CHAPTER – III
METHODOLOGY

3.1 INTRODUCTION

The methodology adopted in the present study related with selection of subjects, selection of variables, experimental design, criterion measures, administration of training programme, collection of data and analysis of collected data have been described here under.

3.2 SELECTION OF SUBJECTS

To achieve the purpose of the study, sixty healthy men adults were selected as subjects from Prerana Educational Society Institute of Technology and Management, Shimoga, Karnataka. The age of the subjects were ranged between 19 to 25 years. All of the subjects had successfully passed a physical exam and completed a medical history questionnaire in which they were screened for any possible injury or illness. The subjects received all the necessary information about the study’s procedures in oral and written form. Each subject completed a medical history form, a training background questionnaire, and a written informed consent form.

3.3 EXPERIMENTAL DESIGN

The selected subjects (N=60) were divided into three equal groups. The experimental Group I underwent Resistance training with Asanas (RTAG), Group II underwent Resistance Training with Ayurvedic Massage (RTAMG), and Group III acted as control group (CG) and did not undergo any training.

3.4 SELECTION OF VARIABLES

The research scholar reviewed the available scientific literature pertaining to physical fitness and skill performance variables from various journals, books and taking into consideration of the criteria, feasibility and
availability of the instrument and the relevance of variables to the present study. The following variables were selected:

**Physical variables**

- Upper body muscular strength
- Lower body muscular strength
- Muscular strength endurance
- Flexibility
- Cardio-vascular endurance

**Physiological variables**

- Resting pulse rate
- Systolic blood pressure
- Diastolic blood pressure
- Maximum oxygen consumption

### 3.5 CRITERION MEASURES

To select the test items as criterion measures to measure the variables, the investigator has sought the experts’ consultation in the field of physical education, and in addition to this the investigator has gone through the literatures related to health, fitness and training methods. The selected tests are highly standardized, appropriate and ideal for the selected variables.

1. Upper body muscular strength and lower body muscular strength was measured by 1RM technique in bench press and half squat respectively and recorded to the nearest kilograms.
2. Muscular strength endurance was measured by using modified sit-ups and recorded in numbers.

3. Flexibility was measured by using sit and reach test and recorded to the nearest centimeters.

4. Cardio-vascular endurance was measured by using 1.5 mile run and recorded to the nearest minutes and seconds.

5. Resting pulse rate was measured by carotid artery and recorded to the nearest beats per minutes.

6. Systolic and diastolic blood pressure was measured by using sphygmomanometer and recorded to the nearest mm/Hg.

7. Maximum oxygen consumption was measured by using Queens College 3 minutes step tests and recorded to the nearest beat per minutes and converted into ml/kg/minute by using the formula \((111.33 - 0.42 \times \text{heart rate (beat per minute)})\).

**3.6 RELIABILITY OF DATA**

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

**3.6.1 Instrument Reliability**

With respect to the instruments used for measuring the variables, certificate of accuracy were obtained from appropriate instrument testing agencies. Moreover, reliability was established by recalibrating the scale by using known amounts of variables wherever required.

**3.6.2 Tester’s Competency**

The assistance of four specially trained physical education research scholars were sought for administration of various test items. They were
oriented about the procedures of measuring and recording the scores in each variable. The assistants were asked to measure few subjects on variables used in the study and coefficient of inter correlation of scores recorded by them was taken. The final measuring programme was conducted only on getting high coefficient of correlation.

3.6.3 Subjects Reliability

The subject reliability was established by test and re-test coefficient of correlation for the scores in each of the criterion measures. Re-testing was done within a period of a week of initial test in each of the criterion measures, to get the data for calculating test and re-test coefficient of correlation for reliability of the subjects.

Table 3.1: Reliability co-efficient of correlation of physical and physiological variables of men adults

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>VARIABLES</th>
<th>‘r’</th>
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<tr>
<td></td>
<td>Physical variables</td>
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<tr>
<td>1.</td>
<td>Upper body muscular strength</td>
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<tr>
<td>2.</td>
<td>Lower body muscular strength</td>
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<td>3.</td>
<td>Muscular strength endurance</td>
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<td>4.</td>
<td>Flexibility</td>
<td>0.93</td>
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<td>5.</td>
<td>Cardiovascular endurance</td>
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<tr>
<td></td>
<td>Physiological Variables</td>
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<td>6.</td>
<td>Resting pulse Rate</td>
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<tr>
<td>7.</td>
<td>Systolic blood pressure</td>
<td>0.89</td>
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<tr>
<td>8.</td>
<td>Diastolic blood pressure</td>
<td>0.98</td>
</tr>
<tr>
<td>9.</td>
<td>Maximum oxygen consumption (VO2 max)</td>
<td>0.93</td>
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</tbody>
</table>

3.7 ORIENTATION OF SUBJECTS

The investigator conducted a meeting with the subjects prior to the administration of test. The purpose, the significance of the study and the requirements of the testing procedure were explained to them in detail so that there was no ambiguity in their minds. All the subjects agreed to extend
their fullest co-operation in the testing procedures and training to put in their best efforts in the interest of the scientific investigation. The subjects were enthusiastic and co-operative throughout the study.

3.8 PILOT STUDY

The present study was mainly concerned with the effects of Resistance training with asanas, resistance training with Ayurvedic massage on selected physical fitness components and physiological variables of men adults. The types of training used in the present study were Resistance training with asanas, resistance training with Ayurvedic massage and Control group. For this purpose, the investigator conducted a pilot study. All the 60 subjects were selected for the pilot study. The subjects were tested with relevant test criterion measures. Based on this initial physical performance and the difficulty faced by the subjects appropriate modification were made to ensure the suitability, intensity, frequency and duration of training programme.

3.9 ADMINISTRATION OF TESTS

The modes of measurement of all criterion measures used in the study are briefly given. In order to get the fullest co-operation from the subjects, the objectives and requirements of the present study were well explained to them, along with demonstration whenever is required.

3.10 PHYSICAL VARIABLES

3.10.1 Upper body Muscular Strength (Bench Press)

Strength of the upper body was measured by bench press test (Jackson and Smith, 1974). The equipment needed for this test is a bench that is approximately 10 to 14 inches wide and weight bar (5 or 6 feet in length) and enough weight plates to be more than sufficient for the strongest subject. The subject was assumed on the floor, with the back straight. The partners helped the subject to lower the weight slowly to subject’s chest and...
then he attempted to raise the weight until his arms were straight. Scoring is the maximum weight lifted by the subject and it is recorded in kilograms.

3.10.2. Lower body Muscular Strength (Half Squat)

Half squat requires adjustable bench, a weight bar (5 to 6 feet in length) with enough weight plates, knee cap and a thick towel to pad bar. After adjusting the desired amount of weight on the bar, two assistants place the bar upon the shoulders (and behind the neck) of the subjects as she/he stands near the edge of the bench. With the feet a comfortable distance apart and a firm grasp of the hands on the bar, the subject lower to an erect sitting position on the bench. Then, without rocking back and forth, the subject returns to the standing position. After the two assistants remove the weight, the performer may readjust the weights if a second trial is to be taken. The total weight of the barbell (including the collars) satisfactorily lifted was recorded over body weight. Only the best lift of two trials is recorded.

3.10.3 Muscular strength endurance

Modified Sit-Ups was a test to measure strength and endurance. The procedure of the test is as follows. The subject lies flat on the back with knees bent and feet on the floor with the heels no more than 1 foot from the buttocks. The knee angle should be no less than 90 degrees. The fingers are interlocked and placed behind the neck with the elbows touching the floor. The feet are held securely by a partner. The student then curls up to a sitting position and touches the elbows to the knees. This exercise is repeated as many times as possible in the time requirement. One point is scored for each correct sit-up. The score is the maximum number of sit-ups completed in 60 seconds (Barrow and Mc Gee, 1989).
3.10.4 Flexibility

Sit and Reach test (AAHPERD) was used to measure the flexibility of subjects. For this the equipments used were sit and reach apparatus and score sheet. The procedure of the test administration is as follows. The sit and reach apparatus should have the 25 cm mark equivalent to the point where the feet touch the box. The subject has to warm-up for the test by performing slow stretching movements before taking actual measurements. The subject would sit barefoot with the legs fully extended with the soles of the feet placed flat against the horizontal cross board of the apparatus, with the inner edge of the sole placed 2 cm from the scale, keeping the knees fully extended, arms evenly stretched and palms down. The subject bends and reaches forward (without jerking) pushing the sliding marker along the scale with the fingertips as far forward as possible. The position of maximum flexion must be held for approximately two seconds. The test is repeated twice. If the knees flex, the trial is not counted. There should be no attempt to hold the knees down. Recording the maximum distance reached to the nearest 0.5cm (Operation manual for “The Canadian Fitness Challenge”, 1982).

3.10.5 Cardiovascular endurance

To measure the cardio vascular endurance 1.5 Mile Run and Walk Test (AAHPERD) was used. For this, the equipments used were Stop Watch, Measuring Tape, Score Card, Pencils and 400 Metres Track. The procedure of the test administration is as follows. The group running can be divided into 2 sections for testing purposes. Each student walked with a partner. While one student was running, the other partner checks laps and marks the time at the finish. The instructor should talk about pace and the time a subject should be running at the end of each lap. The students are instructed to listen to the elapsed time to be called out as they pass the finish at the end of each lap. After they have finished the run, students are instructed to continue walking or jogging for at least a lap in order to regain
normal breathing. Time is recorded to the nearest one-tenth of a second by the instructor after all runners have finished (Barrow et al., 1989).

3.11 PHYSIOLOGICAL VARIABLES

3.11.1 Resting pulse rate

Carotid pulse was checked by the researcher on the side of the neck of the subjects, placing index and middle finger, in the hollow between the windpipe and the large muscle in the neck. Pressed lightly until pulse is felt. Counted the number of pulse for per minute were recorded as a score.

3.11.2 Blood pressure

Sphygmomanometer, stethoscope and a comfortable chair are used to measure the systolic and diastolic blood pressure. The means and methods of this are as follows. The subject was asked to sit on a chair comfortably. While measuring blood pressure, the subject’s right arm was completely made bare to make certain that clothing does not press the blood vessels. The instrument was kept at the level of the heart. The blood pressure measurement was taken with the subject in the sitting position; his forearm was kept straight and relaxed position. The cuff was wrapped round the arm evenly with the lower edge approximately one inch above the anticubal space. The stethoscope receiver was placed firmly over the brachial artery in anticubital space. The cuff was inflated until the artery collapsed fully to the extent that no pulse beat was heard. When no pulse beat was heard, the pressure was slowly released till the first sound of the pulse was heard. This was the systolic blood pressure. When the pressure was further released gradually, the sound of the pulse was reduced in intensity and quality. This recording was the diastolic blood pressure. Both the recordings were in millimeters of mercury (mm of Hg).
3.11.3 Maximum oxygen consumption (Queens College 3 Minute Step Test)

This step test provides a measure of Vo$_2$ max. The equipment required for this test was 16.25 inches or 41.3 cm step, stopwatch, metronome or cadence tape. The subjects stepped up and down on the platform at a rate of 24 steps per minute, for a total of 3 minutes. Afterwards the subject sat immediately on completion of the test, and the heart beats were counted for 15 seconds from 5-20 seconds of recovery. The estimation of VO$_2$max was calculated from the test results, using the formula below:

\[ \text{VO}_2\text{max (ml/kg/min)} = 111.33 - 0.42 \times \text{heart rate (beat per minute)}. \]

3.12 Training Programme

<table>
<thead>
<tr>
<th>TABLE – 3.2</th>
<th>RESISTANCE TRAINING WITH ASANAS</th>
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<tr>
<td>weeks</td>
<td>Intensity</td>
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<td>1st-2nd Week</td>
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<tr>
<td>3rd-4th Week</td>
<td>55%</td>
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<td>5th-6th Week</td>
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<td>7th-8th Week</td>
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<td>70%</td>
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<td>11th-12th Week</td>
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TABLE -3.3
RESISTANCE TRAINING WITH AYURVEDIC MASSAGE

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<th>Repetitions</th>
<th>Sets</th>
<th>Duration of Resistance Training</th>
<th>Density between exercise</th>
<th>Frequency</th>
<th>Duration of Ayurvedic Massage</th>
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</thead>
<tbody>
<tr>
<td>1st-2nd Week</td>
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<td>40 min</td>
<td>2 min</td>
<td>3 days/week</td>
<td>20 min</td>
</tr>
<tr>
<td>3rd-4th Week</td>
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<td>3</td>
<td>40 min</td>
<td>2 min</td>
<td>3 days/week</td>
<td>20 min</td>
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<td>5th-6th Week</td>
<td>60%</td>
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<td>3</td>
<td>40 min</td>
<td>2 min</td>
<td>3 days/week</td>
<td>20 min</td>
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<td>7th-8th Week</td>
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<td>3</td>
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<td>3 days/week</td>
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<td>2 min</td>
<td>3 days/week</td>
<td>20 min</td>
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<tr>
<td>11th-12th Week</td>
<td>75%</td>
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<td>3</td>
<td>40 min</td>
<td>2 min</td>
<td>3 days/week</td>
<td>20 min</td>
</tr>
</tbody>
</table>

The following resistance exercises were selected

**Resistance training for upper body**


**Resistance training for Lower Body**

Squat, leg extension, leg curl and standing heel rise.

3.12.1 **Bench press**

The subjects were asked to lie on a bench press with their legs slightly apart and feet on the floor. Grip the barbell with palms facing up and wider than shoulders. Lift the barbell off the rack to the starting position (above face), arms fully extended. Slowly lower the barbell until it touches the chest, elbows pointing out. Slowly press (raise) the barbell to the starting position

3.12.2 **Shoulder press**

The lift is performed standing, by pressing the weight from the anterior deltoids overhead until the arms are extended.
3.12.3 Triceps extension

Began with, stand up holding a barbell using a pronated grip (palms facing forward) with hands closer than shoulder width apart from each other. Subjects feet should be about shoulder width apart. Then barbell was elevated above their head until arms are fully extended. Elbows were kept in. That was the starting position. Upper arms were kept close to their head and elbows in, perpendicular to the floor, lowering the resistance in a semicircular motion behind head until forearms touched biceps.

3.12.4 Biceps curl

It was started with a standing position with feet kept apart at shoulder width. Barbell was grasped with hands at shoulder width. Grip should be underhand (palms facing upwards). Stand upright and let the bar hang in front of thighs. Bend at elbows to curl the bar to shoulder level. Pause momentarily at this top position. Slowly lower the bar back to the starting position.

3.12.5 Upright row

The subjects were asked to stand erect holding the weights in front of the thighs with palms facing the in front of the thighs. Leading with the elbows, pull the weights up the front of the body until the weights are approximately level with the chest and elbows which are at shoulder height. Slowly lower the weights back down to the starting position.

3.12.6 Leg curl

Lay on the bench facing down. Knees should be just over the edge of the bench. Adjust the machine so that the padding is on the low part of calf muscle. Grip the normally supplied handles. Bend the legs at the knee to bring the padding to touch the back of legs. Return the weight back to the starting position using a controlled movement.
3.12.7 Leg extension

Sat on the machine and press the back firmly against the back pad. Place the ankles behind and in contact with the foot pad. Place the legs parallel to each other. Raise the pad by fully extending the knees. Keep the torso erect and firmly pressed against the back pad. Allow the knees to slowly flex back to the starting position. Keep the torso erect and firmly pressed against the back pad.

3.12.8 Squat

Barbell was held at back of shoulders, keeping palms forward in standing position, while feet kept apart at hip-width. Squat down keep shins perpendicular to the floor until thighs are parallel to the floor. Look forward and keep back straight. Slowly stand up to the starting position.

3.12.9 Standing heel raise

Subjects were asked to stand erect with palm facing forward, hands wider than shoulder width apart and bar resting behind the neck on shoulders. The subjects were instructed to rest balls of feet on two inch block with heels apart and then they raise the body on their toes quickly holding the position for one second.

3.13 ASANAS

The following asanas were selected:

Padahasthasana, Halasana, Trikonasana, Chakrasana, Sarvangasana, Matsyasana, Bhujangasana, dhanurasana, Shalabhasana, Naukasana, Mayurasana, Vajrasana, Yogamudra, Ushtrasana, Ardhamatsyendrasana and Shavasana.
3.13.1 Padahastasana

Subjects were advised to stand with feet together, arms extended upwards and the whole body pulled upwards. Bring arms forward to touch ground in front of feet or to hold the toes with hands. Head should touch the knees, body from hips to feet should remain absolutely straight.

3.13.2 Trikonasana

Subjects were advised to stand straight, feet apart and arms on the sides, palms facing and touching the thighs. While inhaling, raise right arm slowly up to shoulder level, palm facing down with the elbow straight. Then turn the palm upwards and raise the hand so that it is in a straight line, touching the ear. While exhaling, bend as far as possible to the left. This is the final position of Trikonasana. Maintain it for a few seconds and return to normal position gradually. The same is to be done on the other side. This completes the process. The lateral stretch should be felt.

3.13.3 Chakrasana

Subjects were advised to lie on their back. Bend legs at the knees and place them nearer to the hips. Place the palms by the sides of head by bending the elbows and fingers towards body. While inhaling, slowly raise the body upward, resting on the feet and the palms, thus curving the spine. Retain the pose for a few seconds and, breathing normally, gradually increase the duration. Concentrate on the spine. While exhaling slowly come back and rest.

3.13.4 Sarvangasana

Subjects made to lie on their back with legs and arms straight, feet together and palms on the floor beside the body. While exhaling, advised to raise their legs slowly upto 90 and then the whole body and the rest weight on the arms so that the chin touches the jugular notch. Bring the arms and
hands to support the body at the hip region (fingers at the back and thumb in front of the body). The entire weight of body rests on the head, neck and shoulders while the arms are used for balancing. Keep the trunk, legs and hips in a straight line and as vertical as possible. Focus eyes on toes, with chin pressed against the chest. Retain the posture for one for three minutes. While exhaling, return to the lying position by bringing the leg backward and releasing the hands and the palms.

3.13.5 Matsyasana

Subjects were made to sit with legs fully stretched out. Bend each leg at the knees and place feet on the other hip joint. Both the heels are adjusted in such a way that each presses the adjacent portion of the abdomen. This forms the foot-lock in a sitting position. Bend backwards while exhaling and rest weight on the elbows. Push the neck backwards and slightly raises the hip upward thus making an arch of the spine. Then, by making hooks of the forefingers, hold toes on the corresponding side without crossing the arms. This posture should be maintained for some time with slow and deep breathing. For reverting to the original position, release the foot-lock and return to the supine position by lowering the arch.

3.13.6 Halasana

Subjects were advised to lie flat on their back with legs and feet together, arms at the sides, closed and placed beside the thighs. Keeping their legs straight, inhale slowly, and raise the legs to 30, 60 and 90, pausing at each stage. While exhaling push the legs further over and above the head and then beyond, so that they touch the floor (without bending the knees). Stretch the legs as far as possible so that chin presses tightly against the chest. Then raise the hands and try to hold the toes. Retain the pose Breathe normally. While exhaling, return to the standing position. Slowly go through the process in the reverse order.
3.13.7 Bhujangasana

Subjects were advised to lie in the prone position with the forehead resting on the floor, legs straight and feet together, toes pointing backwards, arms bent at the elbows, palms flat on the floor, shoulders and arms on the sides of the chest and fingers kept straight and together. Inhale slowly and raise the upper body (head, neck and chest). Look at the ceiling (sky) with the neck bent as far back as possible. For raising the body, only the back muscles are to be used. Do not push up with your arms. Waist, legs and toes should remain on the ground. Raise the body as much as possible, holding the position and retaining the breath for a few seconds. Exhaling slowly, return to the original position.

3.13.8 Dhanurasana

Subjects were instructed to lie down with face and the forehead touching the ground, arms extended along side the body and legs straight. Bend the legs at the knees towards the hips, bringing them forward so that they can be held firmly by the hands at the ankles on the respective sides. While inhaling, stretch the legs backwards and raise the thighs, chest and head simultaneously. Hands should be kept straight. The weight of the body should be on the navel. Knees should be kept close, if possible, with eyes looking upwards. This posture should be retained for at least a few seconds, holding the breath.

3.13.9 Shalabhasana

The subjects were advised to lie on stomach with legs stretched, and feet together, chin resting on the ground. Keep both hands under the thighs. While inhaling, slowly lift both the legs upwards and stretch as far as possible without bending the knees and toes. Retain this position for some time and then, while exhaling, lower the legs slowly and bring back to the original position.
3.13.10 Naukasana

The subjects were advised to lie down straight on the abdomen with forehead resting on the floor. Keep the feet together and arms extended forward with palms on the floor. While inhaling, raise the arms, head, neck, shoulders, trunk and legs simultaneously as high as possible. Keep elbows and knees straight. Balance the entire weight of body on the navel. Maintain this posture as long as possible.

3.13.11 Mayurasana

The subjects were advised to sit in Vajrasana position. Then place the hands in between the thighs, fingers facing outward. Try to raise their body on the palms slowly. Adjust the elbows on the navel. Hold breath and slowly try to move the body forward. Raise the knees. Then try to go to the final position by stretching the legs back. Balance the body parallel to the ground on the fulcrum of the upper arms. Maintain this posture for 10 to 15 seconds. While releasing the posture, bring the toes to the ground first, then knees and return to the normal position.

3.13.12 Vajrasana

The subjects were advised to sit comfortably, keeping both the legs stretched in front. Bend their right leg at the knee and place the foot under the right hip. In the same manner, fold the left leg and place the foot under the left hip. Try to adjust their feet so that the toes touch each other, and the heels were apart. Keep the knees together and let both the hips fit in between the heels. Place the hands on the thighs and keep the trunk and neck erect.

3.13.13 Ardha Matsyendrasana

The subjects were advised to sit on the ground, stretching both the legs forward. Bend the right leg and place the heel under the left hip. Now bend left leg, cross it over and place the foot by the side of the right knee. Try to hold the left ankle by passing the right arm over the left side of the
left knee. At the same time, exhale and take the left arm behind the back and press the right side under the ribs. This has to be done by twisting the trunk to the back as much as possible. Maintain this posture for a few seconds and increase the duration to two minutes gradually. Repeat the same process on the other side for the same duration.

3.13.14 Yogamudra

The subjects were advised to sit in Vajrasana. Take both hands towards the back and catch the wrist of one hand with the other. Keep neck straight. Slowly start bending from the waist. Continue the bending till forehead touches the ground. After maintaining it for some time raise the forehead and chest. Release the hands also and sit erect.

3.13.15 Ushtrasana

The subjects were advised to sit the on knees. Face the toes down. Keep the knees slightly apart. Bend the neck, chest and back, stretching the hands over the head. Bend backward while exhaling. Place the palms on each heel. Stretch the chest and stomach fully. Remain in this position. While inhaling, came to normal position.

3.13.16 Savasana

The subjects were advised to lie straight on the back with ease. Make distance of about one and half feet between legs. Place hands straight on the ground at the distance of six inches from the body. Palms facing upward, fingers will remain slightly curled, eyes closed. After maintaining it for some time and return.

3.14 AYURVEDIC MASSAGE

After the resistance training 15 minutes rest was given, then subjects were requested to apply ksheera bala taila below the neck in standing position especially joints and extremities upto 20 minutes. After that they were instructed to take hot water bath.
**Ksheera bala tailam**

It is a medicated oil prepared out of Bala (Sida cordifolia) and Cows Milk in Sesame oil base. It is mainly alleviate pain, tones up muscle, increases circulation, nourishes muscle and mitigates tiredness. Massage was done by the subjects themselves. The oil was applied in the direction of hairs as mentioned in the Ayurvedic science.

**3.15 COLLECTION OF DATA**

At the end of the treatment period, as post test, the subject belong to the treatment groups namely resistance training with asanas group (RTAG), resistance training with Ayurvedic massage group (RTAMG) and control group (CG). Were tested on criterion variables (muscular strength, muscular strength endurance, flexibility, cardio-vascular endurance, resting pulse, blood pressure and VO$_2$ max) as such in the pre-test of the same. The collected data were processed with appropriate statistical tool.

**3.16 STATISTICAL TECHNIQUE**

The present study pays attention mainly on testing the means of three treatment groups and secondarily deals with the increase of means in each group from baseline to post treatment for various measures. The statistical tool used for these are described here. The group means gains recorded by the various groups during the experimental period of twelve weeks to the criterion measures were tested for significance by applying depended t-test. Analysis of co-variance was applied to determine whether the three programs of training produced significantly different improvements in selected variables after 12 weeks of training. Since the initial means were not matched, comparison between actual could not be made, all means were adjusted by regression to a common mean. Further the significance of difference of pair of adjusted final group means was tested for significance by applying Scheffe’s post hoc test.