EFFECT OF AEROBIC AND ANAEROBIC TRAINING ON SELECTED PHYSIOLOGICAL AND BODY COMPOSITION PROFILES AMONG MIDDLE AGED OBESE WOMEN

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DECLARATION BY THE SCHOLAR

I **M. GEJALAKSHMI,** Part Time Research Scholar hereby declare that the dissertation entitled **"EFFECT OF AEROBIC AND ANAEROBIC TRAINING ON SELECTED PHYSIOLOGICAL AND BODY COMPOSITION PROFILES AMONG MIDDLE AGED OBESE WOMEN"** submitted to Department of Physical Education, Tamil Nadu Physical Education and Sports University, Chennai for the award of Doctor of Philosophy in Physical Education is my original work and it has not previously formed the basis for the award of any degree, diploma, associate ship, fellowship or any other similar titles to any candidate of any university.

Station:

Date: **(M. GEJALAKSHMI)**

DEDICATED

to

MY FAMILY

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INTRODUCTION

Numerous training procedures are in practice to improve each and every physiological and body composition profiles. Each type of training produces its own effect on fitness. Training effect describes the physiological changes that occur from regular participation in a fitness program. These basic training procedures will serve better when utilized with modification suited to the individual or a group dealt with. The best training program is that which increases the desired quality at a higher rate without causing unwanted effects. Although numerous types of studies exist in the field of physical education, a physical educationist is in need to find some means that tends to encourage students to try harder to increase their level of performance and their breadth and depth of knowledge.

Sports training aim at achieving higher performance in sports competition. In order to achieve higher performance in sports, training should be based on systematic facts and principles and it is done in a planned and systematic manner. A system most suitable for achieving higher performance has to be first made on the basis of which sports training is planned. It is always assessed, planned, organized and improved by a coach or a sports teacher or the athlete himself. The sport training aims at finding hidden reserves and makes the sports person aware of it. It also aims at grater development of the reserves. The sports person controls their day to day routine in such a manner that they are able to do training once or twice a day with high effect. It is a continuous process of perfection, improvement and criterion of means and methods of improving sports performance and factors of performance.

Obesity is from the Latin obesitas, which means "stout, fat, or plump". The Greeks were the first to recognize obesity as a medical disorder. Hippocrates wrote that "Corpulence is not only a disease itself, but the harbinger of others". The Indian surgeon Sushruta (6th century BCE) related obesity to diabetes and heart disorders. He recommended physical work to help cure it and its side effects. For most of human history mankind struggled with food scarcity. Obesity has thus historically been viewed as a sign of wealth and prosperity. Obesity is still seen as a sign of wealth and well-being in many parts of Africa. This has become particularly common since the HIV epidemic began. Obesity is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility, although a few cases are caused primarily by genes, endocrine disorders, medications or psychiatric illness.

1.1 TRAINING

Training is not a recent discovery. In ancient time, people were trained systematically for military and Olympic endeavours. Today athletes prepare themselves for a goal through training. The major objective in training is to cause biological adaptations in order to improve performance in a specific task. To enhance physiological improvement effectively and to bring about a change, specific exercise and over load must be followed. By exercising at a level above normal, a variety of trading adaptations takes place in the body that makes it to function more efficiently.

Sports training are done for improving sports performance. Sports training is a scientifically based and pedagogically organized process which through planned and systematic, effect on performance ability and performance readiness aims at sports perfection and performance improvement as well as at the contest in sports competition". **[Thiess & Schnabel, 1986].** Sports training, based on scientific knowledge, are a pedagogical process of sports perfection which through systematic effect on psycho-physical performance ability and performance readiness aims at leading the sportsman to high and the highest performance. Through active and conscious interaction with the given demands in sports training, the sportsman's personality develops according to the norms and standards of socialist society. **[Harre, 1986]**

1.2 OBESITY

Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems. People are considered obese when their body mass index (BMI), a measurement obtained by dividing a person's weight in kilograms by the square of the person's height in meters, exceeds 30 kg/m^2. Obesity increases the likelihood of various diseases, particularly heart disease, type 2 diabetes, obstructive sleep apnea, certain types of cancer, and osteoarthritis. Obesity is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility, although a few cases are caused primarily by genes, endocrine disorders, medications or psychiatric illness. Evidence to support the view that some obese people eat little yet gain weight due to a slow metabolism is limited; on average obese people have a greater energy expenditure than their thin counterparts due to the energy required to maintain an increased body mass.

Dieting and physical exercise are the mainstays of treatment for obesity. Diet quality can be improved by reducing the consumption of energy-dense foods such as those high in fat and sugars, and by increasing the intake of dietary fiber. Anti-obesity drugs may be taken to reduce appetite or inhibit fat absorption together with a suitable diet. If diet, exercise and medication are not effective, a gastric balloon may assist with weight loss, or surgery may be performed to reduce stomach volume and/or bowel length, leading to earlier satiation and reduced ability to absorb nutrients from food.

Obesity is a leading preventable cause of death worldwide, with increasing prevalence in women, and authorities view it as one of the most serious public health problems of the 21st century. Obesity is stigmatized in much of the modern world (particularly in the Western world), though it was widely perceived as a symbol of wealth and fertility at other times in history, and still is in some parts of the world. In 2013, the American Medical Association classified obesity as a disease. Excessive body weight is associated with various diseases, particularly cardiovascular diseases, diabetes mellitus type 2, obstructive sleep apnea, certain types of cancer, osteoarthritis and asthma. As a result, obesity has been found to reduce life expectancy.

1.3 MORTALITY DUE TO OBESITY

Obesity is one of the leading preventable causes of death worldwide. Large-scale American and European studies have found that mortality risk is lowest at a BMI of 20–25 kg/m^2 in non-smokers and at 24–27 kg/m^2 in current smokers, with risk increasing along with changes in either direction. A BMI above 32 kg/m^2 has been associated with a doubled mortality rate among women over a 16-year period. In the United States obesity is estimated to cause 111,909 to 365,000 deaths per year, while 1 million (7.7%) of deaths in Europe are attributed to excess weight. On average, obesity reduces life expectancy by six to seven years, a BMI of 30–35 kg/m^2 reduces life expectancy by two to four years, while severe obesity (BMI > 40 kg/m^2) reduces life expectancy by ten years.

1.4 MORBIDITY DUE TO OBESITY

Obesity increases the risk of many physical and mental conditions. These comorbidities are most commonly shown in metabolic syndrome, a combination of medical disorders which includes: diabetes mellitus type 2, high blood pressure, high blood cholesterol, and high triglyceride levels. Complications are either directly caused by obesity or indirectly related through mechanisms sharing a common cause such as a poor diet or a sedentary lifestyle. The strength of the link between obesity and specific conditions varies. One of the strongest is the link with type 2 diabetes. Excess body fat underlies 64% of cases of diabetes in men and 77% of cases in women. Health consequences fall into two broad categories: those attributable to the effects of increased fat mass (such as osteoarthritis, obstructive sleep apnea, social stigmatization) and those due to the increased number of fat cells (diabetes, cancer, cardiovascular disease, non-alcoholic fatty liver disease). Increases in body fat alter the body's response to insulin, potentially leading to insulin resistance. Increased fat also creates a proinflammatory state, and a prothrombotic state.

1.5 CAUSES OF OBESITY

At an individual level, a combination of excessive food energy intake and a lack of physical activity is thought to explain most cases of obesity. A limited number of cases are due primarily to genetics, medical reasons, or psychiatric illness. In contrast, increasing rates of obesity at a societal level are felt to be due to an easily accessible and palatable diet, increased reliance on cars, and mechanized manufacturing.

A 2006 review identified ten other possible contributors to the recent increase of obesity: (1) insufficient sleep, (2) endocrine disruptors (environmental pollutants that interfere with lipid metabolism), (3) decreased variability in ambient temperature, (4) decreased rates of smoking, because smoking suppresses appetite, (5) increased use of medications that can cause weight gain (e.g., atypical antipsychotics), (6) proportional increases in ethnic and age groups that tend to be heavier, (7) pregnancy at a later age (which may cause susceptibility to obesity in children), (8) epigenetic risk factors passed on generationally, (9) natural selection for higher BMI, and (10) assortative mating leading to increased concentration of obesity risk factors (this would increase the number of obese people by increasing population variance in weight). While there is substantial evidence supporting the influence of these mechanisms on the increased prevalence of obesity, the evidence is still inconclusive.

1.6 DIET AND OBESITY

Average per capita energy consumption of the world from 1961 to 2002 The per capita dietary energy supply varies markedly between different regions and countries. It has also changed significantly over time. From the early 1970s to the late 1990s the average calories available per person per day (the amount of food bought) increased in all parts of the world except Eastern Europe. The United States had the highest availability with 3,654 calories per person in 1996. This increased further in 2003 to 3,754. During the late 1990s Europeans had 3,394 calories per person, in the developing areas of Asia there were 2,648 calories per person, and in sub-Saharan Africa people had 2,176 calories per person. Total calorie consumption has been found to be related to obesity.

The widespread availability of nutritional guidelines has done little to address the problems of overeating and poor dietary choice. From 1971 to 2000, obesity rates in the United States increased from 14.5% to 30.9%. During the same period, an increase occurred in the average amount of food energy consumed. For women, the average increase was 335 calories per day (1,542 calories in 1971 and 1,877 calories in 2004), while for men the average increase was 168 calories per day (2,450 calories in 1971 and 2,618 calories in 2004). Most of this extra food energy came from an increase in carbohydrate consumption rather than fat consumption. The primary sources of these extra carbohydrates are sweetened beverages, which now account for almost 25 percent of daily food energy in young adults in America, and potato chips. Consumption of sweetened drinks is believed to be contributing to the rising rates of obesity.

As societies become increasingly reliant on energy-dense, big-portions, and fast-food meals, the association between fast-food consumption and obesity becomes more concerning. In the United States consumption of fast-food meals tripled and food energy intake from these meals quadrupled between 1977 and

1995. Agricultural policy and techniques in the United States and Europe have led to lower food prices. In the United States, subsidization of corn, soy, wheat, and rice through the U.S. farm bill has made the main sources of processed food cheap compared to fruits and vegetables. Calorie count laws and nutrition facts labels attempt to steer people toward making healthier food choices, including awareness of how many calories are being consumed. Obese people consistently under-report their food consumption as compared to people of normal weight. This is supported both by tests of people carried out in a calorimeter room and by direct observation.

A sedentary lifestyle plays a significant role in obesity. Worldwide there has been a large shift towards less physically demanding work, and currently at least 30% of the world's population gets insufficient exercise. This is primarily due to increasing use of mechanized transportation and a greater prevalence of labor-saving technology in the home. In women, there appear to be declines in levels of physical activity due to less walking and physical education. World trends in active leisure time physical activity are less clear. The World Health Organization indicates people worldwide are taking up less active recreational pursuits, while a study from Finland found an increase and a study from the United States found leisure-time physical activity has not changed significantly.

1.7 AEROBIC EXERCISE

Aerobic exercise is physical exercise of relatively low intensity that depends primarily on the aerobic energy generating process. Aerobic literally means "living in air", and refers to the use of oxygen to adequately meet energy demands during exercise via aerobic metabolism. Generally, light to moderate intensity activities that are sufficiently supported by aerobic metabolism can be performed for extended periods of time. The intensity should be between 60 and 85% of maximum heart rate.

Aerobic capacity describes the functional capacity of the cardio respiratory system, (the heart, lungs and blood vessels). Aerobic capacity is defined as the maximum amount of oxygen the body can use during a specified period, usually during intense exercise. It is a function both of cardio respiratory performance and the maximum ability to remove and utilize oxygen from circulating blood. The higher the measured cardio respiratory endurance level, the more oxygen has been transported to and used by exercising muscles, and the higher the level of intensity at which the individual can exercise. More simply stated, the higher the aerobic capacity, the higher the level of aerobic fitness. The Cooper and multi-stage fitness tests can also be used to assess functional aerobic capacity for particular jobs or activities.

The degree to which aerobic capacity can be improved by exercise varies vary widely in the human population: while the average response to training is an approximately 17% increase in VO_2max, in any population there are "high responders" who may as much as double their capacity, and "low responders" who will see little or no benefit from training. Studies indicate that approximately 10% of otherwise healthy individuals cannot improve their aerobic capacity with exercise at all. The degree of an individual's responsiveness is highly heritable, suggesting that this trait is genetically determined.

1.8 THE HEALTH BENEFITS OF AEROBIC EXERCISE

Perhaps no area of exercise science has been more studied than the benefits of aerobic exercise. There is a mountain of evidence to prove that regular aerobic exercise will improve your health, your fitness, and much more. Here's a partial list of the documented health benefits of aerobic exercise. Colon cancer, Research is clear that physically active men and women have about a 30%-40% reduction in the risk of developing colon cancer compared with inactive individuals. It appears that 30-60 minutes per day of moderate- to vigorous-intensity physical activity is needed to decrease the risk, and there is a dose-response relationship, which means that the risk declines the more active you are. Breast cancer, There is reasonably clear evidence that physically active women have about a 20%-30% reduction in risk compared with inactive women. Like colon cancer, it appears that 30-60 minutes per day of moderate- to vigorous-intensity physical activity is needed to decrease the risk, and it is likely that there is a dose-response relationship as well. Prostate cancer, Research is inconsistent regarding whether physical activity plays any role in the prevention of this cancer. Lung cancer, There are relatively few studies on physical activity and lung cancer prevention.

The available data suggest that physically active individuals have a lower risk of lung cancer; however, it is difficult to completely account for the risks of active and passive cigarette smoking as well as radon exposure. Other cancers, There is little information on the role of physical activity in preventing other cancers. In one study, aerobic exercise performed five days per week for 30-35 minutes for six weeks at 80% of maximal heart rate reduced fatigue in women being treated for cancer. In another study, 10 weeks of aerobic exercise at 60% of maximum heart rate for 30-40 minutes, four days per week, reduced depression and anxiety in female cancer patients. Aerobic exercise isn't a panacea when it comes to cancer, but evidence suggests that it certainly can help.

Osteoporosis is a disease characterized by low bone density, which can lead to an increased risk of fracture. According to the National Osteoporosis Foundation, osteoporosis is responsible for more than 1.5 million fractures annually, including over 300,000 hip fractures, 700,000 vertebral fractures, 250,000 wrist fractures, and 300,000 fractures at other sites. The good news is that exercise may increase bone density or at least slow the rate of decrease in both men and women. It may not work for everyone, and the precise amount and type of exercise necessary to accrue benefits is unknown.

Most of us who exercise regularly understand that exercise can elevate our mood. There have been a number of studies investigating the effects of exercise on depression. In one of the most recent studies, it was shown that three to five days per week for 12 weeks of biking or treadmill for approximately 30 minutes per workout reduced scores on a depression questionnaire by 47%. It's not a substitute for therapy in a depression that causes someone to be unable to function, but for milder forms of depression, the evidence is persuasive that it can help.

No study has been more conclusive about the role of lifestyle changes (diet and exercise) in preventing diabetes than the Diabetes Prevention Program.

It was a study of more than 3,000 individuals at high risk for diabetes who lost 12-15 pounds and walked 150 minutes per week (five 30-minute walks per day) for three years. They reduced their risk of diabetes by 58%. That's significant considering there are 1 million new cases of diabetes diagnosed each year. Aerobic exercise can also improve insulin resistance. Insulin resistance is a condition in which the body doesn't use insulin properly, and this condition can occur in individuals who do and do not have diabetes. Insulin is a hormone that helps the cells in the body convert glucose (sugar) to energy. Many studies have shown the positive effects of exercise on insulin resistance. In one, 28 obese postmenopausal women with type 2 diabetes did aerobic exercise for 16 weeks, three times per week, for 45-60 minutes, and their insulin sensitivity improved by 20%.

The list of studies that show that aerobic exercise prevents or reduces the occurrence of cardiovascular disease is so long that it would take this entire article and probably five others just like it to review all of the research. One of the most important is one of the earliest. In a study of more than 13,000 men and women, it was shown that the least fit individuals had much higher rates of cardiovascular disease than fit individuals -- in some cases, the risk was twice as high. Aerobic exercise works in many ways to prevent heart disease; two of the most important are by reducing blood pressure and allowing blood vessels to be more compliant (more compliant means that they become less stiff and it's less likely for fat to accumulate and clog up the vessels). Results like these have been proven over and over again.

1.9 ANAEROBIC EXERCISE

Anaerobic exercise is exercise intense enough to trigger lactic acid formation. It is used by athletes in non-endurance sports to promote strength, speed and power and by body builders to build muscle mass. Muscle energy systems trained using anaerobic exercise develop differently compared to aerobic exercise, leading to greater performance in short duration, high intensity activities, which last from mere seconds to up to about 2 minutes. Any activity lasting longer than about two minutes has a large aerobic metabolic component.

Anaerobic metabolism, or anaerobic energy expenditure, is a natural part of whole-body metabolic energy expenditure. Fast twitch muscle (as compared to slow twitch muscle) operates using anaerobic metabolic systems, such that any recruitment of fast twitch muscle fibers leads to increased anaerobic energy expenditure. Intense exercise lasting upwards of about four minutes (e.g., a mile race) may still have a considerable anaerobic energy expenditure component. Anaerobic energy expenditure is difficult to accurately quantify, although several reasonable methods to estimate the anaerobic component to exercise are available. In contrast, aerobic exercise includes lower intensity activities performed for longer periods of time. Activities such as walking, long slow runs, rowing, and cycling require a great deal of oxygen to generate the energy needed for prolonged exercise (i.e., aerobic energy expenditure). In sports which require repeated short bursts of exercise however, the anaerobic system enables muscles to recover for the next burst. Therefore training for many sports demands that both energy producing systems be developed.

There are two types of anaerobic energy systems: 1) the high energy phosphates, ATP adenosine triphosphate and CP creatine phosphate; and 2) anaerobic glycolysis. The high energy phosphates are stored in very limited quantities within muscle cells. Anaerobic glycolysis exclusively uses glucose (and glycogen) as a fuel in the absence of oxygen or more specifically, when ATP is needed at rates that exceed those provided by aerobic metabolism; the consequence of rapid glucose breakdown is the formation of lactic acid (more appropriately, lactate at biological pH levels). Physical activities that last up to about thirty seconds rely primarily on the former, ATP-CP phosphagen system. Beyond this time both aerobic and anaerobic glycolytic metabolic systems begin to predominate.

The by product of anaerobic glycolysis, lactate, has traditionally been thought to be detrimental to muscle function. However, this appears likely only when lactate levels are very high. Elevated lactate levels are only one of many changes that occur within and around muscle cells during intense exercise that can lead to fatigue. Fatigue, that is muscular failure, is a complex subject. Elevated muscle and blood lactate concentrations are a natural consequence of any physical exertion. The effectiveness of anaerobic activity can be improved through training.

1.10 THE HEALTH BENEFITS OF ANAEROBIC EXERCISE

The early stage of any exercise is anaerobic. Sprinting, weight lifting, push-ups, or jumping, in fact any short burst of exertion and high-intensity movement, is considered an anaerobic exercise. There is a reason why it is called anaerobic (without air). During short, intense exercise, our body demands more oxygen than it is available, so it depends on energy that is stored in the muscles. That is the key for its role in any fitness program. Anaerobic exercise is not meant to burn off fat – you need oxygen for that – its main role is to build strong muscles.

Anaerobic exercise basically means "without air or oxygen." These are high-intensity exercises which are performed in a short time frame. The main difference between anaerobic and aerobic exercise lie on the body's requirement of oxygen as fuel for the activity being performed. Aerobic exercises are often low-intensity physical activities which are performed for longer durations. On the other hand, anaerobic exercises are often intense physical activities which last from a few seconds up to two minutes. Some of the popular forms of anaerobic exercises are sprinting, weight lifting and jumping.

Like aerobic exercises, doing anaerobic exercise can prove beneficial to one's health especially if properly integrated into a regular exercise routine. Performing anaerobic exercises strengthens the bones. Regularly doing anaerobic training can help improve bone density, therefore strengthening them. Osteoporosis usually occurs as a person ages, thus anaerobic exercises can be a good line of defense before this condition sets in. People may still perform anaerobic exercises after being diagnosed with bone-related disorders under the supervision of their health care providers. Anaerobic training is also ideal for faster metabolism and reduced fat deposits. The food we eat are turned into sugar which fuels our bodies with energy. The excess amount of sugar is stored in the body and become fat. Since these exercises help build more lean muscles, metabolism automatically revs up. Leaner muscles require more calories to burn, thus leaving little room for fat deposits.

People who regularly perform anaerobic exercises also see significant improvements in their balance and strength, two qualities which come in handy later on in life. Exercises such as weight lifting put much emphasis on strength and balance which may help prevent slips and falls as people grow older. There is also a marked improvement in joint health while indulging in regular anaerobic training. Because the body build more lean muscles and lesser mass while performing these exercises, a portion of the body weight is taken off which relieve pressure from the joints. It helps in projecting good self-image. Because anaerobic exercises often result in a fitter and leaner version of the person performing it, he will find that flexing his muscles is easier to attain. Successfully achieving the kind of body one desires does not only improve physical health, but also boosts positive self-image. In turn, the person becomes more confident and holds a more positive perspective.

1.11 OBJECTIVES OF THE STUDY

1. The major objective of the study was to determine the changes on selected physiological variables due to the effect of aerobic and anaerobic training.

2. The major objective of the study was to determine the changes on selected body composition profiles due to the effect of aerobic and anaerobic training

3. To compare how far the aerobic training differ from anaerobic training in their influences on selected physiological and body composition profiles.

1.12 STATEMENT OF THE PROBLEM

The purpose of the present study was to find out the effect of aerobic and anaerobic training on selected physiological and body composition profiles among middle aged obese women.

1.13 HYPOTHESES

1. It was hypothesized that, the effect of aerobic training may improve the selected physiological variables and body composition profiles among middle aged obese women.
2. It was hypothesized that, the effect of anaerobic training may improve the selected physiological variables and body composition profiles among middle aged obese women.
3. It was hypothesized that, the effect of aerobic training may better than the anaerobic training in the improvement of the selected physiological variables and body composition profiles among middle aged obese women.

1.14 DELIMITATIONS

1. To achieve the purpose of the study, forty-five obese women in and around from Namakkal district, Tamilnadu, India were selected as subjects.
2. The age of the subjects ranged from 35 to 45 years.
3. The selected subjects (N=45) were be classified into three equal groups of fifteen each (n=15) at random. Group-I underwent aerobic training, group-II underwent anaerobic training and group III will act as control.

4. The duration of the training period was restricted to twelve weeks and the number of sessions per week was confined to three.

1.15 LIMITATIONS

1. The growth and development of the subject if any, during the period of experimentation and the possible influence on the dependent variable could not be controlled.
2. Though the subjects were motivated verbally, no attempt was made to differentiate the motivation level during the period of training and testing.
3. The investigator did not take any effort to control or assess the quality and quantity of food intake by each participant.
4. The quantum of physical exertion, life style and physiological stress and other factors that affect the metabolic functions were also considered as limitations.
5. The change in climatic conditions such as temperature, atmospheric pressure, humidity, etc., during the training as well as testing period could not be controlled. So, their influence on the results of the study was recognized as one of the limitations.
6. Apart from the training program the involvement of the subjects in their daily routine are not taken into consideration.

1.16 SIGNIFICANCE OF THE STUDY

Scientists, teachers or coaches use different means to achieve certain goals. Before adopting a method to achieve a goal, one should asses thoroughly the merits and demerits of the existing methods to achieve the goal. Say in selecting a method to develop certain physiological variables and body composition profiles, a coach or a trainer should have a complete understanding of the methods in practice and if necessary, she should be able to modify the basic methods in such a way that suits best her subjects. Adding to this he should keep in mind the equipment required and the facilities available. The results of the study would also help the middle aged obese women in the development of physiological variables and body composition profiles.

1. The study may helps to the physical educationists and coaches to build the best method of training to develop the physiological variables and body composition profiles.
2. This study also may helps to the coaches to prepare the suitable training schedules for the improvement of the performance of the obese women.
3. It also may helps to know about the importance of aerobic and anaerobic training for the obese women.

1. 17 DEFINITIONS OF THE TECHNICAL TERMS

1.17.1 Aerobic

Aerobic literally means "with oxygen", and refers to the use of oxygen in muscles' energy-generating process. Aerobic exercise includes any type of exercise, typically those performed at moderate levels of intensity for extended periods of time, that maintains an increased heart rate. In such exercise, oxygen is used to "burn" fats and glucose in order to produce adenosine triphosphate, the basic energy carrier for all cells.

1.17.2 Anaerobic

Anaerobic means “without air" or "without oxygen." Anaerobic exercise is short-lasting, high-intensity activity, where your body’s demand for oxygen exceeds the oxygen supply available. Anaerobic exercise relies on energy sources that are stored in the muscles and, unlike aerobic exercise, is not dependent on oxygen from (breathing) the air.

1.17.3 Breath holding Time

This is the duration of voluntary holding of the breathing after the maximum inhaling. The holding of breath is performed for a maximum period, which an individual is able to withstand, without restoring to normal breathing.

1.17.4 Systolic Blood Pressure

The pressure exerted on the vessel walls during ventricular contraction, measured in millimeters of mercury by the sphygmomanometer.

1.17.5 Diastolic Blood Pressure

The pressure exerted by the blood on the vessel walls during the resting portion of the cardiac cycle, measured in millimeters of mercury by a sphygmomanometer.

1.17.6 Resting Pulse Rate

Resting pulse rate as the distension of the arterial walls at the beginning of systolic ejection of blood which is not confined to aorta but travels down the arteries as a wave followed by a wave of recoil. The arteries that lie close to the body such as radial artery of the wrist, the arrival of the wave of distension and subsequent recoil may be felt as a distinct throw pulse which offers a convenient method of counting the pulse rate.

1.17.7 Aerobic Power

The maximum rate at which energy is provided by aerobic respiration. Aerobic power is dependent on the ability of the respiratory and circulatory systems to transport oxygen from the air to the respiring tissues, and the ability of the tissues to use the oxygen to break down metabolic fuels. Aerobic power is usually measured in terms of oxygen consumption.

1.17.8 Anaerobic power

Anaerobic power is the amount of work performed using primarily an aerobic energy system

1.17.9 Body Weight

Body Weight is a person's mass or weight. Body weight is measured in kilogram.

1.17.10 Lean Body Mass

The portion of body weight that is lean ie. Not fat. Lean body mass is measured by Lean Body Mass (kg) = body weight (kg) – Fat Mass (kg).

1.17.11 Fat Mass

The portion of body weight that is fat. Fat mass is measured by fat mass (kg) = percentage fat x body weight (kg).

1.17.12 BMI

Body mass index is a key index for relating weight to height. BMI is a person's weight in kilograms (kg) divided by his or her height in meters squared.

Chapter – II

Review of Related Literature

CHAPTER – II

REVIEW OF THE RELATED LITERATURE

A literature review is a body of text that aims to review the critical points of current knowledge including substantive findings as well as theoretical and methodological contributions to a particular topic. Its ultimate goal is to bring the reader up to date with current literature on a topic and forms the basis for another goal, such as future research that may be needed in the area. The present reviews are based upon the available literature in respect to the study under investigation and therefore confined to the studies to which the investigator has accessed. All the relevant literature thus obtained by the researcher has been presented in this chapter to furnish necessary background material to evaluate the significance of the study. The research scholar has made every possible effort to go thorough the literatures related to the problem wherever available. The scholar has gleaned through almost every source like research quarterly, journals of various kinds, periodicals, encyclopedias, relevant books and e-resources to pick up related material.

2.1 REVIEWS ON AEROBIC AND ANAEROBIC TRAINING

Salvadori, et al. (2014) demonstrated that aerobic exercise plays an important role in weight loss programs for obesity by increasing 24 h metabolic rate. While aerobic exercise can result in health and fitness benefits in obese subjects, also independently of weight loss, not completely clear are the effects of bouts of hard exercise on metabolic outcomes. The aim of this study was to test the hypothesis that short-term aerobic activity with anaerobic bouts might result in a greater improvement in the management of obesity than aerobic activity alone. We studied 16 obese subjects (eight men) during a progressive cycloergometric test up to exhaustion, before and after 4 weeks of two different training schedules (6 days/week). Insulin and glycaemia, non-esterified fatty acids (NEFA) and lactic acid were sampled. Group A (eight subjects, four men) performed an aerobic cycle workout; Group B (eight subjects, four men) performed a 25 min aerobic workout followed by 5 min ofanaerobic workout. All the subjects maintained their individual eating habits. The post-training test showed a decrease in AUCs NEFA in Group A ($p < 0.05$) and an increase in Group B ($p < 0.05$), together with an increase in lactic acid in Group A and a decrease in Group B ($p < 0.01$). β-cell function (HOMA2-B) revealed a reduction only in Group A ($p < 0.05$). Group B achieved a greatest reduction in body fat mass than Group A ($p < 0.05$). Aerobic plus anaerobic training seem to produce a greater response in lipid metabolism and not significant modifications in glucose indexes; then, in training prescription for obesity, we might suggest at starting weight loss program aerobic with short bouts of anaerobic training to reduce fat mass and subsequently a prolonged aerobic training alone to ameliorate the metabolic profile.

Sayyed, et al. (2013) examined the effects of light and moderate aerobic intensity on body composition and serum lipid profile in obese/overweight women living in Isfahan. Forty-five middle-aged obese/overweight volunteer women (25-40 years, and body mass index (BMI) ≥25 to 30 kg/m^2) were randomly assigned into three groups: 1. Light aerobics [45-50% heart rate reserve maximum (HRR_{max})], 2. Moderate aerobics (70-75% HRR_{max}), 3. No exercise training (control). Training program lasted for 10 weeks and included three sessions of 60 minutes aerobics per week. The intensity of aerobics was controlled by monitoring heart rate. Body composition was measured using skin fold thickness method. Serum lipid was measured. Both light and moderate aerobics significantly improved weight ($P < 0.000$), fat percent ($P < 0.045$), BMI ($P < 0.000$), fat weight ($P <$ 0/031), lean body weight ($P < 0.02$), waist-to-hip ratio (WHR) ($P < 0.000$), High-density lipoprotein (HDL) ($P < 0.000$). Our findings showed that both light and moderate aerobics improved body composition and serum lipid profile in obese/overweight women. Our findings support the application of aerobics for obese/overweight women. Initially, they can start with light programs and proceed to more intense programs.

Aziz (2012) determined if aerobic and anaerobic training-induced adaptations were compromised as a result of Ramadan fasting. Methods: Twenty adolescent males of the Muslim and non-Muslim faith were divided into fasting (FAS, n = 10) and non-fasting or control (CON, n = 10) groups, respectively. High-intensity interval cycle exercise training was conducted three times per week for seven weeks, with Ramadan fasting falling during training weeks 3 to 6 for the FAS group. Results: Both groups significantly improved their peak oxygen uptake (VO2peak; FAS 2.77 ± 0.33 to 3.08 ± 0.22 and CON 2.61 ± 0.22 to 2.89 ± 0.21 L/min) and maximal anaerobic performance (total work during four Wingate bouts; FAS 53.4 ± 5.2 to 57.7 ± 4.8 and CON 47.4 ± 4.5 to 52.0 ± 4.5 kJ) (all $p < 0.05$). There were no significant differences in the magnitude of improvements made between groups, either for aerobic (FAS 0.31 ± 0.28 vs. CON 0.28 ± 0.12 L/min) or anaerobic (FAS 4.3 ± 3.3 vs. CON 4.6 ± 3.4 kJ) performance (all $p > 0.05$). Indices of training intensity (mean heart rate and mean blood lactate) and mean daily energy and fluid intake were not significantly different between groups throughout the study period. Conclusions: Aerobic and anaerobic adaptations to seven weeks of training were not compromised by four weeks of intermittent Ramadan fasting, possibly because the overall training intensity and nutrient intake were maintained throughout the Ramadan period.

Shalaby (2012) revealed the role of aerobic and anaerobic training programs on CD34+ Stem Cells and chosen physiological variables. Twenty healthy male athletes aged 18–24 years were recruited for this study. Healthy low active males and BMI matched participants (n=10) aged 20–22 years were recruited as controls. Aerobic and anaerobic training programs for 12 weeks were conducted. VO2max pulse observation was carried out using the Astrand Rhyming protocol. RBCs, WBCs, HB and hematocrit were estimated using a coulter counter, lactate by the Accusport apparatus, CD34+ stem cells by flow cytometry. VO2max was increased significantly in case of the aerobic training program compared to anaerobic one (62±2.2 ml/kg/min vs. 54±2.1 ml/kg/min). Haemotological values increased significantly in the anaerobic program when compared to the aerobic one, RBCs (5.3±0.3 and 4.9±0.2 mln/ul), WBCs (6.6±0.5 and 6.1±0.4 thous/ul), HB (15.4±0.4 and 14.2±0.5 g/de), Hematocrit (4.6±1.2 and 4.4±1.1 %), CD34+ stem cells count increased significantly in case of the anaerobic program compared to the aerobic (251.6±21.64 and 130±14.61) and sedentary one (172±24.10). These findings suggest that anaerobic training programs provoke better adaptation to exercise and stem cell counts may differ between trained and sedentary subjects. Circulating immature cells are likely to be involved in angiogenesis and repair process, both mechanisms being associated with strenuous exercise. Knowledge of the physiological effects of training on stem cells might be of potential clinical use.

Agnieszka, et al. (2010) assessed the anaerobic threshold in obese and normal weight women and to analyse the effect of weight-reduction therapy on the determined thresholds. Patients and methods: 42 obese women without concomitant disease (age 30.5 ± 6.9y; BMI 33.6 ± 3.7 $kg \cdot m^{-2}$) and 19 healthy normal weight women (age 27.6 ± 7.0y; BMI 21.2 ± 1.9 $kg \cdot m^{-2}$) performed cycle ergometer incremental ramp exercise test up to exhaustion. The test was repeated in 19 obese women after 12.3 ± 4.2% weight loss. The lactate threshold (LT) and the ventilatory threshold (VT) were determined. Obese women had higher lactate (expressed as oxygen consumption) and ventilator threshold than normal weight women. The lactate threshold was higher than ventilatory one both in obese and normal weight women (1.11 ± 0.21 vs 0.88 ± 0.18 $L \cdot min^{-1}$, $p < 0.001$; 0.94 ± 0.15 vs 0.79 ± 0.23 $L \cdot min^{-1}$, $p < 0.01$, respectively). After weight reduction therapy neither the lactate nor the ventilatory threshold changed significantly. The results concluded that; 1. The higher lactate threshold noted in obese women may be related to the increased fat acid usage in metabolism. 2. Both in obese and normal weight women lactate threshold appears at higher oxygen consumption than ventilatory threshold. 3. The obtained weight reduction, without weight normalisation was insufficient to cause significant changes of lactate and ventilatory thresholds in obese women.

Whyte, et al. (2010) investigated the effects of very high intensity sprint interval training (SIT) on metabolic and vascular risk factors in overweight/obese sedentary men. Ten men (age, 32.1 ± 8.7 years; body mass index, 31.0 ± 3.7 kg m(-2)) participated. After baseline metabolic, anthropometric, and fitness measurements, participants completed a 2-week SIT intervention, comprising 6 sessions of 4 to 6 repeats of 30-second Wingate anaerobic sprints on an electromagnetically braked cycle ergometer, with 4.5-minute recovery between each repetition. Metabolic, anthropometric, and fitness assessments were repeated post-intervention. Both maximal oxygen uptake (2.98 ± 0.15 vs 3.23 ± 0.14 L min(-1), P = .013) and mean Wingate power (579 ± 24 vs 600 ± 19 W, P = .040) significantly increased after 2 weeks of SIT. Insulin sensitivity index (5.35 ± 0.72 vs 4.34 ± 0.72, P = .027) and resting fat oxidation rate in the fasted state (0.13 ± 0.01 vs 0.11 ± 0.01 g min(-1), P = .019) were significantly higher and systolic blood pressure (121 ± 3 vs 127 ± 3 mm Hg, P = .020) and resting carbohydrate oxidation in the fasted state (0.03 ± 0.01 vs 0.08 ± 0.02 g min(-1), P = .037) were significantly lower 24 hours post-intervention compared with baseline, but these changes were no longer significant 72 hours post-intervention. Significant decreases in waist (98.9 ± 3.1 vs 101.3 ± 2.7 cm, P = .004) and hip (109.8 ± 2.2 vs 110.9 ± 2.2 cm, P = .017) circumferences compared with baseline were also observed after the intervention. Thus, 2 weeks of SIT substantially improved a number of metabolic and vascular risk factors in overweight/obese sedentary men, highlighting the potential for this to provide an alternative exercise model for the improvement of vascular and metabolic health in this population.

Tjønna, et al. (2009) compared the effects of a multidisciplinary approach (MTG) and aerobic interval training (AIT) on cardiovascular risk factors in overweight adolescents. A total of 62 overweight and obese adolescents from Trøndelag County in Norway, referred to medical treatment at St Olav's Hospital, Trondheim, Norway, were invited to participate. Of these, 54 adolescents (age, 14.0 +/- 0.3 years) were randomized to either AIT (4 x 4 min intervals at 90% of maximal heart rate, each interval separated by 3 min at 70%, twice a week for 3 months) or to MTG (exercise, dietary and psychological advice, twice a month for 12 months). Follow-up testing occurred at 3 and 12 months. VO(2max) (maximal oxygen uptake) increased more after AIT compared with MTG, both at 3 months (11 compared with 0%; P<0.01) and 12 months (12 compared with -1%; P<0.01). AIT enhanced endothelial function compared with MTG at both 3 months (absolute change, 5.1 compared with 3.9%; P<0.01) and 12 months (absolute change, 6.3 compared with 1.0%; P<0.01). AIT was favourable compared with MTG in reducing BMI (body mass index), percentage of fat, MAP (mean arterial blood pressure) and increasing peak oxygen pulse. In addition, AIT induced a more favourable regulation of blood glucose and insulin compared with MTG. In conclusion, the novel findings of the present proof-of-concept study was that 3 months of twice weekly high-intensity exercise sessions reduced several known cardiovascular risk factors in obese adolescents more than that observed after a multitreatment strategy, which was initiated as hospital treatment. Follow-up at 12 months confirmed that AIT improved or maintained these risk factors to a better degree than MTG.

Perry, et al. (2008) investigated skeletal muscle and whole-body metabolic adaptations that occurred following 6 weeks of HIIT (~1 h of 10 x 4 min intervals at ~90% of peak oxygen consumption (VO2 peak), separated by 2 min rest, 3 d.week-1). A VO2 peak test, a test to exhaustion (TE) at 90% of pre-training VO2 peak, and a 1 h cycle at 60% of pre-training VO2 peak were performed pre- and post-HIIT. Muscle biopsies were sampled during the TE at rest, after 5 min, and at exhaustion. Training power output increased by 21%, and VO2 peak increased by 9% following HIIT. Muscle adaptations at rest included the following: (i) increased cytochrome c oxidase IV content (18%) and maximal activities of the mitochondrial enzymes citrate synthase (26%), beta-hydroxyacyl-CoA dehydrogenase (29%), aspartate-amino transferase (26%), and pyruvate dehydrogenase (PDH; 21%); (ii) increased FAT/CD36, FABPpm, GLUT 4, and MCT 1 and 4 transport proteins (14%-30%); and (iii) increased glycogen content (59%). Major adaptations during exercise included the following: (i) reduced glycogenolysis, lactate accumulation, and substrate phosphorylation (0-5 min of TE); (ii) unchanged PDH activation (carbohydrate oxidation; 0-5 min of TE); (iii) ~2-fold greater time during the TE; and (iv) increased fat oxidation at 60% of pre-training VO2 peak. This study demonstrated that 18 h of repeated high-intensity exercise sessions over 6 weeks (3 d.week-1) is a powerful method to increase whole-body and skeletal muscle capacities to oxidize fat and carbohydrate in previously untrained individuals.

Trapp, et al. (2008) determined the effects of a 15-week high-intensity intermittent exercise (HIIE) program on subcutaneous and trunk fat and insulin resistance of young women. Subjects were randomly assigned to one of the three groups: HIIE (n=15), steady-state exercise (SSE; n=15) or control (CONT; n=15). HIIE and SSE groups underwent a 15-week exercise intervention. Forty-five women with a mean BMI of 23.2+/-2.0 kg m(-2) and age of 20.2+/-2.0 years. Both exercise groups demonstrated a significant improvement (P<0.05) in cardiovascular fitness. However, only the HIIE group had a significant reduction in total body mass (TBM), fat mass (FM), trunk fat and fasting plasma insulin levels. There was significant fat loss (P<0.05) in legs compared to arms in the HIIE group only. Lean compared to overweight women lost less fat after HIIE. Decreases in leptin concentrations were negatively correlated with increases in VO(2peak) (r=-0.57, P<0.05) and positively correlated with decreases in TBM (r=0.47; P<0.0001). There was no significant change in adiponectin levels after training. HIIE three times per week for 15 weeks compared to the same frequency of SSE exercise was associated with significant reductions in total body fat, subcutaneous leg and trunk fat, and insulin resistance in young women.

Wisloff, et al. (2007) compared the training programs with moderate versus high exercise intensity with regard to variables associated with cardiovascular function and prognosis in patients with postinfarction heart failure. Twenty-seven patients with stable postinfarction heart failure who were undergoing optimal medical treatment, including beta-blockers and angiotensin-converting enzyme inhibitors (aged 75.5+/-11.1 years; left ventricular [LV] ejection fraction 29%; VO2peak 13 mL x kg(-1) x min(-1)) were randomized to either moderate continuous training (70% of highest measured heart rate, ie, peak heart rate) or aerobic interval training (95% of peak heart rate) 3 times per week for 12 weeks or to a control group that received standard advice regarding physical activity. VO2peak increased more with aerobic interval training than moderate continuous training (46% versus 14%, P<0.001) and was associated with reverse LV remodeling. LV end-diastolic and end-systolic volumes declined with aerobic interval training only, by 18% and 25%, respectively; LV ejection fraction increased 35%, and pro-brain natriuretic peptide decreased 40%. Improvement in brachial artery flow-mediated dilation (endothelial function) was greater with aerobic interval training, and mitochondrial function in lateral vastus muscle increased with aerobic interval training only. The MacNew global score for quality of life in cardiovascular disease increased in both exercise groups. No changes occurred in the control group. Exercise intensity was an important factor for reversing LV remodeling and improving aerobic capacity, endothelial function, and quality of life in patients with postinfarction heart failure. These findings may have important implications for exercise training in rehabilitation programs and future studies.

Helgerud, et al. (2007) compared the effects of aerobic endurance training at different intensities and with different methods matched for total work and frequency. Responses in maximal oxygen uptake (VO2max), stroke volume of the heart (SV), blood volume, lactate threshold (LT), and running economy (CR) were examined.Forty healthy, nonsmoking, moderately trained male subjects were randomly assigned to one of four groups:1) long slow distance (70% maximal heart rate; HRmax); 2)lactate threshold (85% HRmax); 3) 15/15 interval running (15 s of running at 90-95% HRmax followed by 15 s of active resting at 70% HRmax); and 4) 4 x 4 min of interval running (4 min of running at 90-95% HRmax followed by 3 min of active resting at 70%HRmax). All four training protocols resulted in similar total oxygen consumption and were performed 3 d.wk for 8 wk. High-intensity aerobic interval training resulted in significantly increased VO2max compared with long slow distance and lactate-threshold training intensities (P<0.01). The percentage increases for the 15/15 and 4 x 4 min groups were 5.5 and 7.2%, respectively, reflecting increases in V O2max from 60.5 to 64.4 mL x kg(-1) x min(-1) and 55.5 to 60.4 mL x kg(-1) x min(-1). SV increased significantly by approximately 10% after interval training (P<0.05). High-aerobic intensity endurance interval training is significantly more effective than performing the same total work at either lactate threshold or at 70% HRmax, in improving VO2max. The changes in VO2max correspond with changes in SV, indicating a close link between the two.

Talanian, et al. (2007) examined the effects of seven high-intensity aerobic interval training (HIIT) sessions over 2 wk on skeletal muscle fuel content, mitochondrial enzyme activities, fatty acid transport proteins, peak O(2) consumption (Vo(2 peak)), and whole body metabolic, hormonal, and cardiovascular responses to exercise. Eight women (22.1 +/- 0.2 yr old, 65.0 +/- 2.2 kg body wt, 2.36 +/- 0.24 l/min Vo(2 peak)) performed a Vo(2 peak) test and a 60-min cycling trial at approximately 60% Vo(2 peak) before and after training. Each session consisted of ten 4-min bouts at approximately 90% Vo(2 peak) with 2 min of rest between intervals. Training increased Vo(2 peak) by 13%. After HIIT, plasma epinephrine and heart rate were lower during the final 30 min of the 60-min cycling trial at approximately 60% pretraining Vo(2 peak). Exercise whole body fat oxidation increased by 36% (from 15.0 +/- 2.4 to 20.4 +/- 2.5 g) after HIIT. Resting muscle glycogen and triacylglycerol contents were unaffected by HIIT, but net glycogen use was reduced during the posttraining

60-min cycling trial. HIIT significantly increased muscle mitochondrial beta-hydroxyacyl-CoA dehydrogenase (15.44 +/- 1.57 and 20.35 +/- 1.40 mmol.min(-1).kg wet mass(-1) before and after training, respectively) and citrate synthase (24.45 +/- 1.89 and 29.31 +/- 1.64 mmol.min(-1).kg wet mass(-1) before and after training, respectively) maximal activities by 32% and 20%, while cytoplasmic hormone-sensitive lipase protein content was not significantly increased. Total muscle plasma membrane fatty acid-binding protein content increased significantly (25%), whereas fatty acid translocase/CD36 content was unaffected after HIIT. In summary, seven sessions of HIIT over 2 wk induced marked increases in whole body and skeletal muscle capacity for fatty acid oxidation during exercise in moderately active women.

Trapp, et al. (2007) metabolic response to two different forms of high-intensity intermittent cycle exercise was investigated in young women. Subjects (8 trained and 8 untrained) performed two bouts of high-intensity intermittent exercise: short sprint (SS) (8-s sprint, 12-s recovery) and long sprint (LS) (24-s sprint, 36-s recovery) for 20 min on two separate occasions. Both workload and oxygen uptake were greater in the trained subjects but were not significantly different for SS and LS. Plasma glycerol concentrations significantly increased during exercise. Lactate concentrations rose over the 20 min and were higher for the trained women. Catecholamine concentration was also higher postexercise compared with preexercise for both groups. Both SS and LS produced similar metabolic response although both lactate and catecholamines were higher after the 24-s sprint. In conclusion, these results show that high-intensity intermittent exercise resulted in significant elevations in catecholamines that appear to be related to increased venous glycerol concentrations. The trained compared with the untrained women tended to show an earlier increase in plasma glycerol concentrations during high-intensity exercise.

Ayse, et al. (2006) compared the effects of aerobic and resistance exercise on weight, muscle strength, cardiovascular fitness, blood pressure and mood in obese women who were not on an energy-restricted diet. **Design**: Randomized, prospective, controlled trial. **Setting**: Department of Physical Medicine and Rehabilitation, University Hospital. **Subjects**: Sixty obese women were assigned to one of three groups: aerobic exercise (n=20), resistance exercise (n=20) and control group (n=20). **Interventions**: The aerobic exercise group performed both walking and leg cycle exercise with increasing duration and frequency. The resistance exercise group performed progressive weight-resistance exercises for the upper and lower body. **Main outcome measures**: Before and after a 12-week period, all subjects were evaluated by anthropometric measurement, rating of mood, cardiorespiratory capacity and maximum strength of trained muscles. **Results**: After a 12-week training period, subjects in the resistance group showed significant improvement in one-repetition maximum test of hip abductors (7.95±3.58 kg), quadriceps (14±7.18 kg), biceps (3.37± 2.84 kg) and pectorals (8.75±5.09 kg) compared with those in the control group (P<0.001). VO_2 max increased (0.51±0.40) and Beck Depression Scale scores decreased (-5.40±4.27) in the aerobic exercise group compared with the control group, significantly (P<0.001). Only in hip abductor muscle strength was there a significant increase in the resistance exercise group compared with the aerobic exercise group (P <0.05). **Conclusion**: Both aerobic exercise and resistance exercise resulted in improved performance and exercise capacity in obese women. While aerobic exercise appeared to be beneficial with regard to improving depressive symptoms and maximum oxygen consumption, resistance exercise was beneficial in increasing muscle strength.

Bloomer, et al. (2005) compared oxidative modification of blood proteins, lipids, DNA,and glutathione in the 24 hours following aerobic and anaerobic exercise using similar muscle groups. Ten cross-trained men (24.3 6 3.8 years, [mean 6 *SEM*]) performed in random order 30 minutes of continuous cycling at 70% of V˙ O2max and intermittent dumbbell squatting at 70% of 1 repetition maximum (1RM), eparated by 1–2 weeks, in a crossover design. Blood samples taken before, and immediately, 1, 6, and 24 hours postexercise were analyzed for plasma protein carbonyls (PC), plasma malondialdehyde (MDA), and whole-blood total (TGSH), oxidized (GSSG), nd reduced (GSH) glutathione. Blood samples taken before and 24 hours postexercise were analyzed for serum 8-hydroxy-29- deoxyguanosine (8-OHdG). PC values were greater at 6 and 24 hours postexercise compared with pre-exercise for squatting, with greater PC values at 24 hours postexercise for squatting compared with cycling (0.634 6 0.053 vs. 0.359 6 0.018 nM·mg protein21). There was no significant interaction or main effects for MDA or 8-OHdG. GSSG experienced a shortlived increase and GSH a ransient decrease immediately following both exercise modes. These data suggest that 30 minutes of aerobic and anaerobic exercise performed by young, crosstrained men (a) can increase certain biomarkers of oxidative stress in blood, (b) differentially affect oxidative stress biomarkers, and (c) result in a different magnitude of oxidation based on the macromolecule studied. While protein and glutathione oxidation was increased following acute exercise as performed in this study, future research may investigate methods of reducing macromolecule oxidation, possibly through the use of antioxidant therapy.

George, et al. (2005) examined the effect of aerobic exercise training on insulin sensitivity in overweight and obese girls. Nineteen overweight and obese girls (mean ± SD: age, 13.1 ± 1.8 years; body mass index, 26.8 ± 3.9 kg/m^2) volunteered for this study. Body composition (dual-energy x-ray absorptiometry), insulin sensitivity (oral glucose tolerance test and homeostasis model assessment estimate of insulin resistance; n = 15), adiponectin, C-reactive protein (CRP), interleukin (IL) 6, insulin-like growth factor-1, soluble intercellular adhesion molecule-1 and soluble vascular cell adhesion molecule-1 serum levels, and blood lipids and lipoproteins were assessed before and after 12 weeks of aerobic training. Cardiorespiratory fitness increased by 18.8% ($P < .05$) as a result of training. The area under the insulin concentration curve (insulin area under the curve) decreased by 23.3% (12 781.7 ± 7454.2 vs 9799.0 ± 4918.6 μU·min/mL before and after intervention, respectively; $P = .03$). Insulin sensitivity was improved without changes in body weight (preintervention, 67.9 ± 14.5 kg; postintervention, 68.3 ± 14.0 kg) or percent body fat (preintervention, 41.4% ± 4.8%; postintervention, 40.7% ± 5.2%). The lower limb fat-free mass increased by 6.2% ($P < .01$) as a result of training, and changes in lower limb fat-free mass were correlated with changes in the insulin area under the curve ($r = -.68$; $P < .01$). Serum adiponectin, IL-6, and CRP concentrations did not change (preintervention vs postintervention: adiponectin, 9.57 ± 3.01 vs 9.08 ±

2.32μg/mL; IL-6, 1.67 ± 1.29 vs 1.65 ± 1.25 pg/mL, CRP, 3.21 ± 2.48 vs 2.73 ± 1.88 mg/L) whereas insulin-like growth factor-1 was lower after training (preintervention, 453.8 ± 159.3 ng/mL; postintervention, 403.2 ± 155.1 ng/mL; $P < .05$). In conclusion, 12 weeks of aerobic training improved insulin sensitivity in overweight and obese girls without change in body weight, percent body fat, and circulating concentrations of adiponectin, IL-6, CRP, and other inflammatory markers. These findings suggest that increased physical activity may ameliorate the metabolic abnormalities associated with obesity in children with a mechanism other than the parameters cited earlier.

Okura, et al. (2005) tested the effects on abdominal fat reduction of adding aerobic exercise training to a diet program and obesity phenotype in response to weight loss. A prospective clinical trial with a 14 week weight loss intervention design. In total, 209 overweight and obese women were assigned to four subgroups depending on type of treatment and the subject's obesity phenotype: diet alone (DA) with intra-abdominal fat (IF) obesity (> or =mean IF area), diet plus exercise (DE) with IF obesity, DA with abdominal subcutaneous fat (ASF) obesity (<mean IF area) and DE with ASF obesity. Abdominal fat areas were evaluated by CT scans, with values adjusted for selected variables. Values were adjusted for age, menopausal status and change in body weight and total fat mass. The IF reductions were significantly (P<0.0001) greater in subjects with IF obesity phenotype (-45.1 cm2) compared to the ASF obesity phenotype (-22.2 cm2). The ASF reductions were significantly (P<0.001) greater for subjects with ASF obesity (-74.5 cm2) compared to IF obesity (-55.5 cm2). For IF obesity, the IF reduction was significantly (P<0.01) greater in the DE group (-49.3 cm2) than in the DA group (-37.8 cm2). These results suggest that for individuals with IF obesity, the efficacy on reducing IF of adding aerobic exercise training to a diet-alone weight-reduction program is more prominent (-49.3 cm2/-37.8 cm2=1.3 times) compared with DA. Moreover, abdominal fat reduction was found to be modified by obesity phenotype in response to weight loss.

Dao, et al. (2004) investigated if a multidisciplinary weight loss programme in adolescents suffering severe obesity allows an improvement of anaerobic and aerobic aptitudes. In all, 55 adolescents (33 girls and 22 boys) suffering from severe obesity were enrolled in an interdisciplinary weight reduction programme lasting 6–12 months. Progressive submaximal physical activity was performed and national dietary allowances for adolescents with low levels of physical activity were provided. Total and regional body composition and anaerobic aptitudes (handgrip strength (HGS), vertical jump height (VJH)) and aerobic aptitudes (maximal aerobic power (MAP), maximal oxygen uptake ($\dot{V}O_{2max}$)) were measured before and after weight loss. The mean reduction of body mass index (BMI) was similar in girls (21.4±5.9%) and boys (23.7±6.4%). Fat mass (FM) steepest drop was observed in the trunk (-63.2±10.1% in boys and -51.5±11.4% in girls). The total lean mass (LM) did not vary in both sexes. Right HGS and VJH increased in both sexes (P<0.05), whereas left HGS increased only in boys. MAP and $\dot{V}O_{2max}$ per kg BW increased (P< 0.0001) in both sexes (2.3±0.3*vs* 1.7±0.3 W/kg and 32.8±4.5 *vs* 26.7±4.1 ml/min/kg in girls and 2.8 ± 1.9 *vs*1.9 ± 0.4 W/kg and 39.1 ± 6.3 *vs* 27.9 ± 5.1 ml/min/kg in boys, respectively), whereas MAP and $\dot{V}O_{2max}$ in absolute value and per kg LM increased only in boys (*P*=0.04). Total LM was the strongest determinant of HGS, VJH, MAP and VO_{2max} in both sexes (*P*<0.005). Multidisciplinary weight reduction programme including moderate dietary restriction in combination with regular physical training induced an improvement of anaerobic and aerobic aptitudes, a marked reduction of obesity and a preservation of LM in severely obese adolescents.

Lafortuna, et al.(2004) investigated the effect of gender, age and level of obesity on body composition and anaerobic power output, and to test the hypothesis that variation in body composition affects muscle power output in obesity, a cohort of 377 subjects (112 males and 265 females, aged 18-75 yr) with different levels of obesity [class IIII, body mass index (BMI) range: 30.6-60.3 kg m(-2)] was cross-sectionally investigated. Body composition was assessed with bioelectric impedance analysis (BIA), in standardized conditions and using obesity-specific prediction formulas. Lower limb anaerobic power output (W) was measured with a modification of the Margaria stair climbing test. In males, a similar increase in fat-free mass (FFM) and fat mass (FM) was observed as a function of BMI, while in females, FM increased more than FFM. In both genders, FFM significantly decreased as a function of age (p<0.001), but was higher in men of all ages. Similar patterns of variation were observed in W. A differently significant correlation between BMI and W was observed between men and women, and it was found by multivariate analysis of variance (MANOVA) that W was affected negatively by age (p<0.001) and positively by BMI (p<0.001) in males, while in females only age had a significant effect (p<0.001) but not BMI. A positive correlation (p<0.001) was detected between

FFM and W, in both genders. W per unit body mass, the actual muscle power for rapid external work, was higher in men than in women of all groups, and decreased with age in both genders, but only in older women decreased significantly ($p<0.01$) depending on BMI. It is concluded that the gender-dependent pattern of variation in body composition may be an important determinant of the different motor limitations observed in men and women. Older women (> or =50 yr) with extreme obesity (class III) suffered from the most serious motor dysfunction within this obese cohort. This result may have important clinical relevance in the care of obesity.

Mourot, et al. (2004) compared between constant and interval training exercises. Heart rate variability (HRV) was assessed during the short- (within 1 h) and long- (within 48 h) term recovery following a single bout of either constant (CST) or interval training (SWEET) exercise performed at the same total physical work [9.4 (0.3) kJ kg(-1)]. R-R intervals, systolic (SAP) and diastolic (DAP) arterial pressures were recorded in supine and upright positions before and 1, 24 and 48 h after the termination of the exercises in ten male subjects [mean (SEM), age 24.6 (0.6) years, height 177.2 (1.1) cm and body mass 68.5 (0.9) kg]. The parameters were also recorded in the supine position during the first 20 min following the end of the exercise. Spectral analysis parameters of HRV [total (TP), low- (LF), and high- (HF) frequency power, and LF/TP, HF/TP and LF/HF ratios] were determined over 5 min during each phase. Except for higher HF values in both supine and upright positions during the first hour following CST compared with SWEET, cardiovascular and HRV analysis responses were of the same magnitude after their termination. R-R intervals, TP, and HF/TP were significantly decreased while LF/TP and LF/HF were significantly increased during the early recovery, when compared with control values. This could be a response to the significant decrease in SAP and DAP at this time. Twenty-four and 48 h after the end of the exercise, HRV parameters were at the same levels as before exercises in the supine posture, but a persistent tachycardia continued to be observed in the upright posture, together with reduced TP values, showing that cardiovascular functions were still disturbed. The short-term HRV recovery seemed dependent on the type of exercise, contrary to the long-term recovery.

Rognmo, et al. (2004) assessed the effects of high intensity aerobic interval exercise compared to moderate intensity exercise, representing the same total training load, for increasing VO2peak in stable CAD-patients. Twenty-one stable CAD-patients were randomized to supervised treadmill walking at either high intensity (80-90% of VO2peak) or moderate intensity (50-60% of VO2peak) three times a week for 10 weeks. After training VO2peak increased by 17.9% (P=0.012) in the high intensity group and 7.9% (P=0.038) in the moderate intensity group. The training-induced adaptation was significantly higher in the high intensity group (P=0.011). High intensity aerobic interval exercise is superior to moderate exercise for increasing VO2peak in stable CAD-patients. As VO2peak seems to reflect a continuum between health and cardiovascular disease and death, the present data may be useful in designing effective training programmes for improved health in the future.

Kraemer, et al. (2004) determined the effects of high intensity endurance training (ET) and resistance training (RT) alone and in combination on various military tasks. Thirty-five male soldiers were randomly assigned to one of four training groups: total body resistance training plus endurance training (RT + ET), upper body resistance training plus endurance training (UB + ET), RT only, and ET only. Training was performed 4 days per week for 12 weeks. Testing occurred before and after the 12-week training regimen. All groups significantly improved push-up performance, whereas only the RT + ET group did not improve sit-up performance. The groups that included ET significantly decreased 2-mile run time, however, only RT + ET and UB + ET showed improved loaded 2-mile run time. Leg power increased for groups that included lower body strengthening exercises (RT and RT + ET). Army Physical Fitness Test performance, loaded running, and leg power responded positively to training, however, it appears there is a high degree of specificity when concurrent training regimens are implemented.

Tomlin & **Wenger. (2001)** the relationship between aerobic fitness and recovery from high intensity intermittent exercise. A strong relationship between aerobic fitness and the aerobic response to repeated bouts of high intensity exercise has been established, suggesting that aerobic fitness is important in determining the magnitude of the oxidative response. The elevation of exercise oxygen consumption (VO2) is at least partially responsible for the larger fast component of excess post-exercise oxygen consumption (EPOC) seen in endurance-trained athletes following intense intermittent exercise. Replenishment of phosphocreatine (PCr) has been linked to both fast EPOC and power recovery in repeated efforts. Although 31P magnetic resonance spectroscopy studies appear to support a relationship between endurance training and PCr recovery following both submaximal work and repeated bouts of moderate intensity exercise, PCr resynthesis following single bouts of high intensity effort does not always correlate well with maximal oxygen consumption (VO2max). It appears that intense exercise involving larger muscle mass displays a stronger relationship between VO2max and PCr resynthesis than does intense exercise utilising small muscle mass. A strong relationship between power recovery and endurance fitness, as measured by the percentage VO2max corresponding to a blood lactate concentration of 4 mmol/L, has been demonstrated. The results from most studies examining power recovery and VO2max seem to suggest that endurance training and/or a higher VO2max results in superior power recovery across repeated bouts of high intensity intermittent exercise. Some studies have supported an association between aerobic fitness and lactate removal following high intensity exercise, whereas others have failed to confirm an association. Unfortunately, all studies have relied on measurements of blood lactate to reflect muscle lactate clearance, and different mathematical methods have been used for assessing blood lactate clearance, which may compromise conclusions on lactate removal. In summary, the literature suggests that aerobic fitness enhances recovery from high intensity intermittent exercise through increased aerobic response, improved lactate removal and enhanced PCr regeneration.

Linda, et al. (2000) evaluated the effects of various modes of training on the time-course of changes in lipoprotein-lipid profiles in the blood, cardiovascular fitness, and body composition after 16 weeks of training and 6 weeks of detraining in young women. A group of 48 sedentary but healthy women [mean age 20.4 (SD 1) years] were matched and randomly placed into a control group (CG, *n*=12), an aerobic training group (ATG, *n*=12), a resistance training group (RTG, *n*=12), or a cross-training group that combined both aerobic and resistance training (XTG, *n*=12). The ATG, RTG and XTG trained for 16 weeks and were monitored for changes in blood concentrations of lipoprotein-lipids, cardiovascular fitness, body composition, and dietary composition throughout a 16 week period of training and 6 weeks of detraining. The ATG significantly reduced blood concentrations of triglycerides (TRI) ($P < 0.05$) and significantly increased blood concentrations of high-density lipoprotein-cholesterol (HDL-C) after 16 weeks of training. The correlation between percentage fat and HDL-C was 0.63 ($P < 0.05$), which explained 40% of the variation in HDL-C, while the correlation between maximal oxygen uptake ($\dot{V}O_{2max}$) and HDL-C was 0.48 ($P < 0.05$), which explained 23% of the variation in HDL-C. The ATG increased $\dot{V}O_{2max}$ by 25% ($P < 0.001$) and decreased percentage body fat by 13% ($P < 0.05$) after 16 weeks. Each of the alterations in the ATG had disappeared after the 6 week detraining period. The concentration of total cholesterol (TC), TRI, HDL-C and low density lipoprotein-cholesterol in the blood did not change during the study in RTG, XTG and CG. The RTG increased upper and lower body strength by 29% ($P < 0.001$) and 38%, respectively. The 6 week detraining strength values obtained in RTG were significantly greater than those obtained at baseline. The XTG increased upper and lower body strength by 19% ($P < 0.01$) and 25% ($P < 0.001$), respectively. The 6 week detraining strength values obtained in XTG were significantly greater than those obtained at baseline. The RTG, XTG and CG did not demonstrate any significant changes in either $\dot{V}O_{2max}$, or body composition during the training and detraining periods. The results of this study suggest that aerobic-type exercise improves lipoprotein-lipid profiles, cardiorespiratory fitness and body composition in healthy, young women, while resistance training significantly improved upper and lower body strength only.

Ross, et al. (1999) examined short and long term changes in weight, body composition, and cardiovascular risk profiles produced by diet combined with either structured aerobic exercise or moderate-intensity lifestyle activity. Sixteen-week randomized controlled trial with 1-year follow-up, conducted from August 1995 to December 1996. Forty obese women (mean body mass index [weight in kilograms divided by the square of height in meters], 32.9 kg/m^2; mean weight, 89.2 kg) with a mean age of 42.9 years (range, 21-60 years) seen in a university-based weight management program. Structured aerobic exercise or moderate lifestyle activity; low-fat diet of about 1200 kcal/d. Changes in body weight, body composition, cardiovascular risk profiles, and physical fitness at 16 weeks and at 1 year. Mean (SD) weight losses during the 16-week treatment program were 8.3 (3.8) kg for the aerobic group and 7.9 (4.2) kg for the lifestyle group (within groups, $P<.001$; between groups, $P = .08$). The aerobic group lost significantly less fat-free mass (0.5 [1.3] kg) than the lifestyle group (1.4 [1.3] kg; $P = .03$). During the 1-year follow-up, the aerobic group regained 1.6 [5.5] kg, while the lifestyle group regained 0.08 (4.6) kg. At week 16, serum triglyceride levels and total cholesterol levels were reduced significantly ($P<.001$) from baseline (16.3% and 10.1% reductions, respectively) but did not differ significantly between groups and were not different from baseline or between groups at week 68. A program of diet plus lifestyle activity may offer similar health benefits and be a suitable alternative to diet plus structured aerobic activity for obese women.

Chacon-Mikahil (1998) investigated the effects of aerobic training on the efferent autonomic control of heart rate (HR) during dynamic exercise in middle-aged men, eight of whom underwent exercise training (T) while the other seven continued their sedentary (S) life style. The training was conducted over 10 months (three 1-h sessions/week on a field track at 70-85% of the peak HR). The contribution of sympathetic and parasympathetic exercise tachycardia was determined in terms of differences in the time constant effects on the HR response obtained using a discontinuous protocol (4-min tests at 25, 50, 100 and 125 watts on a cycle ergometer), and a continuous protocol (25 watts/min until exhaustion) allowed the quantification of the parameters (anaerobic threshold, VO_2 AT; peak O_2 uptake, VO_2 peak; power peak) that reflect oxygen transport. The results obtained for the S and the T groups were: 1) a smaller resting HR in T (66 beats/min) when compared to S (84 beats/min); 2) during exercise, a small increase in the fast tachycardia (□0-10 s) related to vagal withdrawal ($P<0.05$, only at 25 watts) was observed in T at all powers; at middle and higher powers a significant decrease ($P<0.05$ at 50, 100 and 125 watts) in the slow tachycardia (□1-4 min) related to a sympathetic-dependent mechanism was observed in T; 3) the VO_2 AT (S = 1.06 and T = 1.33 l/min) and VO_2 peak (S = 1.97 and T = 2.47 l/min) were higher in T ($P<0.05$). These results demonstrate that aerobic training can induce significant physiological adaptations in middle-aged men, mainly expressed as a decrease in the sympathetic effects on heart rate associated with an increase in oxygen transport during dynamic exercise.

Geliebter, et al. (1997) moderate obese subjects (aged 19-48 y) were assigned to one of three groups: diet plus strength training, diet plus aerobic training, or diet only. Sixty-five subjects (25 men and 40 women) completed the study. They received a formula diet with an energy content of 70% of RMR or 5150 +/- 1070 kJ/d (x +/- SD) during the 8-wk intervention. They were seen weekly for individual nutritional counseling. Subjects in the two exercise groups, designed to be isoenergetic, trained three times per week under supervision. Those in the strength-training group performed progressive weight-resistance exercises for the upper and lower body. Those in the aerobic group performed alternate leg and arm cycling. After 8 wk, the mean amount of weight lost, 9.0 kg, did not differ significantly among groups. The strength-training group, however, lost significantly less FFM ($P < 0.05$) than the aerobic and diet-only groups. The strength-training group also showed significant increases ($P < 0.05$) in anthropometrically measured flexed arm muscle mass and grip strength. Mean RMR declined significantly, without differing among groups. Peak oxygen consumption increased the most for the aerobic group ($P = 0.03$). In conclusion, strength training significantly reduced the loss of FFM during dieting but did not prevent the decline in RMR.

Tabata, et al. (1996) consisted of two training experiments using a mechanically braked cycle ergometer. First, the effect of 6 wk of moderate-intensity endurance training (intensity: 70% of maximal oxygen uptake (VO2max), 60 min.d-1, 5 d.wk-1) on the anaerobic capacity (the maximal accumulated oxygen deficit) and VO2max was evaluated. After the training, the anaerobic capacity did not increase significantly ($P > 0.10$), while VO2max increased from 53 +/- 5 ml.kg-1 min-1 to 58 +/- 3 ml.kg-1.min-1 (P < 0.01) (mean +/- SD). Second, to quantify the effect of high-intensity intermittent training on energy release, seven subjects performed an intermittent training exercise 5 d.wk-1 for 6 wk. The exhaustive intermittent training consisted of seven to eight sets of 20-s exercise at an intensity of about 170% of VO2max with a 10-s rest between each bout. After the training period, VO2max increased by 7 ml.kg-1.min-1, while the anaerobic capacity increased by 28%. In conclusion, this study showed that moderate-intensity aerobic training that improves the maximal aerobic power does not change anaerobic capacity and that adequate high-intensity intermittent training may improve both anaerobic and aerobic energy supplying systems significantly, probably through imposing intensive stimuli on both systems.

Douglas, et al. (1996) Contrasting effects of resistance and aerobic training on body composition and metabolism after diet-induced weight loss. This study examined whether exercise training facilitates maintenance of body weight at reduced levels following weight loss by attenuating weight loss-induced reductions in resting metabolism and fat oxidation. The effects of 12 weeks (three times per week) of either aerobic or weight training exercise on body weight, body composition, and energy metabolism during rest and following a meal in 18 older (mean ± SE, 61 ± 1 years; range, 56 to 70) subjects who had recently lost a mean of 9 ± 1 kg were studied. During the exercise training period, the aerobic training group (five women, four men) had a significant ($P < .05$) reduction in body weight (−2.5 ± 0.6 kg) as compared with the weight training group (five women, four men) (0.4 ± 0.9 kg). Eight of nine aerobic training subjects lost additional weight, while six of nine weight training subjects gained weight. Neither type of training reversed the depressions in resting metabolism or fat oxidation rates (ie, resting or postprandial) that had occurred as a consequence of the prior weight loss. Thus, alterations in resting metabolism or fat oxidation (resting or postprandial) do not appear to be the mechanism(s) by which exercise training facilitates maintenance of diet-induced weight loss.

Tremblay, et al. (1994) the impact of two different modes of training on body fatness and skeletal muscle metabolism was investigated in young adults who were subjected to either a 20-week endurance-training (ET) program (eight men and nine women) or a 15-week high-intensity intermittent-training (HIIT) program (five men and five women). The mean estimated total energy cost of the ET program was 120.4 MJ, whereas the corresponding value for the HIIT program was 57.9 MJ. Despite its lower energy cost, the HIIT program induced a more pronounced reduction in subcutaneous adiposity compared with the ET program. When corrected for the energy cost of training, the decrease in the sum of six subcutaneous skinfolds induced by the HIIT program was ninefold greater than by the ET program. Muscle biopsies obtained in the vastus lateralis before and after training showed that both training programs increased similarly the level of the citric acid cycle enzymatic marker. On the other hand, the activity of muscle glycolytic enzymes was increased by the HIIT program, whereas a decrease was observed following the ET program. The enhancing effect of training on muscle 3-hydroxyacyl coenzyme A dehydrogenase (HADH) enzyme activity, a marker of the activity of beta-oxidation, was significantly greater after the HIIT program. In conclusion, these results reinforce the notion that for a given level of energy expenditure, vigorous exercise favors negative energy and lipid balance to a greater extent than exercise of low to moderate intensity. Moreover, the metabolic adaptations taking place in the skeletal muscle in response to the HIIT program appear to favor the process of lipid oxidation.

2.2 SUMMARY

The review of literature helped the investigator to spot out relevant topics and variables. Further the literature helped the investigator to frame the suitable hypothesis leading to the problems. The latest literature also helped the investigator to support her finding with regard to the problem. Further the literature collected in the study also helped the research scholar to summarize her study. The researcher has presented the reviews in the related subjects by depending upon the highly authentic sources. Each review has been written in details in related to my subjects. Finally the researcher puts to an end to this chapter after giving all relevant details to each reviews of this chapter.

The reviews on aerobic and anaerobic training (30) were presented. All the research studies presented in the section proved that the aerobic and anaerobic training contribute significantly for better development of dependent variables. The research studies reviewed were collected from journals available in the websites and some university libraries. Based on the experience gained through review of the studies, the investigator formulated suitable methodology to be followed in this research, which is presented in Chapter III.

Chapter – III

Methodology

CHAPTER – III

METHODOLOGY

In this chapter selection of subjects, selection of variables, experimental design, pilot study, criterion measures and selection of tests, reliability of data, reliability of instruments, reliability of questionnaire, subject reliability, orientation of the subjects, administration of test items, administration of training programs, collection of data, statistical techniques and its justification adopted for the analysis of data have been described.

3.1 SELECTION OF SUBJECTS

The purpose of the study was to find out the effect of aerobic and anaerobic training on selected physiological and body composition profiles among middle aged obese women. To achieve the purpose of this study Forty five middle aged obese women were randomly selected in and around from Namakkal district, Tamil Nadu, India and their age ranged between 35 to 45 years.

3.2 SELECTION OF VARIABLES

The research scholar reviewed the available scientific literature pertaining to the problem from books, journals, magazines, websites, and research papers which revealed the importance of aerobic training and anaerobic training. Taking into consideration of feasibility, criteria and availability of the instruments the following variables were selected for this study.

3.2.1 DEPENDENT VARIABLES

a. Physiological Variables

- Breath Holding Time
- Systolic Blood Pressure
- Diastolic Blood Pressure
- Resting Pulse Rate
- Aerobic Power
- Anaerobic Power

b. Body Composition Profiles

- Body Weight
- Lean Body Mass
- Fat Mass
- Body Mass Index

3.2.2 INDEPENDENT VARIABLES

- Group I – Aerobic Training
- Group II – Anaerobic Training
- Group III – Control Group

3.2 EXPRIMENTAL DESIGN

The study was formulated as a pre and post test random group design, in which forty five obese women were randomly assigned into three equal groups and each group consisting of 15 subjects. Group I underwent Aerobic training and Group II underwent Anaerobic training and Group III act as a control group; they did not undergo any above mentioned special training programme. After assessing the subjects to treatment and control groups, they were tested on selected criterion variables. It was considered as pre – test. After assessing the pre – test performance on criterion variables, the subjects were treated with their respective training programme for twelve weeks. After twelve weeks of their training programme, again the subjects were tested (Post-test) on selected criterion variables as such in the pre – test.

3.4 PILOT STUDY

A pilot study was conducted to assess the initial capacity of the subjects in order to fix the load. For this purpose ten subjects were selected randomly and underwent training packages under watchful eyes of the experts and the researcher. Based on the response of the subjects in the pilot study the training schedule were constructed, however the individual differences were considered while constructing the training programme. The basic principles of training (progression, over load and specificity) were also followed.

3.5 CRITERION MEASURES AND SELECTION OF TESTS

The present study mainly concerns with the effect of aerobic and anaerobic training on selected physiological and body composition profiles among middle aged obese women.

The following tests were administered to measure the selected physiological and body composition profiles. The tests were administered to the subjects before and after the training programme.

TABLE – 3.1

TEST SELECTION

S.No	Variables	Tests	Units
1	Breath Holding Time	Breath Holding	In Seconds
2	Systolic Blood Pressure	Sphygmomanometer	In mmhg
3	Diastolic Blood Pressure		
4	Resting Pulse Rate	Stethoscope	In Beats/Min
5	Aerobic Power	Queens College step test	In ml/kg/min
6	Anaerobic Power	Margaria-Kalamen Power Test	In Watts
7	Body Weight	Bioelectrical Impedance Analyzer (Omron Body Fat Monitor HBF-306)	In Kilograms
8	Lean Body Mass		In Kilograms
9	Fat Mass		In Kilograms
10	Body Mass Index		In Numbers

3.6 RELIABILITY OF DATA

The reliability of data was established by using test-retest method. To achieve this purpose, ten subjects were randomly selected and the test was administered twice after a day's gap. Care was taken to keep all testing conditions uniformly during testing and retesting. The scores recorded for the ten subjects during the test and retests were correlated using Intra Class Correlation for the different variables. The co-efficient of correlation is presented in Table – 3.2.

TABLE – 3.2

RELIABILITY CO-EFFICIENT OF CORRELATION OF TEST-RETEST SCORES

S. No	Variables	Co-efficient of correlation 'r'(N=10)
1	Breath holding time	0.89
2	Systolic Blood Pressure	0.95
3	Diastolic Blood Pressure	0.98
4	Resting Pulse Rate	0.97
5	Aerobic Power	0.96
6	Anaerobic Power	0.97
7	Body Weight	0.98
8	Lean Body Mass	0.94
9	Fat Mass	0.97
10	Body Mass Index	0.90

3.7 RELIABILITY OF INSTRUMENTS

The instrument such as digital stop watch, sphygmomanometer, stethoscope, step benches, bioelectrical impedance analyzer, stadiometer, weighing machine were reliable and accurate enough to carry out the test procedures successively.

3.8 TESTER'S RELIABILITY

To ensure the tester's reliability of the tests the investigator had a number of practice sessions in the teaching procedure and well versed in the technique of conducting the test. Tester reliability of test was established by test-retest process. For this purpose ten subjects were selected at random on the chosen variables, which were recorded twice under identical conditions on different occasions by the different investigator.

3.9 SUBJECTS RELIABILITY

In order to get uniform results from the same subjects, they were used under similar conditions for the same test by the same tester. The test-retest method was used to find out the subjects reliability.

3.10 ORIENTATION TO THE SUBJECTS

The investigator held a meeting with the subjects prior to the administration of tests. The purpose, the significance of this study and the requirements of the testing procedure were explained to them in detail, so that there was no ambiguity in their minds, regarding the efforts required of them. All the subjects voluntarily came forward to co-operate in the testing procedures and the training to put in their best efforts in the interest of the scientific investigation and in order to enhance their own performance. The subjects were very enthusiastic and co-operative throughout the project.

3.11 ADMINISTRATION OF TEST ITEMS

3.12 PHYSIOLOGICAL VARIABLES

3.12.1 Breath Holding Time (Digital Stop Watch)

Purpose:

To measure the ability of the subject to hold the breath for longer time.

Procedure:

The subject stands at ease and in hold deeply after which he hold his breath for a length of time possible to him. The index finger of the respondent served as an indicator to the investigator to know the start and end of the recording time. The centre finger were used to hold the nose avoid letting the air through the nostrils. The subject were requested not be let the air out by opening the mouth while recording the breath holding time.

Scoring:

The time is recorded in seconds and the best of two trials were recorded.

3.12.2 Blood Pressure (Sphygmomanometer)

Purpose:

The purpose was to measure the blood pressure (systolic and diastolic pressure) of the subjects.

Equipments:

Sphygmomanometer was needed.

Procedure:

The measurements were taken with the subjects in supine position. The cuff was wrapped around the arm evenly with the lower edge approximately one inch above the anticubital space. The stethoscope was placed on the medical side of the elbow, over the artery and was made sure that it had no contact with the cuff. The cuff was inflated until the artery was fully collapsed to the extent that number of pulse beat could be heard. Pressure off the cuff was then slowly released as the investigator watched the gauge when sound of the pulse become audible the reading in mm of Hg at that instant was recorded as the systolic pressure. The pressure was farther released gradually as the sound of the pulse change in intensity and quality. The index of the diastolic pressure was would in mm of Hg when the heart beat sound completely ceased.

Scoring:

The blood pressure was measured in millimeters of mercury (mmHg).

3.12.3 Resting Pulse Rate (Stethoscope)

Purpose:

The purpose was to measure the rate of the pulse beat per minute.

Equipments:

Stethoscope, Score Sheet, Stop Watch was needed to execute the test.

Procedure:

For the sake of accuracy, in this study, the students were asked to stay in the hostel for a night. The resting pulse rate was measured in the subject's hostel rooms as soon as they woke up from their sleep in the morning. They were instructed to remain in their beds till the investigator arrived to measure their resting pulse rates. The resting pulse rate was measured while the subject remained lying on the bed around 6.30 a.m. in the morning. The stopwatch was used to count the seconds for starting and ending the pulse beat counts. After every minute, when the stopwatch was stopped, both the subjects and investigator called out the number of beats counted by them simultaneously.

Scoring:

There were five repetitions of such one – minute counts and the highest count were recorded as the subject's resting pulse rate. Number of beats per minute was counted.

3.12.4 Aerobic Power (Queens College Step Test)

Purpose:

This sub-maximal test provides a measure of cardiorespiratory or endurance fitness.

Equipments:

16.25 inches / 41.3 cm step, stopwatch, metronome or cadence tape, pulse rate monitor.

Procedure:

The athlete steps up and down on the platform at a rate of 22 steps per minute for females and at 24 steps per minute for males. The subjects are to step using a four-step cadence, 'up-up-down-down' for 3 minutes. The athlete stops immediately on completion of the test, and the heart beats are counted for 15 seconds from 5-20 seconds of recovery. Multiply this 15 second reading by 4 will give the beats per minute (bpm) value to be used in the calculation below. See video of this test being performed.

Scoring:

An estimation of VO2max can be calculated from the test results, using this formula (McArdle et al.,1972). A rating can be determined using the VO2max norms.

- men: VO2max (ml/kg/min) = 111.33 - 0.42 x heart rate (bpm)
- women: VO2max (ml/kg/min) = 65.81 - 0.1847 x heart rate (bpm)

3.12.5 Anaerobic Power (Margaria-Kalamen Power Test)

Purpose:

This is a classic test of anaerobic power.

Equipments:

Stopwatch, timing mats (optional), tape measure, flight of 12 steps with a starting line of 6 meters in front of the first step. Each step is approximately 17.5 cm high with the 3rd, 6th and 9th step clearly marked. The vertical distance between the 3rd and 9th step must be accurately measured for use in the results formula.

Procedure:

The athlete's weight is determined in kilograms. The athlete is given a few practice runs up the steps to warm up. The athlete stands ready at the starting line 6 meters in front of the first step. On the command "Go", the athlete sprints to and up the flight of steps, taking three steps at a time (stepping on the 3rd, 6th and 9th steps), attempting to go up the steps as fast as possible. The time to get from the 3rd step to the 9th step is recorded (either using a stopwatch or using switch mats placed on the 3rd and 9th steps), starting when the foot was in first in contact with the 3rd step, and stopped when the foot contacts the 9th step. Allow three trials of the test, with 2-3 minutes recovery between each trial.

Scoring:

Power (Watts) is calculated from the formula below, where P = Power (Watts), M = Body mass (kg), D = Vertical distance, between steps 3 & 9 (meters), t = Time (seconds). 9.8 is the constant of gravity: P = (M x D) x 9.8 / t.

3.13 BODY COMPOSITION PROFILES

3.13.1 Body Weight

Purpose:

To measure the body weight.

Equipment:

Weighing machine and score sheet.

Procedure:

The body weight of each subject was taken on a portable weighing machine. Before taking the measurements, care was taken to see that the pointer of weighing machine stood at zero when there was no weight on it. The measurement of body weight was recorded to nearest one tenth a kilogram.

Scoring:

The body weight was recorded with nearest one tenth of kilogram and recorded as score.

3.13.2 Lean Body Mass

Purpose:

To assess the subjects fat mass.

Procedure:

Subject's body weight was measured by using weighing machine and fat mass was measured by using the formula fat mass (kg) = percentage fat X body weight (kg). Lean body mass was calculated by the following formula.

Scoring:

Lean Body Mass (kg) = body weight (kg) – Fat Mass (kg)

3.13.3 Fat Mass

Purpose:

To assess the subjects fat mass.

Procedure:

Subject's percentage of fat and body weight was measured by using Omron body fat monitor and weighing machine respectively. Fat free mass was calculated by the following formula.

Scoring:

Fat mass (kg) = percentage fat X body weight (kg)

3.13.4 Body Mass Index

Purpose:

To measure the body composition of the subjects.

Equipment:

Scales and stadiometer as for weight and height.

Procedure:

BMI is calculated from body mass (Weight in kg) and height in meter. BMI = Weight in kg / (Height in meter)^2. The higher the score usually indicating higher levels of body fat.

Scoring:

Use the table below to determine the BMI rating.

Body Mass Index	Weight Status
Below 18.5	Under weight
18.5-24.9	Normal
25.0-29.9	Overweight
30.0 and above	Obese

3.14 TRAINING PROGRAMME

During the training period the experimental groups underwent their respective training programme in addition to their daily regular activities as per the schedule. Experimental groups namely aerobic training, anaerobic training underwent their respective experimental training on three alternate days per week for twelve weeks. The experimental training programmes were designed based on the resources collected from books, periodicals, e-materials and discussions with the experts. The duration of experimental training were planned for 90 minutes. The subjects reported for experimental training between 7.00 am and 8.30 am. All the subjects involved in this study were carefully monitored throughout the training programme and attained 90% of attendance.

TABLE – 3.3

GENERAL STRUCTURE OF TRAINING PROGRAMS

GROUPS WITH TRAINING PARTICULARS	TRAINING
Group I	Aerobic Training
Group II	Anaerobic Training
Group III	Control Group
Training Duration	Ninety Minutes
Training Session per week	Three days
Total length of training	Twelve Weeks
Training load progression	Every Four Weeks

TABLE – 3.4

AEROBIC TRAINING GROUP (ATG)

Weeks	Training	Duration	Intensity	Time	Frequency /Week	Rest
1-4	Walking	90 Mins	40 to 50%	7.00 to 8.30 AM	3	2 Mins
	Jogging					2 Mins
	Cycling					2 Mins
	Stair Climbing					2 Mins
	Aerobic Dance					2 Mins
	Recreational Games					2 Mins
5-8	Walking	90 Mins	50 to 60%	7.00 to 8.30 AM	3	3 Mins
	Jogging					3 Mins
	Cycling					3 Mins
	Stair Climbing					3 Mins
	Aerobic Dance					3 Mins
	Recreational Games					3 Mins
9-12	Walking	90 Mins	60 to 70%	7.00 to 8.30 AM	3	4 Mins
	Jogging					4 Mins
	Cycling					4 Mins
	Stair Climbing					4 Mins
	Aerobic Dance					4 Mins
	Recreational Games					4 Mins

TABLE – 3.5

ANAEROBIC TRAINING GROUP (AATG)

Weeks	Training	Duration	Intensity	Time	Frequency/Week	Rest
1-4	Running	90 Mins	40 to 50%	7.00 to 8.30 AM	3	2 Mins
	Weight Lifting					2 Mins
	Sprint (100M, 200M)					2 Mins
	Jumping Rope					2 Mins
	Low Intensity Interval Training					2 Mins
	Rapid Burst Exercises					2 Mins
5-8	Running	90 Mins	50 to 60%	7.00 to 8.30 AM	3	3 Mins
	Weight Lifting					3 Mins
	Sprint (100M, 200M)					3 Mins
	Jumping Rope					3 Mins
	Low Intensity Interval Training					3 Mins
	Rapid Burst Exercises					3 Mins
9-12	Running	90 Mins	60 to 70%	7.00 to 8.30 AM	3	4 Mins
	Weight Lifting					4 Mins
	Sprint (100M, 200M)					4 Mins
	Jumping Rope					4 Mins
	Low Intensity Interval Training					4 Mins
	Rapid Burst Exercises					4 Mins

3.15 COLLECTION OF DATA

At the end of the treatment period, as post test, the subjects belong treatment groups namely (ATG) Group I and (AATG) Group II and control group were tested on criterion variables of physiological variables and the body composition profiles as such in the pre test of the same. The collected data were processed with appropriate statistical tool.

3.16 STATISTICAL TECHNIQUES

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 paired ‘t’ test. 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 base line to post treatment for various measures. The statistical tool used for these are described here. Analysis of co variance (ANCOVA) was applied to determine whether the training programmes produced significantly different improvements in selected variables after 12 weeks of training. Since the initial means were not matched, comparisons between actual could not be made, all means were adjusted by regression to a common mean. The significance of difference of pairs of adjusted final group means was tested for significance by applying Scheffe’s post hoc test. In all the cases 0.05 level of confidence was utilized.

Chapter – IV

Analysis of Data and Results of the Study

CHAPTER – IV

ANALYSIS OF THE DATA AND RESULTS OF THE STUDY

This chapter deals with the analysis of data collected from samples under study. The three groups namely aerobic training (ATG) group- I, anaerobic training (AATG) Group- II, and control group - III, were analyzed for the differences in their measures of the physiological and body composition profiles in relation to pre-test, post-test and adjusted post-test scores.

In this study, 45 middle aged obese women those who were residing in and around, Namakkal District, TamilNadu, India were randomly selected and their age ranging between 35 to 45 years. The group mean gains recorded by the various groups during the experimental period of twelve weeks to the criterion measures were tested for the significance by applying ‘t’ test. The groups were not equated in relation to the factors to be examined, hence the difference between means of the three groups in the pre-test had to be taken into account during the analysis of the post-test differences between the group means. This was achieved by the application of the analysis of covariance, where the final means were adjusted for differences in the initial means, and the adjusted means were tested for significance. Whenever the adjusted post-test means were found significant, the scheffe’s post-hoc test was administered to find out the paired means significant difference. Thus the obtained results were interpreted with earlier studies and presented in this chapter well along with graphical presentations.

4.1 TEST OF SIGNIFICANCE

This is the crucial portion of the thesis arrived at the conclusion by examining the hypothesis. The procedure of testing the hypothesis in accordance with the results obtained in relation to the level of confidence which was fixed at 0.05level.

4.2 RESULTS OF TREATMENT EFFECTS

The following tables illustrate the statistical results of the effect of aerobic and anaerobic training on selected physiological and body composition profiles among middle aged obese women.

TABLE – 4.1

SUMMARY OF ‘t’ RATIO ON SELECTED PHYSIOLOGICAL VARIABLES AND BODY COMPOSITION PROFILES OF AEROBIC TRAINING GROUP (ATG)

S.No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	‘t’ Ratio
1	Breath Holding Time	39.40	45.80	6.40	4.83	1.24	5.12*
2	Systolic Blood Pressure	125.53	121.53	4.00	3.58	0.92	4.32*
3	Diastolic Blood Pressure	85.66	82.80	2.86	2.23	0.57	4.97*
4	Resting Pulse Rate	74.26	72.93	1.33	1.44	0.37	3.56*
5	Aerobic Power	56.96	60.92	3.96	1.57	0.40	9.78*
6	Anaerobic Power	559.13	649.33	90.20	66.56	17.18	5.24*
7	Body Weight	78.10	74.69	3.40	2.73	0.70	4.82*
8	Lean Body Mass	51.86	55.79	3.93	1.80	0.46	8.45*
9	Fat Mass	26.24	18.90	7.33	0.94	0.24	30.00*
10	Body Mass Index	31.03	28.98	2.04	2.33	0.60	3.40*

Required table value= 2.14

An examination of table - 4.1 indicates that the obtained ‘t’ ratios were 5.12, 4.32, 4.97, 3.56, 9.78, 5.24, 4.82, 8.45, 30.00 and 3.40 for physiological variables of breath holding time, systolic blood pressure, diastolic blood pressure, resting pulse rate, aerobic power, anaerobic power, body composition profiles of body weight, lean body mass, fat mass and body mass index respectively. The obtained ‘t’ ratios on all the selected variables were found to be greater than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be significant. The results of this study showed that 12 weeks practice of aerobic training group were statistically significant and explained its effects positively.

TABLE – 4.2

SUMMARY OF 't' RATIO ON SELECTED PHYSIOLOGICAL VARIABLES AND BODY COMPOSITION PROFILES OF ANAEROBIC TRAINING GROUP (AATG)

S. No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	't' Ratio
1	Breath Holding Time	40.13	46.13	6.00	2.00	0.51	11.61*
2	Systolic Blood Pressure	126.66	121.80	4.86	3.75	0.97	5.01*
3	Diastolic Blood Pressure	85.80	81.73	4.06	1.57	0.40	9.97*
4	Resting Pulse Rate	74.40	72.53	1.86	2.06	0.53	3.50*
5	Aerobic Power	56.65	58.59	1.94	0.94	0.24	7.96*
6	Anaerobic Power	553.93	634.86	80.93	74.08	19.12	4.23*
7	Body Weight	77.85	75.42	2.43	3.92	1.01	2.40*
8	Lean Body Mass	51.71	56.28	4.57	2.51	0.64	7.03*
9	Fat Mass	26.14	19.13	7.00	1.42	0.36	19.10*
10	Body Mass Index	31.20	29.03	2.16	3.11	0.80	2.69*

Required table value= 2.14

An examination of table - 4.2 indicates that the obtained ‘t’ ratios were 11.61, 5.01, 9.97, 3.50, 7.96, 4.23, 2.40, 7.03, 19.10 and 2.69 for physiological variables of breath holding time, systolic blood pressure, diastolic blood pressure, resting pulse rate, aerobic power, anaerobic power, body composition profiles of body weight, lean body mass, fat mass and body mass index respectively. The obtained ‘t’ ratios on all the selected variables were found to be greater than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be significant. The results of this study showed that 12 weeks practice of anaerobic training group were statistically significant and explained its effects positively.

TABLE – 4.3

SUMMARY OF ‘t’ RATIO ON SELECTED PHYSIOLOGICAL VARIABLES AND BODY COMPOSITION PROFILES VARIABLES OF CONTROL GROUP (CG)

S.No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	‘t’ Ratio
1	Breath Holding Time	36.40	36.86	0.46	1.99	0.51	0.90
2	Systolic Blood Pressure	125.73	126.06	0.33	5.05	1.30	0.25
3	Diastolic Blood Pressure	86.26	86.06	0.20	2.30	0.59	0.33
4	Resting Pulse Rate	74.13	74.03	0.10	1.69	0.43	0.28
5	Aerobic Power	56.87	56.98	0.11	0.34	0.08	1.25
6	Anaerobic Power	565.80	566.80	0.60	2.61	0.67	0.88
7	Body weight	79.20	78.81	0.38	1.66	0.43	0.89
8	Lean Body Mass	52.52	52.28	0.23	0.99	0.25	0.89
9	Fat Mass	26.68	26.52	0.15	0.66	0.17	0.89
10	Body Mass Index	30.56	30.41	0.15	0.65	0.16	0.90

Required table value= 2.14

An examination of table - 4.3 indicates that the obtained ‘t’ ratios were 0.90, 0.25, 0.33, 0.28, 1.25, 0.88, 0.89, 0.89, 0.89 and 0.90 for physiological variables of breath holding time, systolic blood pressure, diastolic blood pressure, resting pulse rate, aerobic power, anaerobic power, body composition profiles of body weight, lean body mass, fat mass and body mass index respectively. The obtained ‘t’ ratios on all the selected variables were found to be lesser than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be insignificant. The results of this study showed that the control group were statistically insignificant.

TABLE – 4.4

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON BREATH HOLDING TIME

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	39.40	40.13	36.40	B	117.37	2	58.68	0.75
S.D ±	8.83	9.41	8.08	W	3248.93	42	77.35	
Post - test mean	45.80	46.13	36.86	B	828.93	2	414.46	4.90*
S.D ±	9.89	9.52	8.05	W	3547.86	42	84.47	
Adjusted post -test mean	45.06	44.67	39.06	B	327.10	2	163.55	15.31*
				W	437.81	41	10.67	

* Significant at 0.05 level of confidence

4.3 RESULTS OF BREATH HOLDING TIME

An examination of table - 4.4 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 0.75. It was found to be lesser than the required ‘F’ ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on breath holding time was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on breath holding time. The obtained F- ratio for the post-test was 4.90. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F-ratio needed for significance, it was inferred that the mean differences among the three groups on the breath holding time used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on breath holding time was 15.31.

The obtained F- ratio on breath holding time among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the performance of breath holding time was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.5.

TABLE – 4.5

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON BREATH HOLDING TIME

Aerobic Training Group	AATG	Control Group	Mean Difference	CI Value
45.06	44.67	---	0.31	3.03
45.06	---	39.06	6.00*	3.03
---	44.67	39.06	5.61*	3.03

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.5 confirmed that aerobic training with control group (6.00), anaerobic training with control group (5.61) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.31) at 0.05 level with the CI value of 0.33.

The pre, post and adjusted means on breath holding time were illustrated through bar diagram in Figure-1.

FIGURE – 1

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON BREATH HOLDING TIME

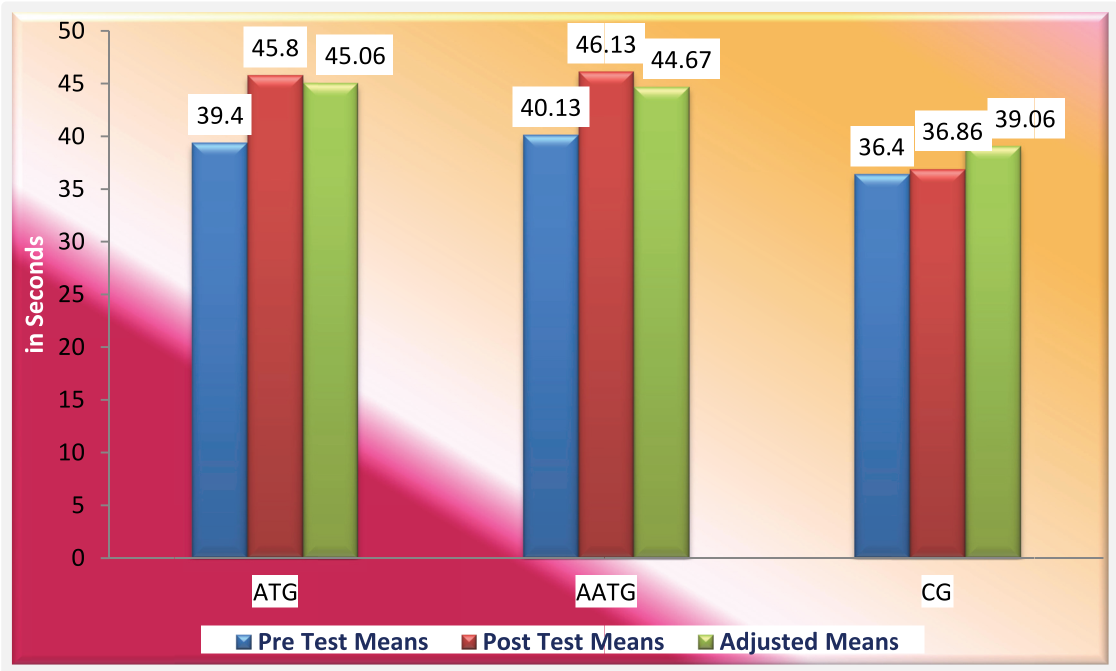


TABLE – 4.6

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON SYSTOLIC BLOOD PRESSURE

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	125.53	126.66	125.73	B	10.97	2	5.48	1.00
S.D ±	2.23	2.46	2.31	W	230.00	42	5.47	
Post - test mean	121.53	121.80	126.06	B	194.13	2	97.06	12.09*
S.D ±	2.85	2.21	3.32	W	337.06	42	8.02	
Adjusted post - test mean	121.37	122.05	125.97	B	185.06	2	92.53	12.38*
				W	306.38	41	7.47	

* Significant at 0.05 level of confidence

4.4 RESULTS OF SYSTOLIC BLOOD PRESSURE

An examination of table - 4.6 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 1.00. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on systolic blood pressure was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on systolic blood pressure. The obtained F- ratio for the post-test was 12.09. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F- ratio needed for significance, it was inferred that the mean differences among the three groups on the systolic blood pressure used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on systolic blood pressure was 12.38.

The obtained F- ratio on systolic blood pressure among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the performance of systolic blood pressure was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.7.

TABLE – 4.7

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON SYSTOLIC BLOOD PRESSURE

ATG	AATG	Control group	Mean difference	CI Value
121.37	122.05	---	0.68	2.53
121.37	---	125.97	4.60*	2.53
---	122.05	125.97	3.92*	2.53

* Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.7 confirmed that aerobic training with control group (4.60), anaerobic training with control group (3.92) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.68) at 0.05 level with the CI value of 2.53.

The pre, post and adjusted means on systolic blood pressure were illustrated through bar diagram in Figure-2.

FIGURE – 2

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON SYSTOLIC BLOOD PRESSURE

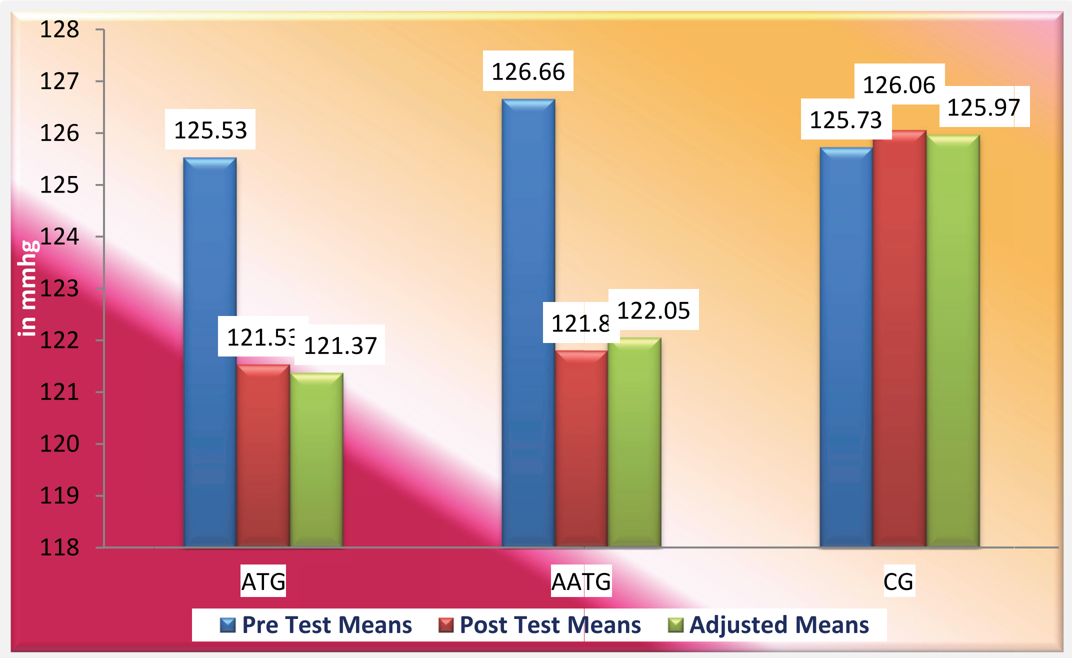


TABLE – 4.8

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON DIASTOLIC BLOOD PRESSURE

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	85.80	86.26	85.91	B	2.97	2	1.48	0.73
S.D ± ±	1.26	1.75	1.41	W	84.66	42	2.01	
Post - test mean	82.80	81.73	86.06	B	152.93	2	76.46	23.56*
S.D ± ±	1.85	1.62	1.90	W	136.26	42	3.24	
Adjusted post - test mean	82.86	81.76	85.97	B	139.73	2	69.86	21.85*
				W	131.09	41	3.19	

* Significant at 0.05 level of confidence

4.5 RESULTS OF DIASTOLIC BLOOD PRESSURE

An examination of table - 4.8 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 0.73. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on diastolic blood pressure was statistically insignificant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on diastolic blood pressure. The obtained F- ratio for the post-test was 23.56. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be lesser than the F- ratio needed for significance, it was inferred that the mean differences among the three groups on the diastolic blood pressure used in the study at the end of the treatment period was statistically insignificant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on diastolic blood pressure was 21.85.

The obtained F- ratio on diastolic blood pressure among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the performance of diastolic blood pressure was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.9.

TABLE – 4.9

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON DIASTOLIC BLOOD PRESSURE

ATG	AATG	Control group	Mean difference	CI Value
82.86	81.76	---	1.10	1.65
82.86	---	85.97	3.11*	1.65
---	81.76	85.97	4.21*	1.65

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.9 confirmed that aerobic training with control group (3.11), anaerobic training with control group (4.21) showed significant differences. There was no significant difference between aerobic training and anaerobic training (1.10) at 0.05 level with the CI value of 1.65.

The pre, post and adjusted means on diastolic blood pressure were illustrated through bar diagram in Figure-3.

FIGURE – 3

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON DIASTOLIC BLOOD PRESSURE

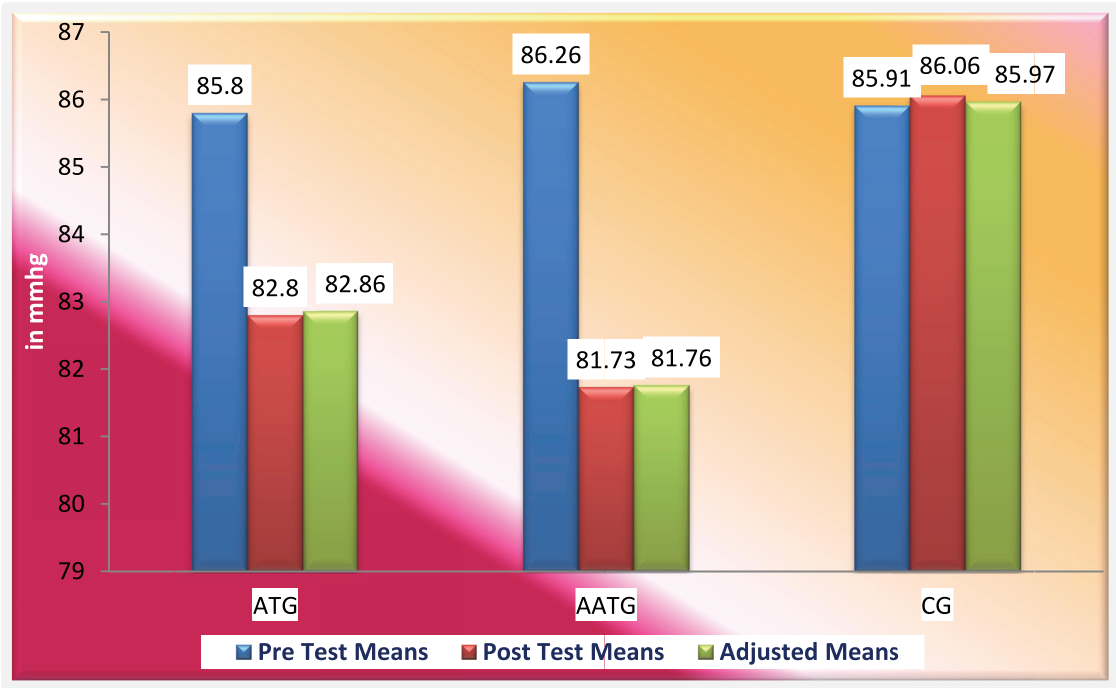


TABLE – 4.10

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON RESTING PULSE RATE

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	74.26	74.40	74.13	B	0.53	2	0.26	0.12
S.D ± ±	1.66	1.72	0.91	W	92.26	42	2.19	
Post - test mean	72.93	72.53	74.03	B	20.80	2	10.40	5.57*
S.D ±	1.03	0.91	1.92	W	78.40	42	1.86	
Adjusted post - test mean	72.93	72.50	74.16	B	22.15	2	11.07	6.16*
				W	73.71	41	1.79	

* Significant at 0.05 level of confidence

4.6 RESULTS OF RESTING PULSE RATE

An examination of table - 4.10 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 0.12. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on resting pulse rate was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on resting pulse rate. The obtained F-ratio for the post-test was 5.57. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F-ratio needed for significance, it was inferred that the mean differences among the three groups on the resting pulse rate used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on resting pulse rate was 6.16.

The obtained F- ratio on resting pulse rate among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the performance of resting pulse rate was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.11.

TABLE – 4.11

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON RESTING PULSE RATE

ATG	AATG	Control group	Mean difference	CI Value
72.93	72.50	---	0.43	1.22
72.93	---	74.16	1.23*	1.22
---	72.50	74.16	1.66*	1.22

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.11 confirmed that aerobic training with control group (1.23), anaerobic training with control group (1.66) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.43) at 0.05 level with the CI value of 1.22.

The pre, post and adjusted means on resting pulse rate were illustrated through bar diagram in Figure-4.

FIGURE - 4

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON RESTING PULSE RATE

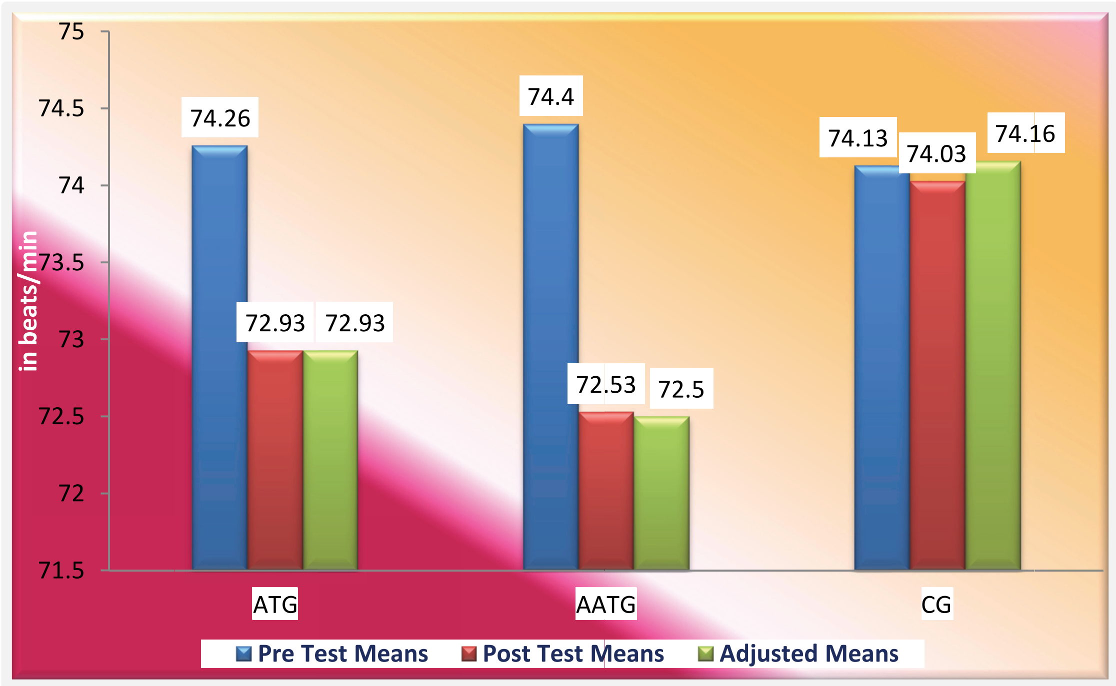


TABLE – 4.12

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON AEROBIC POWER

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	56.96	56.65	56.87	B	0.77	2	0.38	0.04
S.D ±	3.36	2.73	2.65	W	362.48	42	8.63	
Post - test mean	60.92	60.35	56.98	B	136.14	2	68.07	12.49*
S.D ±	2.61	1.43	2.72	W	228.86	42	5.44	
Adjusted post - test mean	60.84	60.46	56.95	B	137.90	2	68.95	33.94*
				W	83.28	41	2.03	

* Significant at 0.05 level of confidence

4.7 RESULTS OF AEROBIC POWER

An examination of table - 4.12 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 0.04. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on aerobic power was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on aerobic power. The obtained F-ratio for the post-test was 12.49. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F-ratio needed for significance, it was inferred that the mean differences among the three groups on the aerobic power used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on aerobic power was 33.94.

The obtained F- ratio on aerobic power among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the performance of aerobic power was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.13.

TABLE – 4.13

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON AEROBIC POWER

ATG	AATG	Control Group	Mean Difference	CI Value
60.84	60.46	---	0.38	1.32
60.84	---	56.95	3.89*	1.32
---	60.46	56.95	3.51*	1.32

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.13 confirmed that aerobic training with control group (3.89), anaerobic training with control group (3.51) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.38) at 0.05 level with the CI value of 1.32.

The pre, post and adjusted means on aerobic power were illustrated through bar diagram in Figure-5.

FIGURE – 5

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON AEROBIC POWER

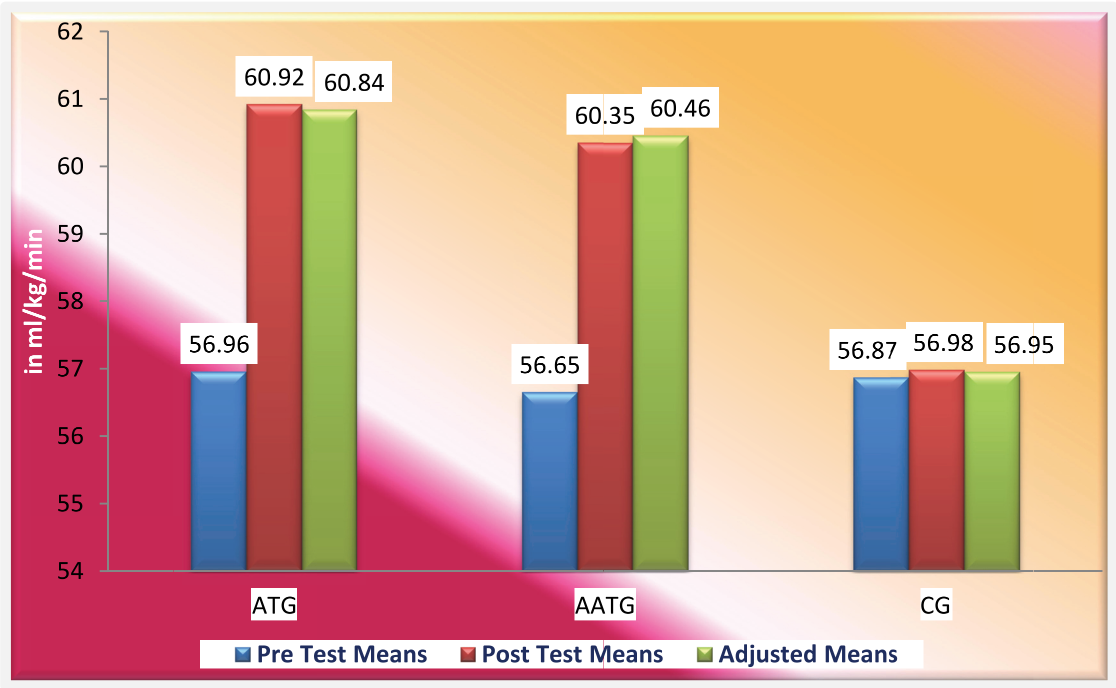


TABLE – 4.14

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON ANAEROBIC POWER

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	559.13	553.93	565.80	B	1061.51	2	530.75	0.08
S.D ±	89.67	83.59	62.47	W	265057.06	42	6310.88	
Post - test mean	649.33	634.86	566.40	B	58874.53	2	29437.26	8.12*
S.D ±	69.00	45.79	63.33	W	152170.66	42	3623.11	
Adjusted post - test mean	649.59	637.85	563.15	B	65754.20	2	32877.10	17.03*
				W	79145.34	41	1930.37	

* Significant at 0.05 level of confidence

4.8 RESULTS OF ANAEROBIC POWER

An examination of table - 4.14 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 0.08. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on anaerobic power was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on anaerobic power. The obtained F-ratio for the post-test was 8.12. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F-ratio needed for significance, it was inferred that the mean differences among the three groups on the anaerobic power used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on anaerobic power was 17.03.

The obtained F- ratio on anaerobic power among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the performance of anaerobic power was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.15.

TABLE – 4.15

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON ANAEROBIC POWER

ATG	AATG	Control Group	Mean Difference	CI Value
649.59	637.85	---	11.74	40.77
649.59	---	563.15	86.44*	40.77
---	637.85	563.15	74.70*	40.77

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.15 confirmed that aerobic training with control group (86.44), anaerobic training with control group (74.70) showed significant differences. There was no significant difference between aerobic training and anaerobic training (11.74) at 0.05 level with the CI value of 40.77.

The pre, post and adjusted means on anaerobic power were illustrated through bar diagram in Figure-6.

FIGURE – 6

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON ANAEROBIC POWER

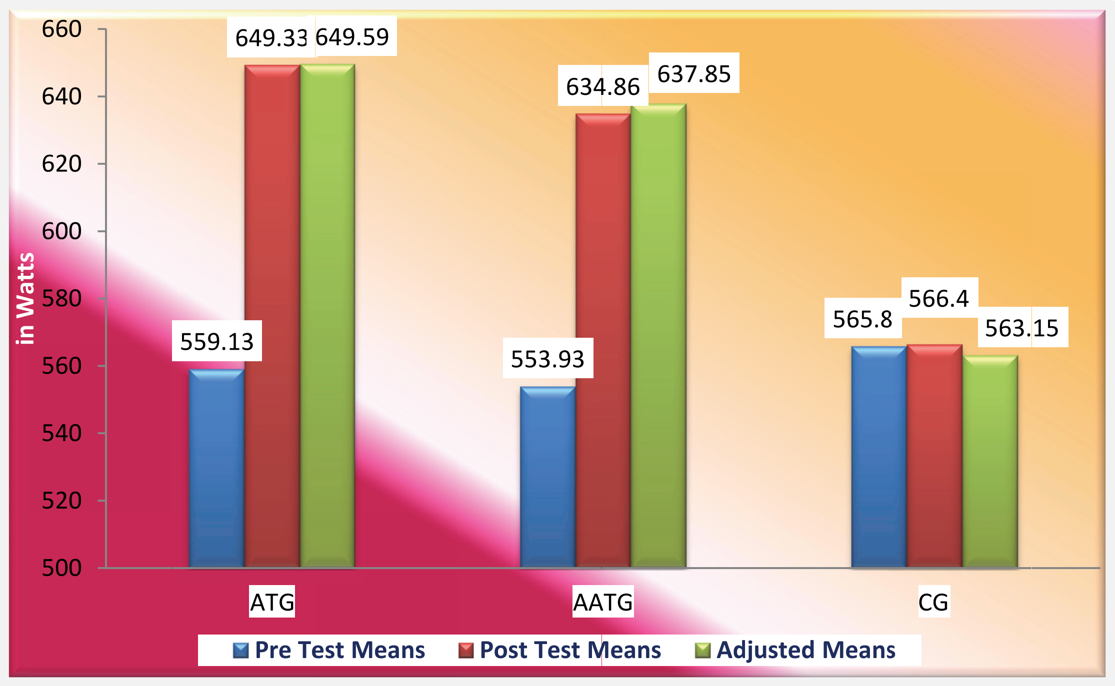


TABLE – 4.16

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON BODY WEIGHT

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	78.10	77.85	79.20	B	15.42	2	7.71	1.51
S.D ±	1.73	2.63	2.29	W	213.33	42	5.07	
Post - test mean	74.69	75.42	78.81	B	145.30	2	72.65	12.56*
S.D ±	2.50	2.61	2.05	W	242.94	42	5.78	
Adjusted post - test mean	74.75	75.54	78.63	B	118.44	2	59.22	10.46*
				W	231.97	41	5.65	

* Significant at 0.05 level of confidence

4.9 RESULTS OF BODY WEIGHT

An examination of table – 4.16 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 1.51. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on body weight was statistically insignificant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on body weight. The obtained F-ratio for the post-test was 12.56. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F-ratio needed for significance, it was inferred that the mean differences among the three groups on the body weight used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on body weight was 10.46.

The obtained F- ratio on body weight among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the body weight was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.17.

TABLE – 4.17

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON BODY WEIGHT

ATG	AATG	Control Group	Mean Difference	CI Value
74.75	75.54	---	0.78	2.20
74.75	---	78.63	3.88*	2.20
---	75.54	78.63	3.09*	2.20

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.17 confirmed that aerobic training with control group (3.88), anaerobic training with control group (3.09) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.78) at 0.05 level with the CI value of 2.20.

The pre, post and adjusted means on body weight were illustrated through bar diagram in Figure-7.

FIGURE – 7

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON BODY WEIGHT

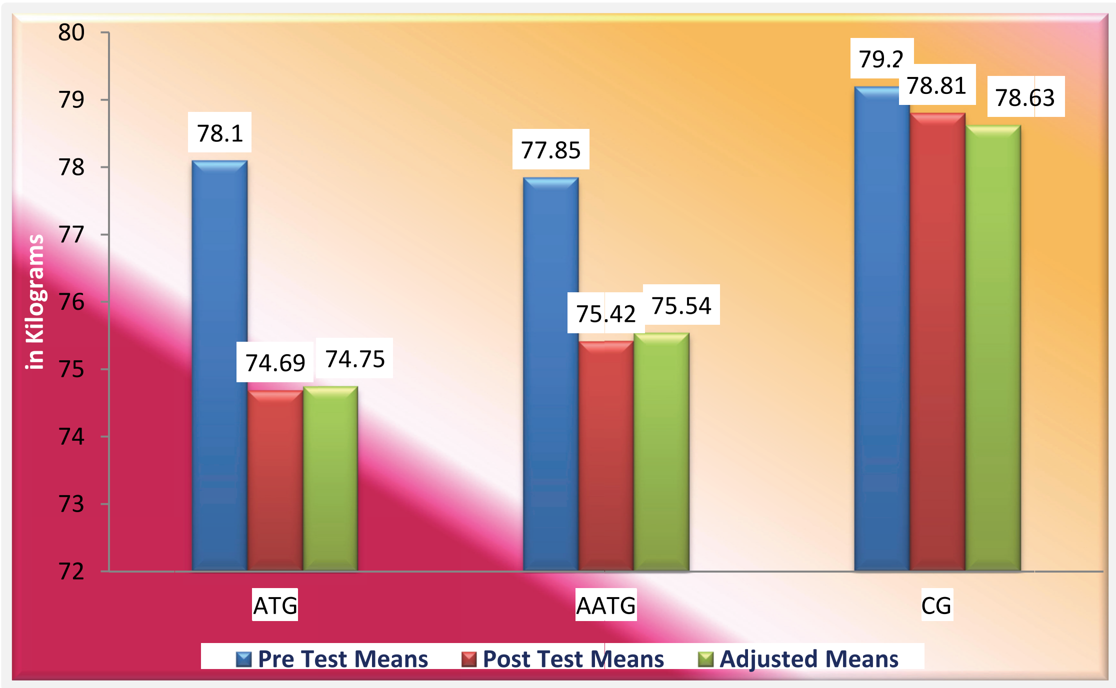


TABLE – 4.18

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON LEAN BODY MASS

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	51.86	51.71	52.52	B	5.55	2	2.77	1.51
S.D ±	1.04	1.58	1.37	W	76.80	42	1.82	
Post - test mean	55.79	56.28	52.28	B	142.36	2	71.18	28.14*
S.D ±	1.70	1.77	1.23	W	106.22	42	2.52	
Adjusted post - test mean	55.83	56.35	52.17	B	144.97	2	72.48	29.06*
				W	102.24	41	2.49	

* Significant at 0.05 level of confidence

4.10 RESULTS OF LEAN BODY MASS

An examination of table - 4.18 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 1.51. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on lean body mass was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on lean body mass. The obtained F-ratio for the post-test was 28.14. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F-ratio needed for significance, it was inferred that the mean differences among the three groups on the lean body mass used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on lean body mass was 29.06.

The obtained F- ratio on lean body mass among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the lean body mass was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.19.

TABLE – 4.19

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON LEAN BODY MASS

ATG	AATG	Control Group	Mean Difference	CI Value
55.83	56.35	---	0.52	1.46
55.83	---	52.17	3.66*	1.46
---	56.35	52.17	4.18*	1.46

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.19 confirmed that aerobic training with control group (3.66), anaerobic training with control group (4.18) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.52) at 0.05 level with the CI value of 1.46.

The pre, post and adjusted means on lean body mass were illustrated through bar diagram in Figure-8.

FIGURE – 8

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON LEAN BODY MASS

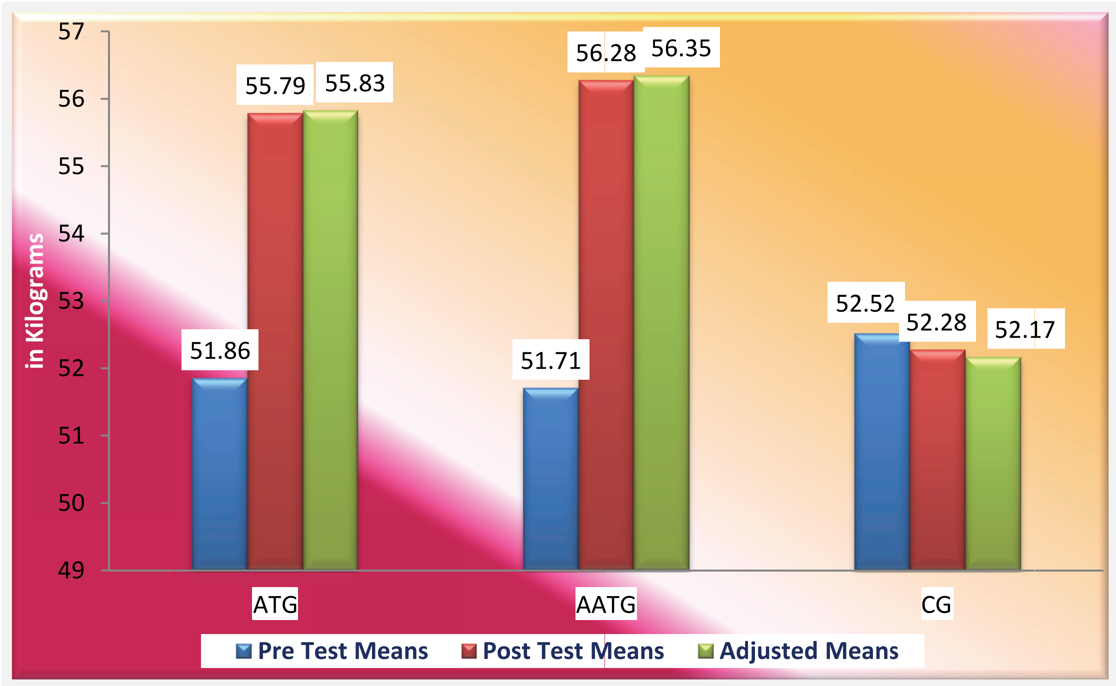


TABLE – 4.20

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON FAT MASS

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	26.24	26.14	26.68	B	2.46	2	1.23	1.51
S.D ±	0.69	1.05	0.91	W	34.13	42	0.81	
Post - test mean	18.90	19.13	26.52	B	564.10	2	282.05	418.45*
S.D ±	0.80	0.83	0.82	W	28.31	42	0.67	
Adjusted post - test mean	18.92	19.18	26.45	B	512.31	2	256.15	395.22*
				W	26.57	41	0.64	

* Significant at 0.05 level of confidence

4.11 RESULTS OF FAT MASS

An examination of table - 4.20 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 1.51. It was found to be lesser than the required 'F' ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on fat mass was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on fat mass. The obtained F- ratio for the post-test was 418.45. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F- ratio needed for significance, it was inferred that the mean differences among the three groups on the fat mass used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on fat mass was 395.22.

The obtained F- ratio on fat mass among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the fat mass was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.21.

TABLE – 4.21

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON FAT MASS

ATG	AATG	Control group	Mean difference	CI Value
18.92	19.18	---	0.26	0.74
18.92	---	26.45	7.53*	0.74
---	19.18	26.45	7.27*	0.74

*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.21 confirmed that aerobic training with control group (7.53), anaerobic training with control group (7.27) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.26) at 0.05 level with the CI value of 0.74.

The pre, post and adjusted means on fat mass were illustrated through bar diagram in Figure-9.

FIGURE – 9

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON FAT MASS

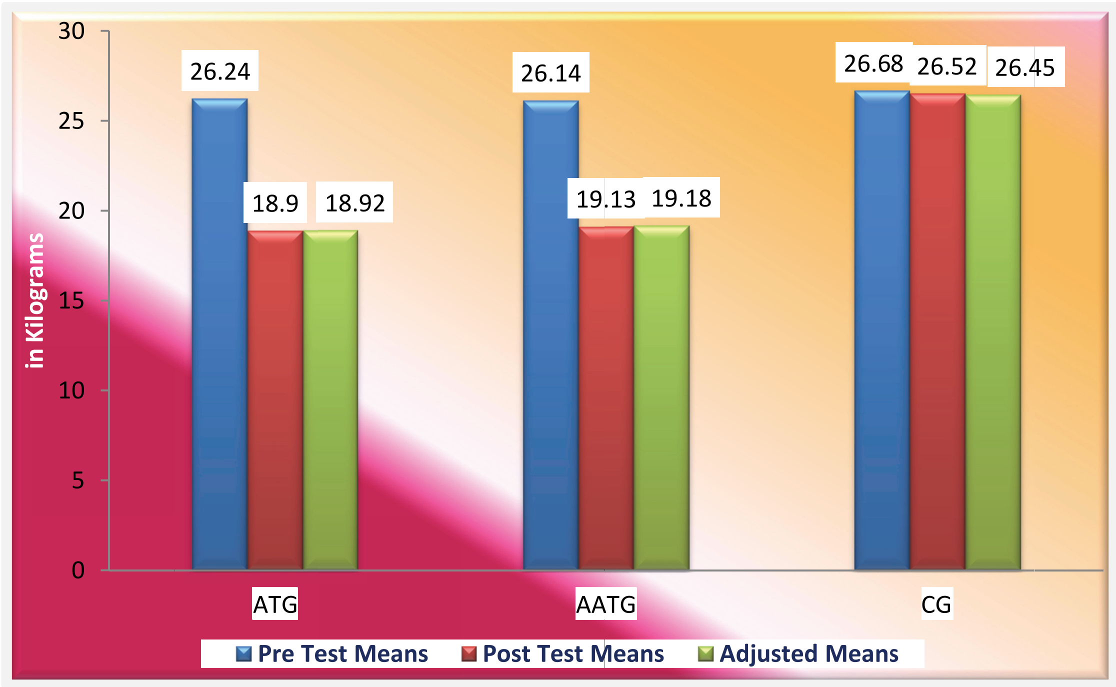


TABLE – 4.22

ANALYSIS OF VARIANCE ON PRE-TEST, POST-TEST AND ANALYSIS OF COVARIANCE ON POST-TEST MEANS OF AEROBIC TRAINING (ATG), ANAEROBIC TRAINING (AATG) AND CONTROL GROUP ON BODY MASS INDEX

	ATG	AATG	Control group	SOV	Sum of squares	df	Mean square	'F' ratio
Pre - test mean	31.03	31.20	30.56	B	3.25	2	1.62	0.30
S.D ±	2.17	2.74	1.96	W	225.87	42	5.37	
Post - test mean	28.98	29.03	30.41	B	19.72	2	9.86	3.31
S.D ±	1.70	1.56	1.88	W	124.77	42	2.97	
Adjusted post - test mean	28.95	28.96	30.52	B	24.18	2	12.09	4.70
				W	105.28	41	2.56	

* Significant at 0.05 level of confidence

4.12 RESULTS OF BODY MASS INDEX

An examination of table - 4.22 indicated that the results of ANOVA for pre test scores of the aerobic training group and anaerobic training group and control group. The obtained F-ratio for the pre-test was 0.30. It was found to be lesser than the required ‘F’ ratio of 3.22. By this it was inferred that the mean difference among the three groups at pre-test on body mass index was statistically not significant. Thus the insignificant F- ratio found in the pre-test mean differences provided a confidence that the samples hailed from same population and devoid of sampling bias.

In the post-test data analysis, the F- test was applied to test the significance of mean difference if any among the aerobic training group and anaerobic training group and control group on body mass index. The obtained F- ratio for the post-test was 3.31. The F-ratio needed for significant differences on the mean, for degrees of freedom 2, 42 was 3.22 at 0.05 level of confidence. Since the observed F-ratio on this variable was found to be higher than the F- ratio needed for significance, it was inferred that the mean differences among the three groups on the body mass index used in the study at the end of the treatment period was statistically significant.

The preliminary aim of the analysis of covariance is adjusting the post-test means for the differences in the pre-test means, and adjusted means were tested for significance. The F-ratio obtained from the testing the adjusted post-test means among the three groups namely aerobic training group and anaerobic training group and control group on body mass index was 4.70.

The obtained F- ratio on body mass index among the three groups was statistically significant since they exceeded the needed F- ratio (3.23) for degree of freedom 2 and 41, at 0.05 level of confidence. From this it was concluded that the body mass index was significantly influenced by the treatments used in this study. To find out which treatment used in the present study is the source for the significance of adjusted means is tested by Scheffe's test. The result of the same is displayed in the table - 4.23.

TABLE – 4.23

SCHEFFE'S TEST FOR THE DIFFERENCES BETWEEN THE ADJUSTED MEANS OF AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON BODY MASS INDEX

ATG	AATG	Control group	Mean difference	CI Value
28.95	28.96	---	0.01	1.48
28.95	---	30.52	1.57*	1.48
---	28.96	30.52	1.56*	1.48

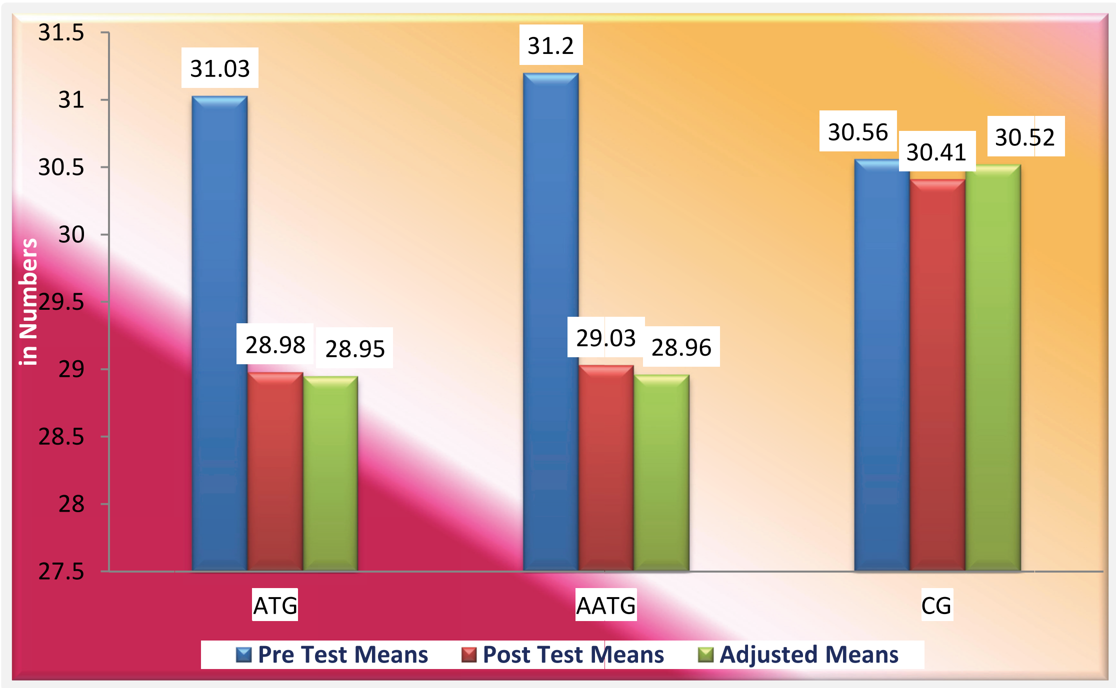
*Significant at 0.05 level of confidence

The multiple comparisons showed in Table 4.23 confirmed that aerobic training with control group (1.57), anaerobic training with control group (1.56) showed significant differences. There was no significant difference between aerobic training and anaerobic training (0.01) at 0.05 level with the CI value of 1.48.

The pre, post and adjusted means on body mass index were illustrated through bar diagram in Figure-10.

FIGURE - 10

PRE POST AND ADJUSTED POST TEST DIFFERENCES OF THE, AEROBIC TRAINING, ANAEROBIC TRAINING AND CONTROL GROUP ON BODY MASS INDEX



4.13 DISCUSSION ON FINDINGS

The prime intention of the researcher was to effect of aerobic and anaerobic training on selected physiological and body composition profiles among middle aged obese women. The theme behind this study was to observe the influences of aerobic and anaerobic training to develop the selected physiological and body composition profiles of middle aged obese women. To achieve this, two different training packages were designed as aerobic training group (ATG) and anaerobic training group (AATG). The results of the effect of two training packages on variables used in this study are analysed so as to reach the theme of the present study, and sources behind such a similarities and variations observed on variables between the training groups, have been discussed here using scientific studies and logical in nature.

While analyzing the results, it was revealed that there were significant differences found in all the experimental groups.

4.14 RESULTS OF AEROBIC TRAINING PROGRAMME

In testing the aerobic training group, the results reveals that the variables used in the study evidencing that ATG has produced significant improvement positively on physiological variables namely breath holding time (6.40, $P<0.05$), systolic blood pressure (4.00, $P<0.05$), diastolic blood pressure (2.86, $P<0.05$), resting pulse rate (1.33, $P<0.05$), aerobic power (3.96, $P<0.05$) and anaerobic power (90.20, $P<0.05$). The ATG has produced significant improvement positively on body composition profiles namely body weight (3.40, $P<0.05$), lean body mass (3.93, $P<0.05$), fat mass (7.33, $P<0.05$) and body mass index (2.04, $P<0.05$).

4.15 RESULTS OF ANAEROBIC TRAINING PROGRAMME

In testing the anaerobic training group, the results reveals that the variables used in the study evidencing that AATG has produced significant improvement positively on physiological variables namely breath holding time (6.00, $P<0.05$), systolic blood pressure (4.86, $P<0.05$), diastolic blood pressure (4.06, $P<0.05$), resting pulse rate (1.86, $P<0.05$), aerobic power (1.94, $P<0.05$) and anaerobic power (80.93, $P<0.05$). The AATG has produced significant improvement positively on body composition profiles namely body weight (2.43, $P<0.05$), lean body mass (4.57, $P<0.05$), fat mass (7.00, $P<0.05$) and body mass index (2.16, $P<0.05$).

4.16 RESULTS OF CONTROL GROUP

In testing the control group, the results reveals that the variables used in the study evidencing that CG has produced insignificant differences on physiological variables namely breath holding time (0.46, $P>0.05$), systolic blood pressure (0.33, $P>0.05$), diastolic blood pressure (0.20, $P>0.05$), resting pulse rate (0.10, $P>0.05$), aerobic power (0.11, $P>0.05$) and anaerobic power (0.60, $P>0.05$). The CG has produced insignificant differences on body composition profiles namely body weight (0.38, $P>0.05$), lean body mass (0.23, $P>0.05$), fat mass (0.15, $P>0.05$) and body mass index (0.15, $P>0.05$).

4.17 DISCUSSION ON HYPOTHESIS

1. First hypothesis stated that, the effect of aerobic training may improve the selected physiological variables and body composition profiles among middle aged obese women.

The findings of the study showed that there were significant improvement in selected physiological variables and body composition profiles among middle aged obese women form their baseline to post training due to influence of aerobic training. Hence the first hypothesis was accepted on the above said variables.

2. Second hypothesis stated that, the effect of anaerobic training may improve the selected physiological variables and body composition profiles among middle aged obese women.

The findings of the study showed that there were significant improvement in selected physiological variables and body composition profiles among middle aged obese women form their baseline to post training due to influence of anaerobic training. Hence the second hypothesis was accepted on the above said variables.

3. Third hypothesis stated that, the effect of aerobic training may better than the anaerobic training in the improvement of the selected physiological variables and body composition profiles among middle aged obese women.

The findings of the study showed that the aerobic training was better in breath holding time, aerobic power, anaerobic power, body weight and fat mass than anaerobic training group. Hence the third hypothesis was partially accepted on the above said variables.

Chapter – V

Summary Conclusions and Recommendations

CHAPTER - V

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY

The purpose of the study was to find out the effect of aerobic and anaerobic training on selected physiological and body composition profiles among middle aged obese women. To achieve the purpose of this study Forty five middle aged obese women were randomly selected in and around from Namakkal district, Tamil Nadu, India and their age ranged between 35 to 45 years.

The study was formulated as a pre and post test random group design, in which forty five obese women were randomly assigned into three equal groups and each group consisting of 15 subjects. Group I underwent Aerobic training and Group II underwent Anaerobic training and Group III act as a control group; they did not undergo any above mentioned special training programme. After assessing the subjects to treatment and control groups, they were tested on selected criterion variables. It was considered as pre – test. After assessing the pre – test performance on criterion variables, the subjects were treated with their respective training programme for twelve weeks. After twelve weeks of their training programme, again the subjects were tested (Post-test) on selected criterion variables as such in the pre – test.

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 paired ‘t’ test. 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 base line to post treatment for various measures. The statistical tool used for these are described here. Analysis of co variance (ANCOVA) was applied to determine whether the training programmes produced significantly different improvements in selected variables after 12 weeks of training. Since the initial means were not matched, comparisons between actual could not be made, all means were adjusted by regression to a common mean. The significance of difference of pairs of adjusted final group means was tested for significance by applying Scheffe’s post hoc test. In all the cases 0.05 level of confidence was utilized.

5.2 CONCLUSIONS

Based on the results of the study the following conclusions were drawn.

1. The aerobic training was a better tool to improve the selected physiological variables and body composition profiles of middle aged obese women.
2. The anaerobic training group was a better tool to improve the selected physiological variables and the body composition profiles of middle aged obese women.
3. The control group did not exhibit any significant changes in the selected physiological variables and selected body composition profiles of middle aged obese women.

5.3 RECOMMENDATIONS

On the basis of the findings and conclusions of the present study, the following recommendations were made.

5.3.1 Recommendations for implication

1. The aerobic training may be recommended to the middle aged obese women to develop the physiological variables of breath holding time, systolic blood pressure, diastolic blood pressure, resting pulse rate, aerobic power, anaerobic power, body composition profiles of body weight, lean body mass, fat mass and body mass index.
2. The anaerobic training may be recommended to the middle aged obese women to develop the physiological variables of breath holding time, systolic blood pressure, diastolic blood pressure, resting pulse rate, aerobic power, anaerobic power, body composition profiles of body weight, lean body mass, fat mass and body mass index.

5.3.2 Recommendations for future research

1. A similar study may be conducted on physical education students and other sports persons to assess their level in the selected variables.
2. A similar study may be conducted on childhood and middle aged men.
3. A similar study may be conducted in greater detail to assess changes on biochemical, psychological and physical fitness variables.
4. To find out the improvement on criterion measures periodically, the same study may be designed with repeated measures.

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Publications

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PHYSICAL EDUCATION

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EFFECT OF AEROBIC TRAINING ON SELECTED PHYSIOLOGICAL VARIABLES AMONG MIDDLE AGED OBESE WOMEN

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Abstract

The purpose of the study was to investigate the effect of aerobic training on selected physiological variables among middle aged obese women. To achieve the purpose of this study thirty middle aged obese women were randomly selected in and around from Namakkal district, Tamil Nadu, India and their age ranged between 35 to 45 years.For the present study pre test – post test randomized group design which consists of control group and experimental group was used. The subjects were randomly assigned to two equal groups of fifteen each and named as Group 'A' and Group 'B'. Group 'A' underwent aerobic training and Group 'B' underwent no training. The data was collected before and after six weeks of training. Paired 't' ratio was computed. The level of significance was set at 0.05. The aerobic training programme produced a significant development on the selected physiological variables. The control group did not exhibit any significant changes in the physiological variables.

Key words: Aerobic Training, Obese Women, Physiological Variables..

Introduction

Training is not a recent discovery. In ancient time, people were trained systematically for military and Olympic endeavours. Today athletes prepare themselves for a goal through training. Obesity is a leading preventable cause of death worldwide, with increasing prevalence in women, and authorities view it as one of the most serious public health problems of the 21st century. Obesity is stigmatized in much of the modern world (particularly in the Western world), though it was widely perceived as a symbol of wealth and fertility at other times in history, and still is in some parts of the world. In 2013, the American Medical Association classified obesity as a disease. Excessive body weight is associated with various diseases, particularly cardiovascular diseases, diabetes mellitus type 2, obstructive sleep apnea, certain types of cancer, osteoarthritis and asthma. As a result, obesity has been found to reduce life expectancy.

Aerobic exercise is physical exercise of relatively low intensity that depends primarily on the aerobic energy generating process. Aerobic literally means "living in air", and refers to the use of oxygen to adequately meet energy demands during exercise via aerobic metabolism. Generally, light to moderate intensity activities that are sufficiently supported by aerobic metabolism can be performed for extended periods of time. The intensity should be between 60 and 85% of maximum heart rate.

Methodology

The purpose of the study was to investigate the effect of aerobic training on selected physiological variables among middle aged obese women. To achieve the purpose of this study thirty middle aged obese women were randomly selected in and around from Namakkal district, Tamil Nadu, India and their age ranged between 35 to 45 years.

For the present study pre test – post test randomized group design which consists of control group and experimental group was used. The subjects were randomly assigned to two equal groups of fifteen each and named as Group ‘A’ and Group ‘B’. Group ‘A’ underwent aerobic training and Group ‘B’ underwent no training. The data was collected before and after six weeks of training. Paired 't' ratio was computed. The level of significance was set at 0.05.

Results and Discussions

The primary objective of the paired 't' ratio was to describe the differences between the pre-test and post-test mean of middle aged obese women.

TABLE – I

SUMMARY OF 't' RATIO ON SELECTED PHYSIOLOGICAL VARIABLES OF AEROBIC TRAINING GROUP (ATG)

S.No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	't' Ratio
1	Breath Holding Time	39.40	45.80	6.40	4.83	1.24	5.12*
2	Systolic Blood Pressure	125.53	121.53	4.00	3.58	0.92	4.32*
3	Diastolic Blood Pressure	85.66	82.80	2.86	2.23	0.57	4.97*

Required table value= 2.14

An examination of table - I indicates that the obtained't' ratios were 5.12, 4.32 and 4.97 for physiological variables of breath holding time, systolic blood pressure and diastolic blood pressure respectively. The obtained't' ratios were found to be greater than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be significant.

Figure – I

PRE AND POST TEST DIFFERENCES OF THE AEROBIC TRAINING ON SELECTED PHYSIOLOGICAL VARIABLES

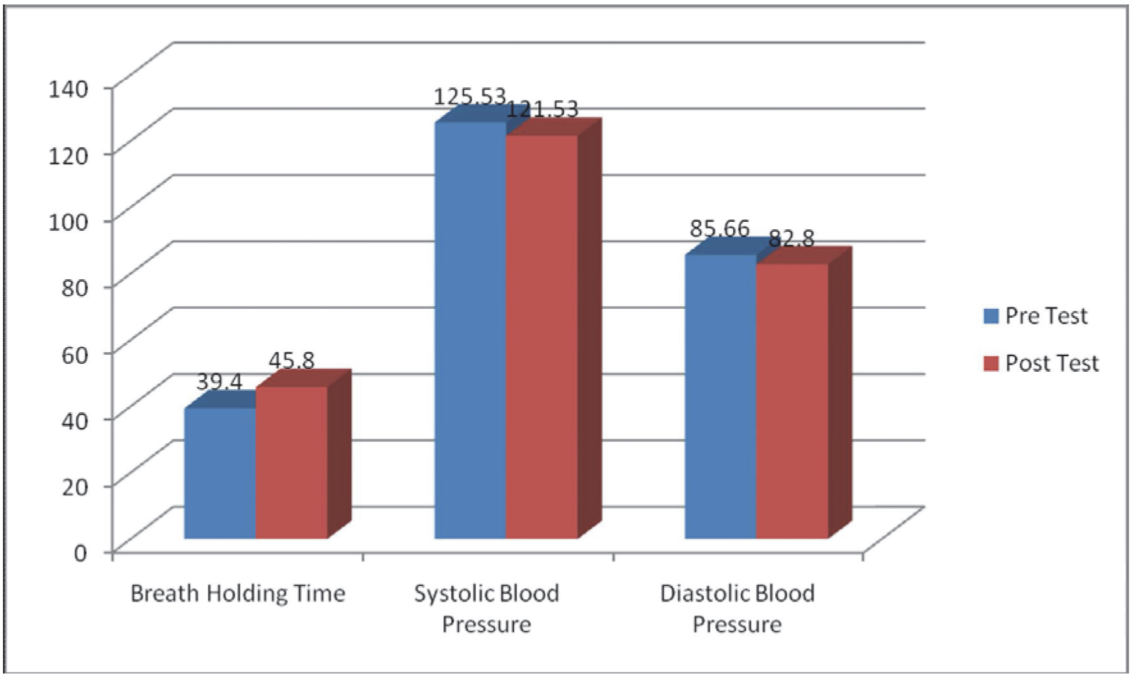


Table – II

SUMMARY OF‘t’ RATIO ON SELECTED BODY COMPOSITION PROFILES VARIABLES OF CONTROL GROUP (CG)

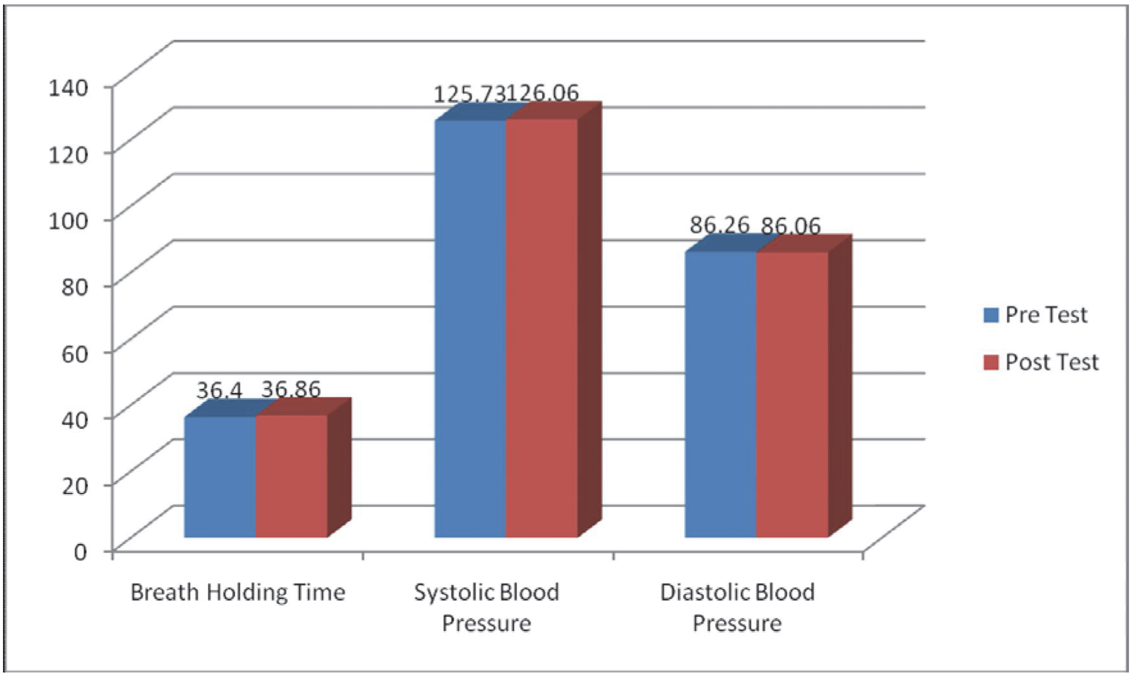
S.No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	‘t’ Ratio
1	Breath Holding Time	36.40	36.86	0.46	1.99	0.51	0.90
2	Systolic Blood Pressure	125.73	126.06	0.33	5.05	1.30	0.25
3	Diastolic Blood Pressure	86.26	86.06	0.20	2.30	0.59	0.33

Required table value= 2.14

An examination of table - II indicates that the obtained'ť' ratios were 0.90, 0.25 and 0.33 for physiological variables of breath holding time, systolic blood pressure and diastolic blood pressure respectively. The obtained'ť' ratios on all the selected variables were found to be lesser than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be insignificant. The results of this study showed that the control group were statistically insignificant.

Figure – II

PRE AND POST TEST DIFFERENCES OF THE CONTROL GROUP ON SELECTED PHYSIOLOGICAL VARIABLES



Conclusions

The aerobic training programme produced a significant development on the selected physiological variables. The control group did not exhibit any significant changes in the physiological variables.

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PHYSICAL EDUCATION

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EFFECT OF ANAEROBIC TRAINING ON SELECTED BODY COMPOSITION PROFILES AMONG MIDDLE AGED OBESE WOMEN

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Abstract

The purpose of the study was to investigate the effect of anaerobic training on selected body composition profiles among middle aged obese women. To achieve the purpose of this study thirty middle aged obese women were randomly selected in and around from Namakkal district, Tamil Nadu, India and their age ranged between 35 to 45 years. For the present study pre test – post test randomized group design which consists of control group and experimental group was used. The subjects were randomly assigned to two equal groups of fifteen each and named as Group 'A' and Group 'B'. Group 'A' underwent anaerobic training and Group 'B' underwent no training. The data was collected before and after six weeks of training. Paired 't' ratio was computed. The level of significance was set at 0.05. The anaerobic training programme produced a significant development on the selected body composition profiles. The control group did not exhibit any significant changes in the body composition profiles.

Key words: Anaerobic Training, Obese Women, Body Composition..

Introduction

Obesity is from the Latin obesitas, which means "stout, fat, or plump". The Greeks were the first to recognize obesity as a medical disorder. Hippocrates wrote that "Corpulence is not only a disease itself, but the harbinger of others". The Indian surgeon Sushruta (6th century BCE) related obesity to diabetes and heart disorders. He recommended physical work to help cure it and its side effects. For most of human history mankind struggled with food scarcity. Obesity has thus historically been viewed as a sign of wealth and prosperity. Obesity is still seen as a sign of wealth and well-being in many parts of Africa. This has become particularly common since the HIV epidemic began. Obesity is most commonly caused by a combination of excessive food energy intake, lack of physical activity, and genetic susceptibility, although a few cases are caused primarily by genes, endocrine disorders, medications or psychiatric illness.

Anaerobic exercise is exercise intense enough to trigger lactic acid formation. It is used by athletes in non-endurance sports to promote strength, speed and power and by body builders to build muscle mass. Muscle energy systems trained using anaerobic exercise develop differently compared to aerobic exercise, leading to greater performance in short duration, high intensity activities, which last from mere seconds to up to about 2 minutes. Any activity lasting longer than about two minutes has a large aerobic metabolic component.

Methodology

The purpose of the study was to investigate the effect of anaerobic training on selected body composition profiles among middle aged obese women. To achieve the purpose of this study thirty middle aged obese women were randomly selected in and around from Namakkal district, Tamil Nadu, India and their age ranged between 35 to 45 years. For the present study pre test – post test randomized group design which consists of control group and experimental group was used. The subjects were randomly assigned to two equal groups of fifteen each and named as Group 'A' and Group 'B'. Group 'A' underwent anaerobic training and Group 'B' underwent no training. The data was collected before and after six weeks of training. Paired 't' ratio was computed. The level of significance was set at 0.05.

Results and Discussions

The primary objective of the paired 't' ratio was to describe the differences between the pre-test and post-test mean of middle aged obese women.

TABLE – I

SUMMARY OF 't' RATIO ON SELECTED BODY COMPOSITION PROFILES OF ANAEROBIC TRAINING GROUP (AATG)

S.No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	't' Ratio
1	Body Weight	77.85	75.42	2.43	3.92	1.01	2.40*
2	Lean Body Mass	51.71	56.28	4.57	2.51	0.64	7.03*
3	Fat Mass	26.14	19.13	7.00	1.42	0.36	19.10*

Required table value= 2.14

An examination of table - I indicates that the obtained't' ratios were 2.40, 7.03 and 19.10 for body composition profiles of body weight, lean body mass and fat mass respectively. The obtained't' ratios were found to be greater than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be significant.

Figure – I

PRE AND POST TEST DIFFERENCES OF THE ANAEROBIC TRAINING ON SELECTED BODY COMPOSITION PROFILES

Table – II

SUMMARY OF't' RATIO ON SELECTED BODY COMPOSITION PROFILES VARIABLES OF CONTROL GROUP (CG)

S.No	Variables	Pre-Test Mean	Post-Test Mean	Mean difference	Std. Dev (±)	σ DM	't' Ratio
1	Body weight	79.20	78.81	0.38	1.66	0.43	0.89
2	Lean Body Mass	52.52	52.28	0.23	0.99	0.25	0.89
3	Fat Mass	26.68	26.52	0.15	0.66	0.17	0.89

Required table value= 2.14

An examination of table - II indicates that the obtained't' ratios were 0.90, 0.25 and 0.33 for body composition profiles of body weight, lean body mass and fat mass respectively. The obtained't' ratios on all the selected variables were found to be lesser than the required table value of 2.14 at 0.05 level of significance for 1, 14 degrees of freedom. Hence it was found to be insignificant. The results of this study showed that the control group were statistically insignificant.

Figure – II

PRE AND POST TEST DIFFERENCES OF THE CONTROL GROUP ON SELECTED BODY COMPOSITION PROFILES

Conclusions

The anaerobic training programme produced a significant development on the selected body composition profiles. The control group did not exhibit any significant changes in the body composition profiles.

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