Chapter III

METHODOLOGY

Research methodology leads the order of following by which the research scholar begins with the primary solution for the matter and reach its final destination. This chapter reveals the procedures adopted for the investigation. The sources and selection of subjects, selection of criterion variables, criterion measures, reliability of data, instrument reliability and subject reliability, tester competency, orientation to the subjects, experimental design, pilot study, training programme schedules, description of asanas, test administrations, control group, collection of data, and statistical technique are explained.

SOURCES AND SELECTION OF SUBJECTS

The purpose of the study was to analyse the effect of various types of training programmes on selected physical, physiological and heamatological parameters of Type 2 diabetic female patients. Eighty female Type 2 diabetic patients of Pondicherry Diabetes Centre, Pondicherry were selected to undergo training and they were divided into four groups. (Walking, Yoga ,Physical fitness and control ) Each group consists of 20 patients in Fig.1 The subjects age ranged from 35 to 45 years.

Each group consists of 20 subjects Group ‘A’ was exposed to walking, to Group B Physical fitness, Group ‘C’ to yoga exercises and Group ‘D’ was restricted from participating in the training programme and was designated as the control group. The selected patients were grouped by the age, body weight, BMI, waist and hip circumference and their health conditions. After the distribution of the subjects into four groups, the difference in age, height, weight, hip and waist circumference and glycemic level were tested using ANOVA and a few minor adjustments were made so that there was no significant differences in these aspects among the four groups.
As Diabetes mellitus is a metabolic disorder, the investigator took a detailed medical evaluation of the patients. Feet inspected daily before and after exercise. Exercise programme avoided in extreme hot and cold weather conditions. Investigator started slowly, build up gradually and include exercises that are familiar to the patients. Prior to the administration of the test the investigator held a series of meeting with the subjects and explained the objectives and the purpose of the study. They were requested to cooperate and participate actively as subjects for this study. Subjects assured their voluntary participation during the training period. 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 course of the study.

**SELECTION OF VARIABLES**

The pivotal role of physical activity in health promotion and prevention of diabetes has been the focus of attention in recent times. For a normal and healthy life, a disease free body must function at optimal efficiency. For a diabetic patient, a progressive decline in body weight, muscle mass, obesity, BMI and insulin level play an important role. An excess of body fat is unhealthy. A reduction in hip and waist circumference and improved distribution of body fat will be considered to avoid diabetic related complications.

Based on the nature of the disease and to test the effect of different training programmes developed specifically in the present study that influence diabetes, the investigator scanned studies, literature and expert opinion from diabetic specialists.

The following variables are selected to assess the influence of different training programme in the Type 2 diabetes patients.
PHYSICAL, PHYSIOLOGICAL AND HEMATOLOGICAL VARIABLES

1. Height
2. Weight
3. BMI (Body Mass Index)
4. Waist circumference
5. Pulse rate
6. Systolic blood pressure
7. Diastolic blood pressure.
8. Fasting plasma sugar (FPG)
9. Post prandial plasma glucose (PPG)
10. HbA1C.

CRITERION MEASURES

Having the expert consultation from diabetic specialists, sports medicine experts and scanning various literature related to different training methods which influence on diabetic patients, the investigator has selected the following test items as criterion measures. The chosen test items are highly standardized, appropriate and ideal to assess the selected variables and were measured by the following tests,

1. Height was measured by stadiometer in centimeters.
2. Weight was measured by weighing machine in kilograms.
3. Waist circumference was measured by using measuring tape in centimeter.
4. BMI (Body Mass Index) was measured by using the formula Height / Weight^2.
5. Resting pulse rate was measured by using palpation method in the radial artery in beats per minute.
6. Systolic and Diastolic bloodpressure was measured by Sphygmomanometer and Stethoscope.

7. FPG and PPG was measured by GOD–POD method.

8. HbA1C was measured by Ion Exchange Resin Method.

**RELIABILITY OF DATA**

The reliability of data was measured by ensuring instruments reliability, testers competency and subject reliability.

**INSTRUMENTS RELIABILITY**

The instruments used to find the blood sugar level, pulse rate, Blood pressure level and HbA1C were available in the laboratory of Pondicherry diabetes specialities center, Pondicherry.

Stopwatches (1/10th of a second), measuring tape, sphygmomanometer, stethoscope, stadiometer and weighing machine were obtained from reputed suppliers of standard equipments and their calibrations were accepted as accurate enough for the purpose of the study.

**SUBJECT RELIABILITY**

The subject reliability was established by test and re-test coefficient of correlation for the scores in each of the criterion measures. The above test, retest co-efficient of correlation values are determined that subject reliability was adequate as the same subjects were used under similar condition by the same tester and no-motivational techniques were used nor any training given.

**TESTER’S COMPETENCY**

The assistance of two experienced physical education teachers was sought on administration of various test items. They were oriented about the procedures
of measuring and recording the scores in each variables. The measurement of blood pressure, pulse rate were taken by the investigator with the help of nursing assistants. The measurements of the blood sugar and HbA1C were taken by a laboratory technician in the diabetic center. All the assistants were asked to measure on a few subjects and co efficient of inter correlation of scores recorded by them was taken. The final measuring programme was conducted only on getting high coefficient of correlation level.

TABLE III

INTRA CLASS RELIABILITY CO-EFFICIENTS OF SELECTED DEPENDENT VARIABLES

<table>
<thead>
<tr>
<th>S.No</th>
<th>Criterion Variables</th>
<th>r-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Body weight</td>
<td>0.96</td>
</tr>
<tr>
<td>2.</td>
<td>BMI</td>
<td>0.97</td>
</tr>
<tr>
<td>3.</td>
<td>Waist circumference</td>
<td>0.89</td>
</tr>
<tr>
<td>4.</td>
<td>Pulse rate</td>
<td>0.971</td>
</tr>
<tr>
<td>5.</td>
<td>Systolic Blood pressure</td>
<td>0.981</td>
</tr>
<tr>
<td>6.</td>
<td>Diastolic blood pressure</td>
<td>0.981</td>
</tr>
<tr>
<td>7.</td>
<td>Fasting plasma sugar</td>
<td>0.979</td>
</tr>
<tr>
<td>8.</td>
<td>Post prandial plasma glucose</td>
<td>0.83</td>
</tr>
<tr>
<td>9.</td>
<td>HbA1C</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Significance at 0.05 level of performance

ORIENTATION OF THE SUBJECTS

The participant group consists of 80 female diabetic patients, aged between 35 to 45 randomly selected from Pondicherry Diabetes Specialities Center. Prior to the administration of test the investigator held five to six sessions meeting with the subjects. Before the commencement of the training programme the investigator
explained to the subjects the purpose of the study and their role in the investigation. Instruction in connection with the testing procedure of selected variables were also explained to the subjects. The investigator personally demonstrated and familiarize the subjects with technique involved in various tests used to collect the data. The necessities of taking blood tests before and after food in strict hygienic conditions were explained. A period of two weeks was utilized to select and teach the walking conditions for group ‘A’, physical exercises for group ‘B’ and yogic exercises for group ‘C’. Control group ‘D’ was not exposed to any of the orientation regarding training. Group A, B&C subjects were motivated to perform well and the recording of measurements were made known to the subjects with a view to familiarizing them about their performance.

EXPERIMENTAL DESIGN

The role exercise in the control of diabetes has been known since ages. Exercise has been often advised as a first step in the treatment of type 2 diabetes mellitus. Regular exercise programmes like walking, physical exercises and yogic exercises are likely to play a role in the prevention of type 2 diabetes. So walking, physical exercises and yogic exercises have been selected as the experimental training programme for the study. The study was formulated using true experimental randomized design.

PILOT STUDY

Pilot study is mainly concerned with the concurrent nature of training and mode of application. This study was conducted to ensure uniformity, intensity and duration of walking, physical exercises and yoga exercises programme. Walking, physical exercises and yoga exercises programmes are planned and organized so that the workload was within the limits of the subjects capacity. For this purpose 30 subjects were (age 35-45) randomly selected from Pondicherry Diabetes Specialities Center, Anna Nagar. Thirty subjects were divided into three groups of
10 each. They were assigned to treatment specially designed for the present study such as walking, physical exercises, and yogic exercises.

Ten subjects (n=10) were designated as walking group ‘A’. As walking is a natural exercise, it is easy to follow the schedule. From light walk to moderate and finally brisk walk for 20 minutes and followed by a cooling down light walk for 5 minutes. Group ‘B’ (n=1) physical exercises group was followed by a conditional warm up for a duration of 10 minutes. After doing selected stretching and bending exercises for 20 minutes a cooling down session was taken up for five to seven minutes. The remaining ten subjects (n=10) were termed as group ‘C’, the yogic exercise group. After warm up, which include simple stretching exercises of 5 minutes, yoga asana programme include the most general and common asanas for a duration of 20 minutes. Savasana was administrated after each asana followed by 3 to 5 minutes as cool down process.

The experimental treatment was conducted for 12 weeks for A,B&C groups. The trainings were administrated in the morning 6.30 A.M. to 7.30 A.M. of six days per week. The scientific structured training schedule was implemented for pilot study. The selected criterion variables were tested with relevant criterion measures.

**EXPERIMENTAL TRAINING PROGRAMME**

Based on the results of the pilot study the training schedule for experimental group ‘A’ ‘B’& ‘C ’ were programmed for six months. During the training programme , the experimental groups underwent their respective training programme six days per week for 24 weeks. Group ‘A’ underwent walking, Group ‘B’ underwent physical exercises and Group ‘C’ underwent yogic training. The intensity of experimental groups were fixed to 50-70% of their maximum heart rate.

The study consisting of a pre test and post test. The experimental groups participated their respective programme for a period of 24 weeks. The post tests
were conducted after a period of six months of exercise programme. The programme was scheduled from 6 to 7.30 A.M. on week days including Saturday. The programme included warm up and warm down. The intensity of programme was increased after every two months.

**TABLE IV**

**GENERAL STRUCTURES OF THREE DIFFERENT TRAINING PROGRAMMES**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>TREATMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Walking</td>
</tr>
<tr>
<td>Group II</td>
<td>Static jogging</td>
</tr>
<tr>
<td>Group III</td>
<td>Yogic exercise</td>
</tr>
<tr>
<td>Group IV</td>
<td>Control Group</td>
</tr>
<tr>
<td>Training duration</td>
<td>Ninety minutes</td>
</tr>
<tr>
<td>Training section</td>
<td>Six per week</td>
</tr>
<tr>
<td>Total length of training</td>
<td>Twenty four weeks</td>
</tr>
<tr>
<td>Training load</td>
<td>Every two months</td>
</tr>
</tbody>
</table>

**PRECAUTIONS TO BE TAKEN**

(a) **Before exercise**

—Be careful about exercising if one has skipped a recent meal.

—Check the blood glucose, If it is below 100, ask to have a small snack.

—Monitor them carefully and question about their health status.

(b) **During the exercise**

—Wear the medical identification or ID card

—Always carry food or glucose tablets so that it is ready to treat hypoglycemia.
(c) After exercise

—Check to see how exercise affected the blood glucose level, heart rate, blood pressure etc.

**TRAINING PROGRAMME**

During the training period, the experimental groups underwent walking, physical exercises, and yogic exercises. The subjects of the experimental group underwent their respective training programme for twenty four weeks with six days per week.

**ADMINISTRATION OF WALKING PROGRAMME**

The experimental Group ‘A’ underwent walking programme. Walking consisted of three phases and each phase for two months. Walking is the simplest form of exercise and is the best workout for the whole body. A regular walking schedule helps to burnout calories and increases physical fitness. Walking reduces the risk of several diseases and strengthens heart, lungs and bones. In the first phase of walking programme, the subjects were asked to brisk walk for 15 minutes after light walk and moderate walk about 5-10 minutes. During the second phase, subjects were undergo their walking treatment for 45 minutes and the final for about 60 minutes. The walking programme included warm up, work out and warm down. The intensity of walking was increased after every two months.

**TABLE V**

<table>
<thead>
<tr>
<th>Month</th>
<th>Warm up</th>
<th>Brisk walk</th>
<th>Warm down</th>
<th>Intensity</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;II</td>
<td>5 minutes</td>
<td>15 minutes</td>
<td>10 minutes</td>
<td>50%</td>
<td>30 minutes</td>
</tr>
<tr>
<td>III&amp;IV</td>
<td>5 minutes</td>
<td>30 minutes</td>
<td>10 minutes</td>
<td>60%</td>
<td>45 minutes</td>
</tr>
<tr>
<td>V&amp;VI</td>
<td>5 minutes</td>
<td>45 minutes</td>
<td>10 minutes</td>
<td>70%</td>
<td>60 minutes</td>
</tr>
</tbody>
</table>
ADMINISTRATION OF PHYSICAL EXERCISES PROGRAMME

Physical exercise is an organized activity that involves continuous participation. Exercise occupies a leading role in keeping a person fit. Physical exercise is the “Exertion of the muscles, limbs and bodily powers, regarded with reference to its effects on the subject, especially such exertion undertaking with a view to the maintenance or improvement of health. Group ‘B’ underwent physical exercise training to improve metabolic fitness. By doing physical exercise, body will burn more calories, and gain high fitness responses. Since the subject were diabetic patients, the exercise intensity was increased phase by phase. After 5 minutes warming up, the duration of physical exercise session was 15-20 minutes at the start of the study, and gradually increased to 25-30 minutes at third and fourth month and at the end of the study it was increased to 45 minute and warm down at 5to 10 minutes.

**TABLE VI**

MONTHLY SCHEDULE FOR PHYSICAL EXERCISE PROGRAMME

<table>
<thead>
<tr>
<th>Month</th>
<th>Warm up</th>
<th>Work out</th>
<th>Warm down</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>I &amp; II</td>
<td>5 minutes</td>
<td>15 minutes</td>
<td>10 minutes</td>
<td>30 minutes</td>
</tr>
<tr>
<td>III &amp; IV</td>
<td>5 minutes</td>
<td>30 minutes</td>
<td>10 minutes</td>
<td>45 minutes</td>
</tr>
<tr>
<td>V &amp; VI</td>
<td>5 minutes</td>
<td>45 minutes</td>
<td>10 minutes</td>
<td>60 minutes</td>
</tr>
</tbody>
</table>

**PHYSICAL EXERCISE WORKOUT INCLUDES:**

1. Stretching exercises
2. Bending exercises
3. Bend knee sit ups
4. Step up
5. Running on the spot with high knee Action
WARM UP

The major purpose of the warm-up is to elevate heart and body temperature, and increase blood flow to the muscles. The warm up period should be gradual consisting of low intense exercise and stretching. Warm up session prepared the skeletal muscles, heart and lungs for progressive increase in further exercise.

Warm up exercises

— Head tilt (side to side, up and down), Neck rotation.
— Arms stretch
— Bend (side)
— Shoulder shrugs
— Leg stretch
— Calf stretch (10 seconds)
— Quadriceps (10 seconds)

Stretching Exercises

The subjects were asked to stretch slow and relaxed by breathe slowly and naturally. Stretching exercise includes side and back of neck, shoulders and waist, middle and lower back, calf, thigh and hamstrings.

Bending Exercises

Bending exercises includes opposite toe touch with hands, touch the floor without bending the knee, sideward toe touch, bend and touch the floor with swinging arms. Each exercise repeat for a period of five to eight minutes.

Bend Knee Sit UPS

The subjects were asked to take a supine position with knees bend to an angle less than 90 degrees and hands clasped behind neck. The performer was
required to lift her trunk, touch her knees with forehead and then lower her trunk touching the mat with her elbows. This procedure was repeated for a period of thirty seconds.

**Step up**

For the stepping exercise, each subject was asked to stand near the 15 inches high bench. On the command ‘Ready-Start’, the subject began stepping up and down the bench to a four count rhythm. The stepping up exercise continued for a period of thirty seconds.

**Running on the spot with high knee action**

The subjects were asked to run on the spot by raising the knees up to the hip level for a period of thirty seconds.

**WARM DOWN**

Warm down gradually brings the heart rate down to its pre exercise level. The cool down promotes blood return to the heart and prevents blood pooling in the legs. The cool down may also stabilize heart action and decrease the amount of muscle soreness following exercise.

For the first two months all the three groups had taken 5-10 minutes extra to finish their exercises. But during the second and third phase, they took approximately I hour to finish the exercises. The exercises programmes was imparted systematically from simple to complex manner with gradual increase of intensity and duration was executed.

The subjects were carefully monitored and questioned about their health status throughout the training programme. None of the subjects reported any difficulty but participated enthusiastically throughout the training programme.
ADMINISTRATION OF YOGIC EXERCISES PROGRAMME

Yoga has became the subject of modern scientific evolution, resulting in the recognition of some of its influence on the human body and its metabolism. Yogic practicers have a useful role in the control of diabetes and prevention of its long term complications. Yogasana Professors and longtime trainers were advised specific yogasanas for women. The holistic approach for women in yoga practice was advocated in the training programme taking in the account.

The exercise programme was imparted systematically from simple to complex manner. The yoga practice of these patients were selected according to the women’s ability and the selection of variables. Group ‘C’ underwent yogic exercise training. The first unit general warming up for 5 minutes and yogasana training including suryanamaskar for 15 minutes and followed by warm down (savasana) as seen in Fig Yoga system which proceeded by discipline of the mind. There are systems which begin with the control of feelings and there are others which take the body as the starting point according to the natural tendencies and abilities of the subject.

**TABLE VII**

MONTHLY SCHEDULE FOR YOGIC PROGRAMME

<table>
<thead>
<tr>
<th>Month</th>
<th>Warm up</th>
<th>Selected asanas</th>
<th>Repetition</th>
<th>Set</th>
<th>Intensity</th>
<th>Rest in between asana</th>
<th>Total duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&amp;II</td>
<td>10 minutes</td>
<td>5 asanas</td>
<td>4</td>
<td>3</td>
<td>50%</td>
<td>30 seconds</td>
<td>30 minutes</td>
</tr>
<tr>
<td>III&amp;IV</td>
<td>10 minutes</td>
<td>7 asanas</td>
<td>6</td>
<td>5</td>
<td>60%</td>
<td>30 seconds</td>
<td>45 minutes</td>
</tr>
<tr>
<td>V&amp;VI</td>
<td>10 minutes</td>
<td>9 asanas</td>
<td>8</td>
<td>7</td>
<td>70%</td>
<td>30 seconds</td>
<td>60 minutes</td>
</tr>
</tbody>
</table>

Warm up includes breathing exercise and suryanamaskar for ten minutes
At the beginning suryanamaskar was performed with three to five repetitions. The asanas mentioned below were done slowly and each poses were maintained for 25-30 seconds followed by savasana. After two or three asanas, the subjects were asked to relax by doing savasana.

On the second phase, they practiced yoga asanas for 30 minutes includes suryanamaskar and selected asanas.

For the third phase, V& VI th month of training period the yogic exercise groups had taken 60-70 minutes to complete the training programme.

Selected Asanas were follows;

1. Trikonasana (triangle pose)
2. Tadasana (mountain pose)
3. Padmasana (lotus pose)
4. Ardha matsyendrasana (half spinal twist)
5. Bhujangasana (cobra pose)
6. Paschimottanasana (posterior stretch)
7. Dhanurasana (bow pose)
8. Salabhasana (locust pose)
9. Yoga mudra (wind releasing)
10. Savasana (corpse pose)
YOGASANAS

SURYANAMASKAR

“Surya” in Sanskrit means “The Sun God” and “Namaskar” means “connoting obeisance”. Surya Namaskar or the sun salutation hence literally means “saluting to the sun”.

STARTING POSITION: The subjects were asked to stand up and keep the legs apart at about two feet distance. The hands were at the sides. The head was kept straight and breathing was normal.

STEPS OF PRACTICE:

1. Subjects stand straight as in Tadasana or the mountain pose. Keep feet together and palms placed in front of the chest in prayer position. Take several deep breaths.

2. Subject inhale and raise both towards the sky, in sidewise circular movement. Gently arch back backwards as far as possible.

3. Started exhale and bend forward. Touch the floor with fingers and place hands besides the feet. Try touching the knees with forehead and if necessary, bend their knees.

4. Inhale and stretch the right leg back as far as possible, arms straight.
5. Exhale and bring the left leg behind, keeping it aligned with the right leg. Palm should be firmly placed on the ground. Look down in between the hands. Inhale.

6. While exhaling, lower the body so that the toes, knees, chest, hands and forehead touch the floor. But keep abdomen slightly raised from the ground.

7. Inhale and stretch forward. Raise the body from the waist. Legs should be straight and palms under the shoulder by bending the arms from the elbow.

8. Exhale and raise the body from the hips.

9. Repeat step 4, but this time with the left leg being stretched back.

10. Repeat step 3

11. Repeat step 2

12. End the sun salutation by exhaling and lowering arms to the sides in slow motion. Relax!

**BENEFITS**

- It stretches the abdominal muscles and improves digestive system.

- It removes excess fat from belly.

- It boosts blood circulation.

- It provides vitality and strength.

- It makes the spine and waist flexible.
1. PADMASANA

STARTING POSITION: The subjects sat on the floor with legs stretched forward without any strain and discomfort. Their spine, neck and head were kept in an erect position.

DESCRIPTION OF ASANA: The subjects held their right foot with their left hand and slowly flexed their right leg and placed it on their left thigh close to the left groin. The same method was followed with their left leg. Having attained this position; they sat erect with eyes closed and hands placed on their knees. The thumb and index finger of each hand to meet together and other three fingers were kept open straight and joined together. Subjects maintained the lotus form for 20 to 30 seconds, as seen in fig.

BACK TO POSITION: Subjects released their legs slowly and stretched their legs comfortably for the next repetition.

BENEFITS:

· This asana improves concentration and breathing.

· This asana activates all the organs of digestive system.

· It makes the hip-joints, knees and ankles more flexible.
2. ARDHA MATSYENDRASANA

STARTING POSITION: Sit erect. Stretch out your legs. Place the right heel in the perineum. Keep the right thigh straight.

DESCRIPTION OF ASANAS: Place the left foot flat on the floor, crossing the right knee. The left heel should rest close to the right side of the right knee. Pass the right arm over the left side of the left knee and line it up with the left calf. Grasp the left big toe with the index finger, middle finger and thumb of the right hand. Slide the left hand across the small of the back and grasp the root of the right thigh. Turn round the head, neck, shoulders and the whole trunk to the left and bring the chin in line with the left shoulder. Look as far behind you as you can. Keep the head and spine erect.

BACK TO POSITION: Maintain this position until strain is felt. Release in the reverse order. Repeat on the other side.

BENEFITS

· A protruding belly gets reduced and the waist becomes resilient.

· As the spine is twisted spirally, each movable vertebra rotates in its socket, as a result of which the spinal column, particularly the lumbar vertebrae, becomes more flexible.
3. BHUJANGASANA

STARTING POSITION: The subjects were in a prone lying position with the forehead on the ground. They placed the palms on the ground underneath the shoulders, with feet together.

DESCRIPTION OF ASANA: The hands were slowly bent at the elbow and the palms were brought forward up to the chest level. The elbows were closer to the body. The head was slowly raised to the position with the chin resting on the floor. It was further raised with the support of the hands. The subjects arched back and tried to look behind. The trunk was raised up to the navel region. This position was maintained for 20 to 30 seconds, as seen in fig.

BACK TO POSITION: The head was brought down. The head and the chest were brought together to the ground. The chin was drawn in and the forehead was touching the ground. The palms were taken backward and the hands were pressed against the body and palms were touching the sides of the body. After few seconds the same asana was repeated.

BENEFITS:

· It is very useful for removing excess fat in the abdomen and waist and reducing the hips.

· The alternate compression and stretching of the abdomen improves the digestive system and stimulates the appetite. Bhujangasana alleviates the pain in the back and neck.

· It helps to cure low blood pressure.

· It strengthens the arms, wrists, shoulders and the posterior.
4. PASCHIMOTHASANA

STARTING POSITION: the subjects sat on the floor with both the legs stretched forward and slowly raised the arms over head.

DESCRIPTION OF ASANA: Then the subjects slowly bent forward exhaling breath and hands held on the big toes with the index fingers and thumbs of the corresponding hands. Retained this pose while breathing normally, as seen in fig.

Slowly the subjects tried to bring the face towards the knee to eventually rest it between them. The elbow was bent, touching the floor on the outside of either leg. The position was maintained for 20 to 30 seconds.

BACK TO POSITION: The subjects released their hands from their toes, slowly raised their heads and got back to the starting position.

BENEFITS

· Paschimotanasana is a fine stretching exercise for the back of the whole body, from the heels to the top of the spine.

· This asana is good for reducing fatty deposits in the abdomen, hips, backside and thighs. Obese persons may repeat it as many times as possible to reduce their waist and protruding belly.
5. DHANURASANA

![image of dhanurasana]

STARTING POSITION: The subjects were asked to lie down with their abdomen, chest and chin resting on the ground with stretched arms.

DESCRIPTION OF ASANA: Subjects were asked to bend the legs backwards and grasp the corresponding ankles firmly. Raise the chin and bend the head and neck backward without raising the chest. Inhaling, pull the legs slowly upward towards the ceiling, until the body is balanced on the navel region which alone should touch the floor.

BACK TO POSITION: Keep the head up and backward. Hold the breath and maintain the posture until the strain is felt. Exhaling return slowly to the starting position in the reverse order.

BENEFITS:

· It can be specially prescribed for those suffering from diabetes as it stimulates pancreatic action.

· Dhanurasana promotes digestion by stimulating gastric secretions and relieves congestion of blood in the abdominal viscera.

· It strengthens the muscles of the thighs and buttocks. It makes the abdominal, lumbar and pelvic muscles supple and strong.

· It reduces excess fat around the abdomen, waist, hips and thighs and is specially beneficial to women.
6. ARDHA SALABHASANA

STARTING POSITION: The subjects were in a prone lying position. With forehead on the ground, the feet were together and their arms were close to the body.

DESCRIPTION OF ASANA: The forehead was slowly raised till the chin supported the head. Fingers were closed making a fist. One leg was raised slowly upward and knee was kept straight. The other leg was on the floor. This position was maintained for 20 to 30 seconds. This same asana was repeated with the other leg also, as seen in fig.

BACK TO POSITION: The leg was slowly lowered down to the ground. The fingers were unfolded. The chin was drawn inward and forehead was placed on the ground.

BENEFITS:

- This asana is a good exercise for the legs, thighs, hips, buttocks, the lower abdomen, diaphragm and wrists.
- The blood circulation improves.
- It greatly influences the activity of the adrenal and prostate glands and the reproductive organs and glands.
- It dissolves excess fat from the thighs, hips, waist, abdomen and the posterior.
- A protruding belly gets reduced and the waist becomes resilient and supple.
7. YOGA MUDRA

STARTING POSITION: The subjects sat on the floor. The legs were stretched forward, paced the right foot on the left thigh and left foot on the right thigh.

DESCRIPTION OF ASANA: The hands were brought back and held the wrist of one hand with the other hand. Spine was straight, neck and head was also kept straight upward. The head was lowered down towards the ground, while lowering the head down they exhaled gradually and simultaneously. The head touched the ground and the breath was retained. The hands were gradually raised upwards without strain. This position was maintained for 20 to 30 seconds, as seen in fig.

BACK TO POSITION: They started inhaling while lowering down the hands and gradually returned to the position of readiness. After few seconds of rest they repeated the same asana.

BENEFITS

· This asana corrects the disorders of the spine; removes gastric troubles and constipation. It stretches the neck and back.

· It increases the efficiency of the internal organs.

· Blood circulation to all the internal organs is increased.

· It reduces fats from the abdomen and lower back.
8. TRIKONASANA

STARTING POSITION: The subjects stood on the floor and kept their legs at about two and a half feet distance from one another, and the hands were on the sides.

DESCRIPTION OF ASANA: Both hands were raised sideward up to their shoulder level, and the palms faced downwards. They inhaled slowly while raising their hands to the sideward. Then they started exhaling and lowered the left hand and touched the left foot, the right hand was towards the sky. By the time they touched their foot they completed exhaling. The same procedure was repeated on the right side also as seen in fig.

BACK TO POSITION: They raised their body and stood erect. The hands were brought down to their sides. This asana was repeated after a few seconds of rest.

BENEFITS:

- This asana reduces excess fat in the abdomen, waist and hips and massages that area of the flank where fat accumulates.
- It increases the flexibility of the waist and the hip joints.
- It benefits women by slimming the waistline and giving shape and grace to the hip line.
- Practicing Trikonasana regularly improves the appetite. It also helps digestion and the assimilation of food.
- It will help a person to attain full stature.
9. TALASANA

STARTING POSITION: Subjects were stand erect, feet apart and look straight ahead.

DESCRIPTION OF ASANAS: Subjects while inhaling, slowly raise the arms overhead with the palms facing each other. Raise the heels slowly, and lift toes slowly until you stand on tiptoe. Exhale slowly and keep balance, inhale slowly again. Raise the heels as high as possible and stretch the body to the maximum. Stretch the neck and head backwards and look up.

BACK TO POSITION: The subjects were asked to hold breath and keep balance comfortably. While exhaling, relax the body and return to the starting position.

BENEFITS:

· Talasana fully stretches the upper portion of the body.

· It expands the ribcage and increases the capacity of the lungs.

· It firms up the respiratory muscles and the muscles of the neck, lower back, abdomen and pelvis.

· Diabetic patients may practice this asana with advantage as it activates the pancreas.
10. SAVASANA

STARTING POSITION: the subjects were in a supine lying position. The feet were together, with straight knees. The hands were close to the body. The palms were touching the sides of the body.

DESCRIPTION OF ASANA: the right and left legs were spread apart. They were flat on the ground. The right hand was moved to the right side. The left hand was moved to the left side. The head was straight and eyes were closed. The whole body was in relaxed position. This position was maintained for 20 to 30 seconds, as seen in fig

BACK TO POSITION: The left hand was taken close to the body, then the right hand was placed close to the body. The left and right legs were kept straight in the line with the body. After few seconds of rest the same asana was repeated.

BENEFITS

· Savasana, rightly practised, pacifies the body and quietens the mind by discharging muscular, nervous, mental and emotional tensions almost immediately.

· This asana relaxed all the muscles, nerves and organs.

· This asana has very good effect upon the patients as well as upon any yoga practitioner.
ADMINISTRATION OF TEST

1. HEIGHT

**Purpose**: The purpose of the test was to measure the height of the subjects.

**Equipment**: Stadiometer, scale, piece of chalk, pencil and score sheet.

**Procedure**: The subject was made to stand on the stadiometer with bare foot. At the time of measuring the heels are on the platform without elevating it, and the scale is brought down firmly in contact with vertex. A mark is made with chalk piece on the side of scale in the stadiometer. After that the subject stepped away from the stadiometer stand board.

**Scoring**: The vertical distance from the stadiometer standboard to chalk piece mark is measured. The measurement is taken to the nearest one centimeter.

2. BODY WEIGHT

**Purpose**: The purpose of the test was to measure the body weight.

**Equipment**: A standard weighting machine.

**Procedure**: The weight should be recorded preferably on an empty stomach, without shoes, slippers and maximum clothing. The subject was taken to stand barefoot in the center of the platform exerting equal pressure on the feet without any movement. The machine was repeatedly calibrated with the help of an accurate balance. The zero was ensured before the subject stood on its platform and after the subject got down.

**Scoring**: The weight was recorded in kilograms.
3. **BMI** (Body Mass Index)

Body mass index is defined by the expression of

\[
\frac{\text{Weight (kg)}}{\text{Height (m)}^2}
\]

A BMI of below 25 is acceptable, 25-30 is overweight, and above 30 is obese.

4. **WAIST CIRCUMFERENCE**

**Purpose:** To measure the waist circumference of the subjects.

**Equipments:** Measuring tape, Pencil, and score sheet.

**Procedure:** Waist circumference is typically taken to be the half-way point between the bottom rib and the iliac crest, usually measured in centimeters.

**Scoring:** The reading in the measuring tape is taken to the nearest one centimeter.

5. **RESTING PULSE RATE**

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

**Equipment:** A stop watch (1/100) of a second and a chair.

**Procedure:** The pulse rates of all the subjects were recorded in a sitting position in the morning between 6.30 to 7.30 am. Before taking the pulse rate, the subject was asked to relax for about 30 minutes. To measure the pulse rate, the finger tip was placed on the radial artery at the thumb side of the wrist about an inch from the base of the thumb. At the same time as the signal to start counting was given, it should be designated as “zero” and the number of palpation was counted for one full minute.

**Scoring:** The number of pulse beats per minute was recorded as the score.
6. BLOOD PRESSURE

**Purpose:** To measure the pressure in the arteries exerted by the blood during the systolic and diastolic phase of cardiac cycle.

**Equipments:** Blood pressure cuff, chairs for the subject to sit in, sphygmomanometer, and stethoscope.

**Procedure:** Ask the subject to lie down in supine position on the bed minimum for 5 minutes. Tie the BP cuff properly at the proper position of the arm of the subject.

**First phase**

There is short sharp sound, associated with first heart sound. This indicates systolic pressure.

**Second phase**

The sharp sound repeated by a murmur. This phase is very short or even may be absent.

**Third phase**

This is the longest and distinct, accompanied by loud clear sound.

**Fourth phase**

The clear sound becomes muffled and distant. This indicates diastolic pressure. Below this all sounds disappear. In order to record rapidly changing blood pressure use of electronic pressure transducer is made. These convert the pressure into electrical signals, which are recorded on high speed electrical recorders.
7. BLOOD SUGAR

REQUIREMENTS

1. Disposable syringe and needle
2. Alcohol
3. Sterile gauze or cotton
4. Collection bottle containing anticoagulant
5. Disposable gloves

SOURCE: Blood is generally obtained of the veins of forearm or wrist by performing venipuncture. The medial cubital vein is usually chosen for venipuncture because it does not roll or slip beneath the skin.

PROCEDURE:

Ask the subject to sit calmly alongside of the table, keeping her arm on the table with palm upwards. Venipuncture should be performed with proper care and skill. The veins hence to be enlarged applying a tourniquet in the arm just above the elbow and just tight enough to stop the blood flow. Select the puncture site carefully after inspecting the arm. Clean the area with cotton touched alcohol. Remove the syringe and needle from the protective wrap. Ensure that the needle is not blocked and the syringe does not contain air. Grasp the elbow of the subject with your left hand hold his arm fully extended. Anchor the vein with your thumb and draw the skin tight over the vein to prevent it from moving. Hold the syringe in the right hand and push it firmly and steadily into the center of the vein. The needle should be held at an angle of 30-40 degree and introduced into the vein steadily and firmly. Push the needle along the line of the vein to a depth of 1-1.5 cm. Look for blood appearing in the barrel, slightly pull back the piston and fill with the required amount of blood.
8. **FPG (Fasting Plasma Glucose)**

For the estimation of FPG, a standard test using the GOD – Method was administrated. The blood samples (fasting) of the subjects were drawn in the morning. One ml of blood was drawn and poured into a vial with anti coagulants and incubated at room temperature for 10 minutes. After the serum was separated, with the help of the reagents provided in Trinder’s method, the readings were directly read on the computerized photometer.

— Normal value 70-110 mg/dl.

9. **PPG (Post Prandial Plasma Glucose)**

A standard test using the POD –method was administrated for the estimation of PPG. The blood samples of the subjects were drawn in the morning after two hours of breakfast. One ml of blood was drawn and poured into the vial with anticoagulants and it was incubated at room temperature for 10 minutes. After the serum was separated with the help of the reagent provided in the Trinder’s method, readings were taken from the computerized photometer.

— Normal value 90-130 mg/dl.


10. **HbA1C**

Glycosylated hemoglobin (GHB) is a normal adult hemoglobin (HbA1) which is covalently bonded to a glucose molecule. GHb concentration is dependent on the average blood glucose concentration. GHb reflects on the long time metabolic control of glucose in individuals. GHb is now widely recognized as an important test for the diagnosis of Diabetes Mellitus and is a reliable indicator of the efficacy of therapy.
For the estimation of HbA1C, The best acceptable method is Ion-exchange chromatography by BIORAD. Whole blood is mixed with using lysing reagent to prepare a hemosate. This is then mixed with a weekly binding cation-exchange resin. The non-glycosylated hemoglobin binds to the resin leaving GHb free in the supernatant. The GHb percentage is determined by measuring the absorbance of the GHb fraction and the total Hb.

\[
\frac{A_{\text{of GHb}}}{A_{\text{of THb}}} = \frac{\text{GHb %}}{7.2 \times \text{temp.factor (Tf)}}
\]

By using conversion chart of Glycosylated Hemoglobin A1%, Mean blood glucose and Glycosylated Hemoglobin A1c% is taken.

**EXPECTED RANGE**

- Non Diabetic :<8.0 %
- Good control:8.0-9.0 %
- Fair control :9.0-10.0 %
- Poor control: 10.0 % and above.


**CONTROL GROUP**

The subjects in the present study were permitted to undergo their natural lifestyle during the course of experiment. They were not given any specific training programme.

**COLLECTION OF DATA**

Subjects of the four groups namely walking group, physical exercises group, yogic exercises and control group were tested on selected criterion variables (height, weight, BMI, waist circumference, pulse rate, diastolic and systolic blood
pressures, PPG, FPG and HbAiC were treated with their respective training programme. It was considered as pre test score of them on the selected variables. On completion of pre-test, they were treated with the respective training programme for a period of six months. At the end of six month, all the subjects belonging to various treatment groups and control group were tested on selected variables. The data was collected by the researcher in person on an experimental basis. The data on height, bodyweight waist circumference, pulse rate, systolic and diastolic blood pressure, blood sugar and HbAiC were collected by administrating the appropriate tests and measurements procedures. All were given a chance to get familiar with the desired test and the procedures were explained prior to the administration of the tests. The collected data were processed with appropriate statistical techniques.

**STATISTICAL TECHNIQUE**

To analyze the data obtained from the physical, physiological and hematological variables of experimental and control groups the standard statistical procedures were applied. Analysis of covariance (ANACOVA) was used to find out the significant difference among experimental groups. The test of significance was fixed at 0.05 level of confidence. If the adjusted post test was significant, Scheffé’s post hoc-test was used to determine the significance of the paired mean differences. (Clarke and Clarke)