Chapter – III

METHODOLOGY

This chapter contains the detailed explanations about how the whole research work was conducted. This includes purpose of the study, the research questions, hypotheses of the study, the sources of data, the procedures of data collection, selection of colleges and subjects, criteria, Experimental design, variables selected for the comparisons, how reliability and validity established for the various tests of the criterion variables, frame of the training program, schedule of exercises, the type of statistical tools (techniques) used to analyze the data and at what significance level the results were compared and understood to draw the conclusions and to test the research hypotheses. The study is a descriptive survey which employed both quantitative and qualitative techniques of data analysis.

3.1. Sources of Data

The study employed 180 (N=180) male Volunteered students as a primary data source that are belonged to four colleges in the city of Visakhapatnam namely, B.V.K. Degree College, Dr.L.B. Degree College, Gayatri Vidya Parishad Degree College, and Prism Degree College (See Appendix- I to Appendix-III).

In addition, secondary data source like books, research journals and scientific articles were used in this study (See Chapter V, under Bibliography and References).

3.2. Selection of Colleges and Subjects

There are many colleges in and around the city of Visakhapatnam. Basing on conducive environments (situations) for conducting an experimental study four colleges were selected amongst others from the city of Visakhapatnam as mentioned below.
1. B.V.K. Degree College (Bhartiya Vidya Kendram Degree College).

2. Dr. Lankapalli Bullayya College

3. Gayatri Vidya Parishad Degree College,

4. Prism Degree College

These colleges were selected on the basis of their necessary infrastructural facilities and the availability of the sports facilities. Hence, 180 male students (45 from each college) were randomly selected as subjects for this actual research study.

These Colleges are offering degree programs in various disciplines as they are recognized by the state government of Andhra Pradesh and affiliated to Andhra University, Visakhapatnam.

Visakhapatnam is one of the famous cities in India having various natural resources and being a centre for education in Andhra Pradesh, India as there are several state and private run schools, Polytechnic colleges, Degree Colleges, Engineering colleges, Medical College and Universities(Appendix XVI).

The following criteria were used for selecting subjects for this study.

1. **Sex**: Male students

2. **Age**: Ranging between 19 and 23 years during the academic year 2011-2012.

3 **Health Statuses**: Healthy subjects were selected basing on their medical certificates.

4. **Experiences towards Sports Activity**: Only none Physical Education students and who had no previous experience in any kind of regular physical exercise, sports and games in their college and Andhra University were selected for this study.

Andhra University is one of the oldest premier universities in India and located in the heart of Visakhapatnam city. Six hundred thirty six (636) colleges are affiliated to Andhra University (Appendix XV).
3.3. Experimental Design

The study employed 180 male Volunteered students who were made randomly into three groups for the research study as follows.

1. Experimental group as a **Control Group** (60 students from four colleges; each 15 students). This group includes subjects who never engaged in any health related physical fitness exercises and therapeutic massage interventions (Appendix- I).

2. Experimental group as an **Experimental Group - A** (60 students from four colleges; each 15 students). This group comprises subjects who engaged only in health related physical fitness exercises (Appendix- II).

3. Experimental group as an **Experimental Group - B** (60 students from four colleges; each 15 students). This group comprises subjects who engaged both in health related physical fitness exercises and therapeutic massage interventions (Appendix- III).

The experimental groups (except control group) were engaged in the training program for consecutive twelve weeks throughout the study period.

All groups were subjected to pre-test sessions prior to the training program for the experimental treatments.

Finally, for all groups, post-tests were administered after the twelfth week of the training period on the selected health related physical fitness variables with the help of American Association for Health, Physical Education and Recreation (AAHPER) youth fitness testing manual to find out the effect of health related physical fitness exercises and therapeutic massage interventions particularly related to the strengths of calf and thigh muscles.

3.4. Selection of Variables

Based on the American Association for health, Physical Education and Recreation (AAHPER) youth fitness testing manual, health related physical fitness exercises were taken for the study and comparative analysis on these
variables among the selected three groups of study, i.e., Control Group, Experimental Group - A, and Experimental Group - B.

Based on the guide line of AAHPER youth fitness testing manual, for experimental research studies like this one, tests were conducted twice throughout the study program as follows.

1. Tests were administered before the starting of the actual training program of twelve weeks.

2. Tests were administered after the end of the actual training program of twelve weeks.

Accordingly, the following six variables were selected for pre-tests and post-tests of this study.

a) **Long Jump from Stationary Position**: To measure the Explosive-strength of calf and thigh muscles of subjects’ involved in the test administration.

b) **Shuttle Run**: To measure speed-strength of thigh and calf muscles of subjects’.

c) **50 Meters Dash**: To measure Speed-strength of calf and thigh muscles of subjects’.

d) **Hop steps with Right Leg (2x10 meters)**: To examine the explosive-strength and functional performances of the right leg (calf and thigh muscles) of subjects’.

e) **Hop Steps with Left Leg (2x10 meters)**: To examine the Explosive-strength and functional performances of the left leg (calf and thigh muscles) of subjects’.

f) **800 Meters Run**: To measure Speed-endurance and strength of calf and thigh muscles of subjects’.

**3.5. Instrument Reliability**

The reliability of the testing procedure and the test measurements were established through using the well calibrated and standard equipment like
electronic and digital stop watches of high repute manufacture (Casio and Fastrack), statures, Harpenden Skin folds Caliper, Karada Scan (Omron), Stadiometer, Pedometer (Omron), and measuring tapes were used for this research study. In addition, cones relay batons, Skipping ropes, and lime powder were used for the study. The instruments were purchased from reputed firms and they were branded new and were kept in good condition. Hence, their calibrations were accepted as accurate enough for the purpose of this study.

3.6. Competency of Testers and Reliability of Tests

There were well trained testers (College and University physical Directors) who assisted the investigator. The purposes and the testing procedures were explained to the testers to ensure uniformity, reliability, and liability of the testing techniques.

Reliability was established by the test and retest method. Appropriate care was taken by the researcher that each test item was administered by the same tester to ensure consistency of result which was obtained in each test item. The scores (data) obtained from the subjects during the period of test administration were analyzed using the mean, standard deviation, t'- Value, p-Value and F- value (ANOVA).

All measurements were taken only under the control of the investigator of this study.

3.7. Orientation of the subjects

The subjects for this study were well oriented on the scope of the investigation. The testing techniques and test procedures were described. Whatever and whenever necessary, explanations and demonstrations were executed by the investigator.

3.8. Pilot Study

A pilot study in health related physical fitness exercises with therapeutic massage was conducted before the actual research study to ensure the validity and reliability of the study, types of exercises, intensity, duration and
repetitions of workouts. In this program thirty six male Volunteered subjects ranging between the age of 19 and 23 years were participated from four colleges namely, B.V.K. Degree College, Dr. Lankapalli Bullayya College, Gayatri Vidya Parishad Degree College, and Prism Degree College.

Nine subjects were participated from each college mentioned above in which 12 of the subjects were not engaged in any health related physical fitness exercises and therapeutic massage interventions as a Control Group. 12 of other subjects were grouped as an Experimental Group -A who engaged only in health related physical fitness exercises and the rest of 12 subjects also were grouped as an Experimental Group -B who engaged in both of health related physical fitness exercises and therapeutic massage interventions.

The subjects were told and guided taking part in physical exercises and massage interventions as long as possible with their maximal efforts.

Pre-test and post-test measurements were taken on all subjects of Experimental Group - A, Experimental Group-B and Control Group. Thus, significant performances were observed in groups of Experimental Group - A students and Experimental Group - B students.

Finally, results collected from the pilot study were declared to all subjects for their overall satisfaction and kept with the investigator for further reference.

This pilot study was conducted for one month (July, 2011) at the Institute of Yoga and Consciousness (Yoga Village), Andhra University (Appendix- XIII).

3. 9. Frame of the Training Program

The training program of this study was structured based on the results and methodology employed for pilot study which was carried out previously i.e., types of exercises, frequency of exercises, intensity, duration of time and etc were applied also in this training program,

Basing on the frame of the training program, types of exercises were divided in two main parts. The first part includes 15 apparatus exercises (exercises with machines in Gym) which were practiced twice a week in the Gym. The
second parts of the exercises were 13 free exercises practiced twice a week in the Gym, on stairs and on well laid 400 meter track (standard running track).

Massage interventions with different techniques also were practiced throughout the training program. Some of the physiological and physical variables (4 variables) such as blood pressure, pulse rate, height and weight measurements were frequently observed during the training program.

Thus, the subjects were told to perform the selected exercises and massage interventions throughout the program (twelve weeks) under researcher’s guidance (See Figures 3.1 to 3.55).

Three main centers were selected for the training programs namely, Department of physical Education, Andhra University, Institute of Yoga and Consciousness (Yoga village), Andhra University, and Dr. Lankapalli Bullayya College, Andhra University (See Appendices XII, XIII, and XIV).

Two of these centers i.e., Department of Physical Education, Andhra University, and Dr. Lankapalli Bullayya College, Andhra University were well equipped with modern Gymnasiums, well laid play grounds and massage parlors while Institute of Yoga and Consciousness (Yoga Village) was well equipped with modern massage parlors and spacious Yoga halls.

3.10. Physiological and Physical Variables

Some of the physiological and physical variables such as pulse rate, blood pressure, height and weight measurements were frequently observed during the course of the study.

3.10.1. Resting Pulse Rate: The pulse rate is the number of times a person’s heart beats in one minute. The pulse rate can give important information about overall health and fitness status of each subject taking part in experimental studies.

Normal values of heart rate depend on the person's age and fitness level. The pulse should be regular, meaning that the time between pulsations is the same. An irregular pulse often indicates an electrical problem in the heart. This may be normal for a given person or may indicate a life-threatening
problem. For example, irregular pulse rate can be due to as heart attack or enlargement of the heart.

In most people, the pulse is an accurate measure of heart rate. Under certain circumstances, including arrhythmias, some of the heart beats are ineffective and the aorta is not stretched enough to create a palpable pressure wave. The pulse is irregular and the heart rate can be higher than the pulse rate. In this case, the heart rate should be determined by auscultation of the heart apex. The pulse deficit should be determined by simultaneous palpation at the radial artery and auscultation at the heart apex (Figure 3.1)

3.10.2. Blood Pressure: The force exerted by blood against the arterial walls is said to be blood pressure. It is measured in millimeters of Mercury (mmHg). Blood pressure is expressed as a ratio (eg.120/80).

The first number is the systolic pressure or the pressure when the heart pushes blood out into the arteries. The second number is the diastolic pressure or the pressure when the heart rests. (http://www.quickmedical.com/Life Source/facts.html).

3.10.2.1. Systolic Blood Pressure: The blood pressure rises when the heart is contracting. It is specifically the maximum arterial pressure during contraction of the left ventricle of the heart. The time at which ventricular contraction occurs is called systolic. A systolic murmur is a heart murmur heard during systole, the time the heart contracts, between the normal first and second heart sounds. “Systolic” comes from the Greek ‘Systole”, means “a drawing together or a contraction”. The term has been in use since the 16th century to denote the contraction of the heart muscle.

Normally, the body maintains the pressure of blood in the arteries within a narrow range. If blood pressure is too high, it can damage a blood vessel and even rupture it, causing bleeding or other complications. If blood pressure is too low, not enough blood reaches all parts of the body; as a result cells do not receive enough oxygen and nutrients and waste products are not adequately removed. Even so, having low blood pressure is generally better than having high blood pressure. Healthy people, who have blood pressure,
that is low, but still in the normal range tend to live longer than those who have higher normal blood pressure.

3.10.2.2. Diastolic Blood Pressure: It is the minimum pressure that remains within the artery when the heart is at rest. It refers to the time when the heart is in a period of relaxation and dilatation. The diastolic pressure is specifically the minimum arterial pressure during relaxation and dilatation of the ventricles of the heart when the ventricles fill with blood.

A diastolic murmur is a heart murmur heard during diastole, the time the heart relaxes."Diastolic “comes from the Greek diastole meaning “a drawing apart”. The term has been in use since the 16th century to denote the period of relaxation of the heart muscle (Figure 3.2).

3.10.3. Height and Weight Measurements

Height and weight are amongst physical variables which are mostly used in experimental researches.

Height and weight measurements are used to calculate your body mass index, or BMI, a measure of healthy versus unhealthy weight.

Body Mass Index (BMI) is a number based on your height and weight. BMI determines whether your weight is appropriate according to your height. BMI can determine whether you are considered to be underweight, overweight, obese or within normal range. Your BMI can help you evaluate any lifestyle changes that may be needed in order to lose weight, gain muscle or gain fat. Although BMI is useful for determining overall health, it is not the only factor in determining obesity, and should only be used by adults. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m²). For example, an adult who weighs 70kg and whose height is 1.75m will have a BMI of 22.9 (BMI = 70 kg / (1.75 m²) = 70 / 3.06 = 22.9).

Hence, measuring your weight and height accurately is very important when monitoring your health status (Figures 3.3 and 3.4).
3.11. Exercise Schedule

The running program of the training was scheduled in the evening session for Experimental group - A (subjects engaged only in health related physical fitness exercises) between 6p.m. and 6:50 p.m. for six days a week. (Appendix-X)

In the same way, a training program was set up in the morning session for experimental group - B (Subjects engaged both in health related physical fitness exercises with therapeutic massage interventions) between 6a.m. and 6:50a.m. for three days a week and 6a.m. to7:25 a.m. for another three days a week (Appendix- XI).

Totally, six days a week were set-up for the exercise schedule i.e., Monday, Tuesday, Wednesday, Thursday, Friday and Saturday while Sunday was set up as a holiday (rest day) for all experimental groups.

This program was conducted for consecutive three months (September, October, and November, 2011).

In connection with this research study, different pictures were taken during the training sessions with respect to various practical and technical activities including massage interventions (Figures 3.1 to 3.55).
Figure 3.1: Measuring Pulse Rate (Heart Beats)

Figure 3.1 shows when pulse rate is measured placing two fingers on the radial artery on the thumb side of the wrist (left arm) with palm facing up and pressed slightly until the subject feels the radial pulse and counted at the point of termination for 10 seconds and multiplied by 6 to get maximum (normal) resting heart rate. (Crude formula, K.H.Cooper 1992).

For an adult, a normal resting heart rate (RHR) ranges from 60 to 100 beats a minute. For a well-trained athlete, a normal resting heart rate may be closer to 40 beats a minute. For healthy adults, a lower heart rate at rest generally implies more efficient heart function and better cardiovascular fitness.

To measure your heart rate, simply check your pulse with your palm facing upward, place two fingers on the thumb side of your wrist or place your index and third fingers on your neck to the side of your windpipe. When you feel your pulse, count the number of beats in 10 seconds. Time yourself with a timer or the second hand on a clock or watch. Multiply this number by 6 to determine how many times your heart beats in one minute. (http://www.realpolice.net/forums/physical-fitness-132/98630-heart-rate-where-you-chart.html).
Figure 3.2 shows that a qualified medical practitioner is measuring and the investigator is recording the blood Pressure of the subjects taking part in the study.

Blood pressure may be excessively high (hypertension) or low (hypotension). Either condition may lead to heart disease, organ damage, stroke, or early mortality. Hence, the investigator of this study strictly followed the following guidelines for the assessment of blood pressure in order to manage the training and test administration load of each variable applied on subjects during the course of the study.
<table>
<thead>
<tr>
<th>BP Classification</th>
<th>BP Systolic (mmHg)</th>
<th>BP Diastolic (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;120</td>
<td>and &lt;80</td>
</tr>
<tr>
<td>Pre-hypertension</td>
<td>120 - 139</td>
<td>or 80 - 89</td>
</tr>
<tr>
<td>Stage 1 Hypertension</td>
<td>140 - 159</td>
<td>or 90 - 99</td>
</tr>
<tr>
<td>Stage 2 Hypertension</td>
<td>&gt; 160</td>
<td>or &gt; 100</td>
</tr>
</tbody>
</table>

**Figure 3.3: Measuring of Weight**

*Figure 3.3* displays when subject’s weight is measured by the investigator on a calibrated body scale to the nearest 0.1 kilogram.

Height and weight measurements are used to calculate your body mass index.

Body Mass Index (BMI) is a number based on your height and weight. BMI determines whether your weight is appropriate according to your height. BMI can determine whether you are considered to be underweight, overweight,
obese or within normal range. Your BMI can help you evaluate any lifestyle changes that may be needed in order to lose weight, gain muscle or gain fat. Although BMI is useful for determining overall health, it is not the only factor in determining obesity. It is defined as the weight in kilograms divided by the square of the height in meters (kg/m²). For example, an adult who weighs 70kg and whose height is 1.75m will have a BMI of 22.9 (\(\text{BMI} = \frac{70 \text{ kg}}{(1.75 \text{ m}^2)} = \frac{70}{3.06} = 22.9\)).

**Calculating BMI**

BMI is calculated by dividing weight (in kilograms) by height (in meters) squared. The World Health Organization defines overweight as having a BMI value of 25.0 to 29.9, while a BMI of greater than 30 is considered obese. A BMI value of 18.5 to 24.9 is generally considered normal, and a BMI less than 18.5 is defined as underweight. The cut off points were chosen as a result of numerous research studies, both observational and epidemiologic in nature, which relate BMI to risk of disease and premature death.

**BMI CLASSIFICATION**

<table>
<thead>
<tr>
<th>Weight Classification/category</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5-24.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>25-29.9</td>
</tr>
<tr>
<td>Obese</td>
<td>30-39.9</td>
</tr>
<tr>
<td></td>
<td>(30.0-34.9- class I obesity)</td>
</tr>
<tr>
<td></td>
<td>(35.0-39.9- class II obesity)</td>
</tr>
<tr>
<td>Morbidly Obese</td>
<td>≥40.0- class III obesity</td>
</tr>
</tbody>
</table>
Now you may know your BMI basing on the above classification. After calculating your BMI, you've either fell into one of five weight categories i.e., underweight, normal, overweight, obese or morbidly obese. 
(http://www.livestrong.com/article/40808-body-mass-index-advantages/)

**Figure 3.4: Measuring of Height**

![Figure 3.4 displays when height was measured with wall-mounted stadiometer (stature of Bio+plus) to the nearest 0.1 meter.](image)

Measuring height and weight accurately is important when monitoring your health. Height and weight measurements are used to calculate your body mass index, or BMI, a measure of healthy versus unhealthy weight. Body Mass Index (BMI) is a statistical measure of an individual's scaled weight according to his/her height. It is a simple index of weight-for-height and is widely used by medical, health and fitness professionals to classify underweight, overweight and obesity in adults. The ratio between average weight and height depends on several factors, including age, gender, build and percentage of body fat. During adolescence and teenage, our body is in
growth mode, due to which we tend to gain and lose weight more rapidly than an average adult. The ideal height weight ratio for men is quite different from the same for women. Similarly, a well built individual may actually weigh more than the average weight suggested for him in various height weight ratio charts, as muscle cells weigh more than fat cells. One thing we need to keep in mind is that every human being is different when it comes to correct body weight calculations, and these differences are depicted in the way we put on and lose weight. (http://www.buzzle.com/articles/average-weight-for-height.html), (http://apps.who.int/bmi/index.jsp?introPage=intro_3.html)

Figure 3.5: Leg Press Exercise at 45° angles - Starting Position with Flexed Legs

![Leg Press Exercise](image)
The above Figures 3.5 & 3.6 display the starting and finishing of leg press exercises at 45° angles using the adjustable machine against plates of 25 kgs. At the beginning of the practice the subject starts with flexed legs and at the end of the practice finishes with extended legs. This exercise is practiced against the resistance of plates weighing 25 kgs. In this exercise the main thigh and calf muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on calf and thigh are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.7: Leg Press Exercise at $90^0$ angles - Starting Position with Flexed Legs

Figure 3.8: Leg Press Exercise at $90^0$ angles - Finishing with Extended Legs
The Figures 3.7 & 3.8 display the starting and finishing of leg press exercises at 90° angles using the adjustable machine against plates of 25 kgs.

At the beginning of the practice the subject starts with flexed legs and at the end of the practice finishes with extended legs. This exercise is practiced against the resistance of plates weighing 25 kgs. In this exercise the main thigh and calf muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on calf and thigh are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.9: Leg Press Exercise at $180^\circ$ angles - Starting Position with Flexed Legs

Figure 3.10: Leg Press Exercise at $180^\circ$ angles - Finishing with Extended Legs
The Figures 3.9 & 3.10 display the starting and finishing of leg press exercises at $180^\circ$ angles using the adjustable machine against plates of 25 kgs.

At the beginning of the practice the subject starts with flexed legs and at the end of the practice finishes with extended legs. This exercise is practiced against the resistance of plates weighing 25 kgs. In this exercise the main thigh and calf muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on calf and thigh are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.11: Leg Extension Exercise - Starting with Flexed Legs

Figure 3.12: Leg Extension Exercise - Finishing with Extended Legs
The Figures 3.11 & 3.12 display the starting and finishing of leg extension exercises using the adjustable machine against plates of 15 kgs.

At the beginning of the practice the subject starts with flexed legs and at the end of the practice finishes with extended legs. This exercise is practiced against the resistance of plates weighing 15 kgs. In this exercise the main thigh and calf muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on calf and thigh are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.13: Leg Curl Exercise - Starting with Extended Legs

Figure 3.14: Leg Curl Exercise - Finishing with Flexed Legs
The **Figures 3.13 & 3.14** display the starting and finishing of leg curl exercises using the adjustable machine against plates of 15 kgs.

At the beginning of the practice the subject starts with flexed legs and at the end of the practice finishes with extended legs. This exercise is practiced against the resistance of plates weighing 15 kgs. In this exercise the main calf and thigh muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on thigh and calf are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.15: Front Squat Exercise - Starting with Flexed Legs

Figure 3.16: Front Squat Exercise - Finishing with Extended Legs
The Figures 3.15 & 3.16 display the starting and finishing of front squat exercises using the adjustable machine against plates of 30 kgs.

At the beginning of the practice the subject starts with flexed legs and at the end of the practice finishes with extended legs. This exercise is practiced against the resistance of plates weighing 30 kgs. In this exercise the main calf and thigh muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on thigh and calf are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.17: Heel Raise Exercise - Starting with Neutral Position

Figure 3.18: Heel Raise Exercise - Finishing with Raised Leg
The **Figures 3.17 & 3.18** display the starting and finishing of heel raise exercises using the parallel bar with 35 kgs. At the beginning of the practice the subject starts with neutral position and finishes the practice with extended legs. This exercise is practiced against the resistance of plates weighing 35 kgs. In this exercise the main calf muscles (gastrocnemius) and some other muscles are also exclusively involving in the movements of expansion and flexion. These exercises are very effective for strengthening of calf muscles.
Figure 3.19: Cycling on Stationary Bike

Figure 3.19 shows that the subject is cycling on stationary bike. This is the resistance exercise against firmly adjusted pedals. In this exercise the main calf and thigh muscles (quadriceps, hamstrings, gastrocnemius) and some other muscles on calf and thigh are also exclusively involving in the movements of expansion and flexion as the quadriceps group expand, the hamstrings group contract and vice versa.
Figure 3.20 displays that one of the subjects is executing double legs hopping on upstairs. In this exercise the main calf and thigh muscles are exclusively involving in the movements of expansion and flexion of knee joints.

This exercise if properly done is very effective for improving explosive strength and strength endurance of calf and thigh muscles.
Figure 3.21 shows that one of the subjects is executing double legs hopping on downstairs. The main calf and thigh muscles are exclusively involving in the movements of expansion and flexion of knee joints.

This exercise if properly done is very effective for improving explosive strength and strength endurance of thigh and calf muscles.
Figure 3.22: Jogging Cum Walking Exercise

Figure 3.22 shows that the subjects are practicing (jogging cum walking) on standard running track for 25 minutes in moderate intensity. In this exercise the main calf and thigh muscles and some other muscles are also exclusively involving in the movement.

The joints such as ankle, knee, hip and elbow joints are actively involving in the movement of this exercise.
Figure 3.23 shows that the subjects are performing full squat exercise with the investigator of this study. Squats work nearly every major muscle group in your body including Calves, Hips, Thighs, Gluts, Quads, Lower Back, and Abs.
In this Figure 3.24, some of the subjects are engaged in half squat exercise. This exercise if properly done is very effective for improving explosive-strength and strength-endurance of calf and thigh muscles.
Figure 3.25: Lateral Lunging (Right Side)

In this Figure 3.25, subjects are practicing lateral lunging (right side) with the investigator. This exercise is very effective for improving explosive- strength and strength- endurance of calf and thigh muscles.
In this Figure 3.26, some of the subjects are practicing lateral lunging (left side).

This exercise strengthens the calf and thigh muscles and some other muscles attached to thigh and calf.
This Figure 3.27, displays that some of the subjects with the investigator are practicing Vajrasana or thunderbolts pose. This thunderbolt pose (sitting on folded legs, resting buttock on calves and heels) is the best stretch for quadriceps muscle groups and massages the nerve fibers. In addition, this practice will also bring tranquility to the mind if practiced with the eyes closed for five to ten minutes.
Figure 3.28: Squat Jump Exercise - Starting Position

Figure 3.29: Squat Jump Exercise - On flight as to accomplish the Jump
Figures 3.28 & 3.29 display the 'squat jump', where the jumper (subject) starts from a stationary semi-squatted position and flight as to finish the jump.

The squat jump requires good movement coordination, especially in the timing of the arm swing and the extension of the hips and legs. A jumper must also choose the right depth of movement (range of knee and hip flexion). This exercise is very effective for improving explosive-strength and strength-endurance of calf and thigh muscles.
Figure 3.30: Standing Vertical Jump – Starting Position

Figure 3.31: Standing Vertical Jump - On flight as to accomplish the Jump
Figures 3.30 & 3.31 show that the jumper (subject) starts a vertical jump from a stationary semi-squatted position and flight with flexed legs and semi stretched arms as to finish the jump.

Vertical jumping is a complex task requiring quick and harmonized coordination of jumper's body segments, first for the push-off, then for the flight and lastly for the landing.

This exercise is very effective for improving explosive- strength and strength-endurance of calf and thigh muscles. The investigator is nearby for technical assistances.
In this Figure 3.32, the subject is practicing rope skipping while the investigator is checking the subject’s efficiency against time using stopwatch. Jumping rope is a type of cardiovascular exercise that engages the whole body through consistent hops in the air. It strengthens your bones, muscles and increases your stamina and endurance. The calves are among the primary muscles involved with leaping ability. Since jumping rope puts a heavy emphasis on the calves, this activity can increase your vertical leap. This can be especially beneficial in sports such as basketball, football, baseball and volleyball. Rope-jumping can also be used at the beginning of workouts for warming-up.
In the above Figure 3.33, the subject, lying prone on a table in a relaxed position was massaged by the investigator on his calf muscle (Gastrocnemius muscle) of right leg using Effleurage Massage technique for a period of three to five minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of effleurage without irritation of the skin or hair on the leg.
In the above Figure 3.34, the subject, lying prone on a table in a relaxed position was massaged by the investigator on his calf muscle of right leg using Petrissage Massage technique for a period of three to five minutes. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of petrissage without irritation of the skin or hair on the leg.
In the above Figure 3.35, the subject, lying prone on a table in a relaxed position was massaged by the investigator on his calf muscle of left leg using Petrissage Massage technique for a period of three to five minutes. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of petrissage without irritation of the skin or hair on the leg.
This Figure 3.36 displays that the subject was massaged by the investigator using the Vibration technique of massage (shaking movement) at the calf muscle of his right leg. As massage is an excellent form of passive exercise, it can be applied when it is required for relaxation and also for the purpose of treatment interventions. As far back as 400 B.C., the great Hippocrates, the father of modern medicine, employed massage and manipulation in healing his patients (H.K. Bakhru 1991). (H.K. Bakhru. Nature Cure for Common Disease, Jaico, Mumbai, India, 1991)
In the above Figure 3.37, the subject, lying prone on a table in a relaxed position was massaged by the investigator on his calf muscle of left leg using Tapotement Massage technique for a period of three to five minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of tapotement without irritation of the skin or hair on the leg.
The above Figure 3.38 shows that the subject, lying prone on a table in a relaxed position was massaged by the investigator on his thigh muscle of left leg using Effleurage Massage technique for a period of three minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of Effleurage without irritation of the skin or hair on the leg.
In the above **Figure 3.39**, the subject, sitting on a table in a relaxed position was massaged by the investigator on his thigh muscle of right leg using Effleurage Massage technique for a period of three minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of Effleurage without irritation of the skin or hair on the leg.
Figure 3.40: Thigh Massage (Quadriceps Muscles) - Left Leg

In this Figure 3.40, the subject lying supine on a table in a relaxed position was massaged by the investigator on his thigh muscle of left leg using Petrissage Massage technique for a period of three minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of Petrissage without irritation of the skin or hair on the leg.
The above Figure 3.41 shows that the subject, lying prone on a table in a relaxed position was massaged by the investigator on his thigh muscle of right leg using Petrissage Massage technique for a period of three minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of Petrissage without irritation of the skin or hair on the leg.
In this Figure 3.42, the subject, lying prone on a table in a relaxed position was massaged by the investigator on his back thigh of left leg using Tapotement Massage technique for a period of three minutes and then the other leg. Cold pressed vegetable based oil was applied during the workout. The amount of oil applied was sufficient to provide comfort during the moderate application of tapotement without irritation of the skin or hair on the leg.


3.12. Test Administration

Six of the variables of health related physical fitness exercises were selected in test administrations for this study.

To measure these components, the researcher conducted the relevant field tests. The following were the valid tests conducted on the subjects as these components are clearly discussed in the AAHPER youth fitness testing manual.

The researcher selected the AAHPER youth fitness testing manual as it is considered to be the most reliable and valid with respect to health related physical fitness tests and measurements.

Two main centers were selected for test administration namely, Department of Physical Education, Andhra University, and Dr.Lankapalli Bullayya College, Andhra University (Appendices III and V).

In connection with administration of tests, 13 different pictures were taken during test administrations of practical and technical activities as shown below (Figures 3.43 to Figure 3.55).

3.12.1: Test Item – I, Long Jump from Stationary Position

Purpose

The purpose of this test was to determine the subject’s ability to release explosive strength (maximum force) in the fastest time as possible.

Facilities and Equipment

Outdoor long jump sand pit, measuring tape, lime, and score sheets were used.

Procedure

The subjects stood with a comfortable position just behind the scratch line (take-off line), with feet slightly apart. The subjects were instructed to take off with both feet. The subject crouched and swung his arms while jumping forward into the jumping pit. The jump was accomplished by simultaneously...
extending the knees and swinging the arms forward. Three trials were given. Foul was called when the subject crossed the take off line and when he took off with one leg during the execution of the jump. The procedure for the administration of the test of Long Jump from stationary position is shown in the following figures (Figures 3.43, 3.44 & 3.45.)

Figure 3.43: Long Jump from Stationary Position - Starting
Figure 3.44: Flight to Accomplish the Long Jump from Stationary Position

Figure 3.45: Measuring the Distance of Long Jump
Figures 3.43, 3.44 & 3.45 display starting of long jump from a stationary position commanded by the investigator, flight to accomplish the long jump and measuring of distance covered by the subject. The distance was measured by the qualified Physical Director, Department of Physical Education, Andhra University.

Instructions

You must take off with both feet simultaneously, jump horizontally from the scratch line into the prepared long jump sand pit and land with both feet. Try not to fall backward after landing. You can jump further by crouching before the jump and swinging your arms.

Scoring

Measurement was taken from the end of the scratch line (take off line) to the nearest break point as the performance of the subjects. Out of three trials, only the better trial was recorded to the nearest centimeters.

Testing Personnel

One trained tester can administer, judge and record the score with one assistant.

3.12.2: Test Item – II, Shuttle Run (4x 10 Meters)

Purpose

The purpose of this test was to determine the speed-strength and agility of the subjects in a given distance of 40 (4 x 10 Meters) of shuttle run.

Facilities and Equipment

Two lines parallel to each other are drawn on the play ground 10 meters apart. Two relay batons and stop watches are needed.
Procedure

Two parallel lines were drawn on a play ground 10 meters apart. The relay batons were placed behind the line other than the starting line. The subject stood behind the starting line. At the sound of the whistle the subject ran towards the block and at the same time the stop watch was started. The subject picked one of the relay batons and returned to the starting line with maximum speed and placed the baton behind the line. The subject followed the same pattern and picked the second baton and returned to the starting line thereby covering a distance of 4 x 10 meters. Two trials were given. The procedure for the administration of the test of Shuttle Run is shown in the following figures (Figures 3.46 & 3.47).

Figure 3.46: Shuttle Run - Starting
Figures 3.46 & 3.47 display the starting of shuttle run commanded by the investigator and finishing of the run accomplished by the subject. The elapsed time was taken by the qualified time keeper, Physical Director, Dept. of Physical Education, Andhra University.

Instructions

On the signal “Go” you must run as fast as you can to the opposite parallel line and pick up a baton. You should return the baton over the second line where you place it on the playground. Do not throw it. You return for the second baton and this time, you may run across the starting line as fast as you can without placing the baton on the floor.

Scoring

The score is the elapsed time recorded in hundredth of seconds for the better of two trials. These timings were raw scores of the subjects for the test of shuttle run.
Testing Personnel

One well trained tester can administer this test and record scores with two timers. Two regular stop watches were used for recording of time.

3.12.3: Test Item – III, 50 Meters Dash

Purpose

The purpose of this test was to determine the speed - strength of the subjects involved in the administration of test and measurement for 50 meters dash.

Facilities and Equipment

Running track on football field, or play ground with starting line, a 50 meter course and a finish line. Two stop watches or a split - second timer (1/100 of a second), lime, whistle and score sheets were used.

Procedures

Fifty meters dash test was administered to determine the subject’s speed. A starting line and a finishing line with fifty meters apart were marked. Two lanes of 1.25meters width were also marked from the starting line up to the finishing line. Subjects in pairs run simultaneously. Subjects were asked to stand behind the scratch line (starting line). The investigator used the command “on your marks”, “set” and blew the “whistle”. At the sound of the whistle the subjects run at their maximum speed. At the same time the sound of the whistle accompanied by a downward sweep of the investigator’s arm as a signal to the time keepers. Two stop watches were used by two time keepers. The procedure for the administration of the test of 50 Meters Dash is shown in the next figures (Figures 3.48 &3.49).
Figure 3.48: 50 Meters Dash - Starting

Figure 3.49: 50 Meters Dash - Finishing
Figures 3.48 & 3.49 show that the investigator commands to start the 50 Meter Dash from the starting line while the two subjects run just to finish the 50 meter dash and the two time keepers record the elapsed time with digital stop watches of high repute manufacture (Casio). The time keepers take the elapsed time carefully as they are well qualified as physical Directors in Dr.Lankapalli Bullayya College, Visakhapatnam.

Instructions

You may take any lane behind the starting line you wish. On the command “Go” you are to run as fast as you can across the finish line. Do not slow down until you are crossing the finish line; then you may slow down gradually.

Scoring

The elapsed time from the starting signal until the runner crosses the finish line was measured to the nearest hundredth of seconds. (1/100 of seconds).

Testing Personnel

Two qualified timers were involved for administering the test and recording scores.

3.12.4: Test Item – IV, Hop Steps with Right Leg (2 x 10 Meters)

Purpose

The purpose of this test was to examine the speed, explosive-strength and functional performances of the right leg (thigh and calf muscles) of subjects in a given distance of twenty meters (2 x 10 Meters).

Facilities and Equipment

Two lines parallel to each other were drawn on the play ground of 10 meters apart, cones and stop watches were used.

Procedure

Two parallel lines were drawn on a play ground of 10 meters apart with two cones for marking the right spot. Each cone is put on parallel lines; one is put on starting line and the other one is put straight on opposite line. The subject
stood behind the starting line. At the sound of the whistle the subject hopped on his right leg towards the parallel line. The subject after reaching the parallel line, he returned clock-wise (at the back of the cone) to the starting line with maximum speed and crossed the starting line thereby covering a distance of twenty meters (2 x 10 meters). Two trials were given. The procedure for the administration of the test of Hop steps with Right Leg is shown in the following figures (Figures 3.50 &3.51).
Figure 3.50: Hop Steps with Right Leg - Starting

Figure 3.51: Hop Steps with Right Leg - Finishing
Figures 3.50 & 3.51 show the starting of hop steps with right leg commanded by the investigator and finishing of the run (twenty meters) accomplished by the subject. The elapsed time was taken by the qualified time keeper, Physical Director, Dept. of Physical Education, Andhra University.

**Instructions**

On the signal “Go” you must skip on your right leg to the opposite parallel line and cross the line. Immediately, you should return back towards the starting line and you may cross the line as fast as you can.

**Scoring**

The score is the elapsed time recorded in seconds (hundredth of seconds) and the score is taken for the better one out of two trials.

**Testing Personnel**

Two trained personnel (one timer and one scorer) were needed for administering the test and recording scores.

**3.12.5: Test Item – V, Hop Steps with left Leg (2 x 10 Meters)**

**Purpose**

The purpose of this test was to examine the speed, explosive-strength and functional performances of the left leg (thigh and calf muscles) of subjects in a given distance of twenty meters (2 x 10 Meters).

**Facilities and Equipment**

Two lines parallel to each other were drawn on the play ground 10 meters apart, cones and stop watches were used.

**Procedure**

Two parallel lines were drawn on a play ground of 10 meters apart with two cones for marking the right spot. Each cone is put on parallel lines; one is put on starting line and the other one is put straight on opposite line. The subject stood behind the starting line. At the sound of the whistle the subject hopped with his left leg towards the parallel line. The subject after reaching the parallel
line, he returned counter-clock wise (at the back of the cone) to the starting line with maximum speed and crossed the starting line thereby covering a distance of twenty meters (2 x 10 meters). Two trials were given. The procedure for the administration of the test of Hop steps with Left Leg is shown in the following figures (Figures 3.52 & 3.53).

Figure 3.52: Hop Steps with Left Leg- Starting
Figures 3.52 & 3.53 show the starting of hop steps with left leg commanded by the investigator and finishing of the run (twenty meters) accomplished by the subject. The elapsed time was recorded in seconds by the qualified time keeper using digital stop watch of high repute manufacture (Casio).

Instructions

On the signal “Go” you must skip on your left leg to the opposite parallel line and cross the line. Immediately, you should return back towards the starting line and you may cross it as fast as you can.

Scoring

The score is the elapsed time recorded in seconds (hundredth of seconds) and the score is taken for the better one out of two trials.

Testing Personnel

Two trained personnel (one timer and one scorer) were involved for administering the test and recording scores.
3.12.6: Test Item – VI, 800 Meters Run

Purpose

The purpose of this test was to determine the speed-endurance and strength of both legs of thigh and calf muscles of subjects’.

Facilities and Equipment

A well laid 400 meter track with a starting lines, stop watches, lime, whistle and score sheets were used.

Procedures

Eight hundred meters test was administered to determine the strength-endurance of subjects taking part in the experiment. Two lanes of 1.25meters width were also marked. Subjects were asked to stand behind the starting lines and then subjects in pairs run simultaneously two laps of the track. The starting and finishing lines are from the same spot of the track. The investigator used the command “on your marks”, “set” and blew the “whistle”. At the sound of the whistle the subjects run and at the same time the sound of the whistle used as a signal to the time keepers. Two stop watches were used by two time keepers. The procedure for the administration of 800 Meters Run is shown in the following figures (Figures 3.54 &3.55).
Figure 3.54: 800 Meters Run - Starting

Figure 3.55: 800 Meters Run - Finishing
Figures 3.54 & 3.55 show the starting of 800 Meters Run commanded by the investigator and finishing of the distance of 800 Meters accomplished by the subjects. The elapsed time was recorded in seconds as a raw score by the qualified time keepers using digital stop watches of high repute manufacture (Casio).

The time keepers recorded the elapsed time carefully as they are qualified as physical Directors in Dr.Lankapalli Bullayya College, Visakhapatnam.

Instructions

A Subject would be asked to run the 800 meters as per his own pace. He will run two laps (two rounds) of the 400 meter track. He should run as far as he can. He must pace himself not to run too fast at the beginning of the run but keeps running at a speed that he can continue.

Scoring

The elapsed time to the nearest hundredth of a second (1/100 of seconds) were taken as a raw score of the run.

Testing Personnel

Two trained timers and one scorer (college and university physical Directors) were involved at the time of execution this test.

All the above tests of six components were conducted after brief orientations to the subjects of the study. The subjects were asked to put their best performance and sincere cooperation to see that the results are comparable.

All the tests were conducted as per the standard directions prescribed in the AAHPER testing protocols.

3.13. Procedures and Methods of Data Analysis

All the above described tests for measuring the individual components of health-related physical fitness exercises with therapeutic massage interventions were conducted and the score of the subjects were collected and organized accordingly. Separate score sheets were designed to note the performances and readings of each of the subject who took part in the test
administration. Individual’s scores on each of the 6 items for test and measurements and the mean values of the independent variables' values were entered into the SPSS computer software. Mean, Standard Deviation, Analysis of Variance (ANOVA) and t-test were calculated to see if significant differences were observed among the means of the participants on independent physical fitness variables. For details see Chapter IV, Tables 4.1 to 4.37 and Graphs 4.1 to 4.24.