration of $1/10^{\text{th}}$ of a second, nose clip, pencil and a score sheet.

Procedure

The test consisted of voluntarily forced inhalation and holding breathe as long as possible without inhaling or exhaling after holding the breath. The

subject was asked to sit on the chair with a nose clip clamped over the nostrils and voluntarily forced maximal inhalation through her mouth. The stopwatch was started, once the maximum inhalation was reached by the subject raising the index finger. It was stopped as soon as the subject started to exhale. To prevent exhalation or inhalation through mouth during the recording time the subject was instructed to couple her lips tightly. The investigator carefully monitored on the subject's mouth to avoid exhalation or inhalation through the mouth. Two trials were permitted for each subject and the best time was recorded.

Scoring

The better of the two breaths holding time was recorded in seconds by using the stopwatch to the nearest one tenth of a second as breath holding time. ***(Digital Stop Watch)***

VO_{2max}

Purpose

To assess the VO_{2max} uptake of the subjects.

Facility and Equipments required

Weighing machine, 40 centimeters height bench, metronome and materials like protocol by *Mathews and Fox(1981)* and nomogram by *Astrand(1977)*.

Procedure

The subject was weighed prior to the test. He was asked to step up and down on 40 centimeters height bench 30 times per minutes for the total duration of 10 minutes, in accordance with the cadence of metronome after the practice of 4 count stepping exercises as below.

Up —Left foot up

Two —Right foot up—stand erect

Three – Left Foot down

Four – Right foot down

To record the submaximal exercise pulse rate, monitor was made use of. It was placed on a table near the 40 centimeters height bench while the electric card of the monitor was inserted in to the switch point and the input card was fastened around the left thumb of the subject. The switch was put on for operation.

On command, the subjects stepped up and down in accordance with the cadence of the metronome. When the 5th minutes were reached the pulse rate for one minute between 5th and 10th minutes was recorded as the sub maximal pulse rate. However, it has been the convention that the test could be brought to an end when two successive pulses showed a difference of not more than five beats among them.

VO₂ max is expressed either as an absolute rate in (for example) litres of oxygen per minute (L/min) or as a relative rate in (for example) millilitres of oxygen per kilogram of body mass per minute (e.g., mL/(kg·min)). The latter expression is often used to compare the performance of endurance sports athletes. However, VO₂ max generally does not vary linearly with body mass, either among individuals within a species or among species, so comparisons of the performance capacities of individuals or species that differ in body size must be done with appropriate statistical procedures, such as analysis of covariance. *(Wikipedia, the free encyclopedia)*

Scoring

The secured pulse rate and the measured weight of the subject were aligned in the set nomogram and the VO₂ max of the subject was predicted and recorded.

ANAEROBIC POWER

(MargariaKalamen Anaerobic Power Test)

Purpose

To measure the anaerobic power of the subject.

Equipments Used

1. A firm fifteen step staircase
2. Digital timer with switch mats to switch 'ON' and switch 'OFF' the time.

Procedure

The subjects stood six meters in front of the stair. They ran up the stairs as rapidly as possible, taking three steps at a time. The clock was started as the subject stepped on the first switch mat (on the 3rd step) and stopped as he stepped on the ninth step. The time it took to traverse the distance between stair 3 and stair 9 was recorded in seconds.

Scoring

The power generated is a product of the subject's weight (W) and vertical distance (D) divided by time (t).

$$\frac{W \times D}{t}$$

Where,

P = Power

W = Weight of the subject in kilograms

D = Vertical height between third and ninth steps in stairs

t = Time from third to ninth step in seconds

RATING SCALE FOR ASSESSING SKILL PERFORMANCES

A four point rating scale corresponding to the rating scale prepared by (Schall, 1985) was employed to assess the skill performances of the volleyball players during game situations. Data in the five skills namely; set, attack, block, pass and serve were rated on a scale from zero to three.

These ratings are made using the following scale of values:

Set

- 3 – Excellent (set the ball for score)
- 2 – Good (variation given in the setting)
- 1 – Poor (set the ball with out of reach)
- 0 – Failure (Setting error)

Attack

- 3 – Excellent (Kill, return for point or side out / deep attack)
- 2 – Good (Play resulting in attaining attack advantage./touching the block, but not retrieved back).
- 1 – Poor (Play giving opponent attack advantage / smashed ball defended by opponent)
- 0 – Failure (attack which goes outside, net, dead block) /error or foul)

Block

- 3 – Excellent (Dead block, or return for point)
- 2 – Good (Blocker touches the ball, and the defender is able to retrieve the ball / play that results in attaining attack advantage)
- 1 – Poor (Blocker touches the ball, but the defender cannot retrieve the ball (touchout) / play giving opponent attack advantage)
- 0 – Failure (Error / foul / blocker can't be able to touch a successful attack)

Pass (serve reception)

- 3 – Excellent (Perfect pass for multiple attacks)
- 2 – Good (Pass that can be set for non-quick attack)
- 1 – Poor (Pass that result in no attack advantage)
- 0 – Failure (Passing error/Failure of reception)

Serve

- 3 – Excellent (Service ace, ball not controlled, immediate score)
- 2 – Good (Aggressive serve that results in no attack)
- 1 – Poor (Serve that is passed well for multiple attack)
- 0 – Failure (Serving error)

With the help of the above rating system, data are used to calculate each player's percentage for each skill. The total score secured by a player in all the three sets divided by the number of attempts will give the average score for each skill. A skill with few attempts has equal weight as one with many. The rating of the players was done by three experienced players as per the rating scale during match situations.

3.14 COLLECTION OF THE DATA

Subjects of the four groups namely group-I: high intensity plyometric training, group-II: anaerobic training (resistance training), group-III: cross training(combination of high intensity plyometric training followed by a resistance training in the same session) and group-IV: control group (CG) were tested on selected criterion variables motor fitness variables (agility, speed,

explosive power, flexibility and co-ordination), physiological variables (resting pulse rate, respiratory rate, VO_{2max} , breath holding time and anaerobic power) and volleyball skill performance variables (set, attack, block, pass and serve). The initial test was performed and considered as pre-test score on the selected criterion variables. On completion of pre-test, they were treated with their respective treatments: weekly three days in the morning session for a training duration of one and half hours for a period of twelve weeks. At the end of twelve weeks, all the four groups were tested again on all selected variables and it was kept as post-test score. The collected data were analyzed with appropriate statistical techniques.

3.15 STATISTICAL TECHNIQUE

The data collected from the three groups before and after the experimental period were statistically examined for significant improvement by dependent 't' test.

One hundred subjects were divided randomly and assigned them into four groups of twenty five 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. Since three groups were involved, whenever the 'F' ratio was found to be significant for adjusted post test means, Scheffe's test was followed as a post hoc test to determine which of the paired means difference was significant. In all the cases 0.05 level was fixed as level of significance to test the hypotheses.