# EFFECT OF AEROBIC EXERCISE ON SELECTED HEALTH RELATED PHYSICAL FITNESS COMPONENTS, PHYSIOLOGICAL PARAMETERS AND LIPID PROFILE OF MEKELLE UNIVERSITY STUDENTS, ETHIOPIA

**MSc. THESIS**

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**HARAMAYA UNIVERSITY, HARAMAYA**

# Effect of Aerobic Exercise on Health Related Physical Fitness Components, Physiological Parameters and Lipid Profile of Mekelle University Students, Ethiopia

**A Thesis Submitted to the Department of Sport Science,**
**School of Graduate Studies**
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**MASTERS OF SCIENCE IN SPORT MEDICINE**

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## HARAMAYA UNIVERSITY

## SCHOOL OF GRADUATE STUDIES

As thesis research advisors, we hereby certify that we have read and evaluated this thesis prepared under our guidance by **Ashenafi Mengstu Tuumay** entitled "Effect of aerobic exercise on health related physical fitness components, physiological parameters and lipid profile of Mekelle University students, Ethiopia". We recommend that to be submitted as fulfilling the thesis requirement.

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# DEDICATION

I dedicate this work to my beloved family; To my father Mengstu Tuumay, my mother Kalayta Gebre, my sisters Kasu Mengstu, Mulu Mengstu, Hiwet Mengstu and my brother Girmay Mengstu.

## STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work, I have followed all ethical and technical principles of scholarship in the preparation, data collection, data analysis and compilation of this thesis. Any scholarly matter that is included in the thesis has been given recognition through citation.

This thesis is submitted in partial fulfillment of the requirements for a master's degree in sport medicine at Haramaya University. The thesis is deposited in the Haramaya University library and is made available to borrowers under the rules of the library. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of any academic degree, diploma or certificate.

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# BIOGRAPHICAL SKETCH

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACSM | American College of Sport Medicine |
| AHA | American Heart Association |
| BMI | Body Mass Index |
| BP | Blood Pressure |
| CVE | Cardiovascular Endurance |
| DBP | Diastolic Blood Pressure |
| HDL | High Density Lipoprotein Cholesterol |
| HR | Heart Rate |
| HRmax | Maximum Heart Rate |
| IDL | Intermediate Density Lipoprotein |
| LDL | Low Density Lipoprotein Cholesterol |
| Pot | Post- test |
| Pt | Pre -test |
| SAT | Saturday |
| SBP | Systolic Blood Pressure |
| SPSS | Statistical Package for Social Science |
| T | Tuesday |
| TC | Total Cholesterol |
| TG | Triglyceride |
| TH | Thursday |
| VLDL | Very Low Density Lipoprotein |
| WHO | World Health Organization |

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**EFFECT OF AEROBIC EXERCISE ON SELECTED HEALTH RELATED PHYSICAL FITNESS COMPONENTS, PHYSIOLOGICAL PARAMETERS AND LIPID PROFILE OF MEKELLE UNIVERSITY STUDENTS, ETHIOPIA**

# ABSTRACT

*The purpose of this study was to investigate the effect of aerobic exercise on selected health related physical fitness components, physiological parameters and lipid profile of Mekelle University students. To achieve the objective of this study 20 male students were selected purposely from the total population of 35 aged between 19 and 22. Informal experimental design was used to conduct this study. The exercise training was designed for twelve weeks, three days per week, and the duration was 40, 50, 60 minutes per session with moderate intensity (55-69HRmax). Each session had warming up, stretching exercise, main part (aerobic exercises) and cooling down. Throughout the study jumping ropes, stop watch, digital tabletop, pentra 400, tread mill, test tube, stationery cycle bike, ruler and tape meter were used during test and training. The training and field test were held at Mekelle University main campus. The laboratory measurements were conducted in Ayder comprehensive specialized hospital. 5ml blood sample was collected from the participants before and after the aerobic exercise to measure the total cholesterol, triglyceride, high density lipoprotein and low density lipoprotein. The collected data were analyzed using SPSS version 21 software and paired "T" test was used to compare the pre and posttest results. The level of significance was fixed at ($P \leq 0.05$). Based on the analysis made, it was observed that twelve weeks aerobic exercise led to positive significant change in measurement value of body mass (59.65 ± 5.11 and 55.05 ± 4.08), flexibility (9.05 ± 5.62 to 13.25 ± 5.08), body composition (20.02 ± 1.15 to 18.44 ± 0.99), cardiovascular endurance (2770.75 ± 367.86 to 3093.15 ± 275.09), diastolic blood pressure (68.9 ± 6.28 to 65.3 ± 5.02), systolic blood pressure (122.85 ± 9.84 to 114.1 ± 5.35), resting heart rate (71.35 ± 6.72 to 64.05 ± 5.88), total cholesterol (116.6 ± 17.94 to 102.45 ± 15.32), triglyceride (91.6 ± 15.28 to 82.25 ± 13.49), high density lipoprotein (38.2 ± 6.56 to 41.05 ± 3.79) and low density lipoprotein (59.9 ± 15.14 to 45.25 ± 13.45). In general aerobic exercise decreases body mass, systolic blood pressure, diastolic blood pressure, resting heart rate, total cholesterol, body composition, triglyceride and low density lipoprotein. Aerobic exercise also improves flexibility, cardiovascular endurance, and high density lipoprotein.*

**Keywords:** Flexibility, body mass, Cholesterol, Blood pressure, Triglyceride

# 1. INTRODUCTION

## 1.1. Background of the Study

### Health related physical fitness

Health related physical fitness is the portion of physical fitness directed toward the prevention of or rehabilitation from disease, the development of a high level of functional capacity for the necessary and discretionary tasks of life, and the maintenance or enhancement of physiological functions in biological systems that are not involved in performance but are influenced by habitual activity. Maintaining an appropriate level of health related fitness allows a person to meet , reduce the risk of disease and injury, work efficiently, participate and enjoy physical activity (sports, recreation, leisure) and look one's physical best ( plowman, 2011).

### Aerobic exercise

Aerobic exercise is a physical exercise of relatively low intensity that depends primarily on the aerobic energy generating process. Aerobic means "with oxygen", 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 and it refers to exercise that requires the consumption of substantially more oxygen than at rest, and can be undertaken for a prolonged duration without excessive fatigue (Mathewos, 2013).

Participation in moderate-intensity physical activity on a daily basis produces significant health benefits, even if fitness levels do not increase. Improvements in health benefits depend on the volume (i.e., combination of frequency, intensity, and duration) of physical activity. HDL increases in response to endurance training. This response appears to be related to the exercise training dose and is less dramatic in women than in men. Moderate-intensity (60% of heart rate reserve) walking program is as effective as a high intensity (80% of heart rate reserve) program improving the HDL profile of women as long as the total training volume is similar (Morrow *et al.,* 2005).

Regular physical activity positively affect the blood lipid and lipoprotein profile. The scientific understanding is that physical activity or planned exercise positively alters blood triglyceride levels. However, total blood cholesterol is not usually changed after exercise training unless body weight is lowered or dietary composition is changed. What does happen is that the way cholesterol is carried by the blood lipoprotein is changed so that more of the good high density lipoprotein cholesterol is found in the blood (Durstine *et al*., 2002).

If your blood pressure is at a desirable level — less than 120/80 mm Hg — exercise can help prevent it from rising as you age. Regular exercise also helps you maintain a healthy weight — another important way to control blood pressure. But to keep your blood pressure low, you need to keep exercising on a regular basis. It takes about one to three months for regular exercise to have an impact on your blood pressure. The benefits last only as long as you continue to exercise (Linden and Chambers, 1994).

## 1.2. Statement of the Problem

The benefits of aerobic exercise are innumerable or countless. They include systemic changes such as reduced cholesterol and blood pressure, improved muscular endurance, reduced body fat, increased metabolism. Aerobic activities strengthen the heart and lungs, making them more efficient and durable, improving quality and quantity of life. Exercise not extends life, but also gives more energy to live it to the fullest (Kathleen, 2006).

Aerobic exercise improves the strength of your bones, ligaments and tendons, allows your body to use fats and sugars more efficiently, burns lots of calories and plays an important role in reducing the onset and symptoms of aging and illness. Aerobic exercise reduces risk of heart disease, vascular disease and diabetes and can help those trying to quit smoking by relieving cravings and improving lung function (Kathleen, 2006).

Different scholars from different continent has undertaken various studies that revolves the effect of aerobic training on improvement and efficiency of health related physical fitness components and lipid profile of sedentary as well as individuals who participate in different sport activities in the planet. Even though, health related physical fitness, physiological parameters, and lipid profile were more interconnected, but scholars did not conduct enough studies regarding the effect of

aerobic training on health related physical fitness, physiological parameters, and lipid profile at Mekelle University.

Therefore the main intent or emphasis of this study was to examine the effect of aerobic exercise on health related physical fitness components, physiological parameters and lipid profile of Mekelle University students, Ethiopia.

It was hypothesized that;

**$H_1$**: There would be positive significant difference due to the influence of twelve weeks of aerobic exercises on health related physical fitness variables such as flexibility, body composition and cardiovascular endurance.
**$H_0$**: There would be no significant difference due to the influence of twelve weeks of aerobic exercises on health related physical fitness variables such as flexibility, body composition and cardiovascular endurance.
**$H_1$**: There would be positive significant difference due to the influence of aerobic training on lipid profiles such as total cholesterol, LDL, HDL and triglycerides.
**$H_0$**: There would be no significant difference due to the influence of aerobic training on lipid profiles such as total cholesterol, LDL, HDL and triglycerides.
**$H_1$**: There would be positive significant difference due to the effect of aerobic training on the systolic blood pressure, diastolic blood pressure and resting heart rate.
**$H_0$**: There would be no significant difference due to the effect of aerobic training on the systolic blood pressure, diastolic blood pressure and resting heart rate.

## 1.3. Scope of the Study

To achieve the objective of the study, 20 (twenty) Mekelle University first year sport science male students were selected. Cardio-vascular endurance, flexibility, and body composition, lipid profiles such as HDL, LDL, TC and TG, physiological variables (systolic blood pressure, diastolic blood pressure and resting heart rate) were selected as dependent variables for this study.

The aerobic exercise or training was considered as independent variable. The duration of the training period was restricted to twelve weeks and the number of days per week were confined to

three days per week. The intensity of the exercises was moderate (HRmax 55-69) with 40-60 minutes of exercise per session. The data were collected prior to and immediately after the twelve weeks training period.

## 1.4. Significance of the Study

The findings of this study would be significant in the following ways:

The findings of the study would add to the existing source of knowledge with regard to the twelve weeks aerobic training on health related physical fitness, physiological parameters and lipid profiles.

This study would help to measure the increase/decrease of the lipoprotein levels due to the effect of aerobic exercise training methods.

The findings of the study would help the students to compare and contrast the changes that occurred in health related physical fitness, physiological variables and lipid profile variables before and after the aerobic exercise.

The study would endorse research and growth in the field of aerobic exercise.

## 1.5. Objective of the Study

### 1.5.1. General objective

The general objective of this study was to investigate the effect of aerobic exercise on health related physical fitness components, physiological parameters and lipid profile of Mekelle University students.

### 1.5.2. Specific objectives

The specific objectives of this study were:

1. To measure the effect of aerobic exercises on health related physical fitness variables such as, flexibility, cardiovascular endurance and body composition

2. To measure the effect of aerobic training on physiological variables such as, systolic blood pressure, diastolic blood pressure and resting heart rate

3. To determine the lipid profile variables such as total cholesterol, triglycerides, low density lipoprotein cholesterol and high density lipoprotein cholesterol before and after the twelve weeks of aerobic exercise.

## 1.6. Limitations of the study

The following problems were beyond the control of the investigator while conducting the study;

1. It was not possible to control absolutely the day-to-day activities of the participants selected for the study ,medication, their normal diet, ingestion of alcohol and caffeine of the participants:
2. Atmosphere, Climatic conditions, percentage of humidity were not controlled by the researcher.

# 2. REVIEW OF RELATED LITERATURES

## 2.1. Health related Physical Fitness

Physical Educators have long believed that exercise is important to maintain good health. Today degenerative diseases like Cancer, Heart disease, Strokes have replaced communicable disease like tuberculosis, Pneumonia as leading to death. Medical Research shows that poor aerobic fitness, obesity and lack of development of certain types of muscular strength, flexibility are related to certain disease. Health related Physical fitness is defined by the following components. Muscular strength, Muscular endurance, Cardio vascular endurance, Muscular Flexibility and Body composition (Ted A Baumgartner and Andrew S. Jackson, 1982).

### 2.1.1. Cardio Vascular Endurance

Cardio-vascular Endurance, Cardio-vascular fitness or aerobic fitness has been defined as the ability of the lungs, heart and blood vessels to deliver adequate amounts of oxygen and nutrition to the cells to meet the demands of prolonged Physical activity.

Cardiovascular endurance is determined by maximal amount of oxygen that the human body is able to utilize per minute for physical activity. The value is commonly expressed in millimeters of oxygen per kilogram of body weight per minute of physical activity (ml/kg/min).

Since all tissues and organs of the body utilize oxygen to function, a higher amount of oxygen consumption is required for a more efficient cardiovascular system (Werner W K *et al*., 1990).

### 2.1.2. Flexibility

Flexibility, mobility and suppleness all mean the range of limb movement around joints. In any movement there are two groups of muscles at work, protagonist muscles which cause the movement to take place and opposing the movement and determining the amount of flexibility are the antagonistic muscles (Werner W K *et al.,* 1990).

### 2.1.3. Body Composition

Body composition is a key component of an individual's health and physical fitness profile.

Obesity is a serious health problem that reduces life expectancy by increasing one's risk of

developing coronary artery diseases, etc. Too little body fat also poses a health risk because the body needs a certain amount of fat for normal physiological functions (Morrow *et al*., 2005).

Essential lipids, such as phospholipids, are needed for cell membrane formation: nonessential lipids, like triglycerides found in adipose tissue, provide thermal insulation and store metabolic fuel. In addition, lipids are involved in the transport and storage of fat-soluble vitamins (A, D, E and K) and in the functioning of the nervous system and the reproductive system, as well as in growth and maturation during pubescence (Morrow *et al*., 2005).

## 2.2. Blood

Blood is considered a tissue consisting of Red blood corpuscles (erythrocytes), White blood corpuscles (Leukocytes), platelets and liquid plasma. It is a carrier for gas, oxygen, carbon-di-oxide, metabolites, and products of digestion, hormones, enzymes and clotting factor. A 70 kg individual has a blood volume about six liters (85ml/kg) about one twelfth of the body weight and about three liters of plasma (45ml/kg). Blood has many diverse functions such as respiration, nutrition, excretion, maintenance of body temperature and osmotic pressure, defense against infection and transport of metabolites and hormones from the site of production to target organs and enzymes, chiefly the plasma specific enzymes (S. Ramakrishnan *et al.*, 1980).

## 2.3. Lipids

Lipid comprises 18-20 percent of the total body weight in the human adult. Neutral fat (Triglycerides, triacyl glycerols) is the forms in which fat is stored in the body adipose tissue, the subcutaneous fat pads, peri-renal fat depots, inter – muscular connective tissue and the fat depots of mesentery and omentum. About 70-80 percent of the lipids in adipose tissue are due to triacyl glycerols (Ravikumar, 2009 ).

Lipids are transported through blood plasma, from their sites of origin to their sites of utilization or storage, the level of plasma lipid at any time can be considered to represent the net balance between production, utilization and storage. Lipids, through hydrophobic compound, are present in plasma as stable hydrophilic lipoprotein complexes. These complexes are combination of triacyl glycerols and phospholipids, with cholesterol and plasma protein (Ravikumar, 2009 ).

Lipoprotein levels are directly relate to the process of atherosclerosis and therefore to the occurrence of CHD. Although total serum cholesterol has been found to be related to CHD, its atherogenic effect depends on the structure of cholesterol or, on the ratio between low density lipoprotein cholesterol (LDL) and high density lipoprotein cholesterol(HDL) (Nile, 2007).

It is assumed that LDL may act directly or indirectly to cause endothelial damage with subsequent proliferation of arterial smooth muscle cells resulting in an accumulation of lipidsnand a progression to atherosclerotic plaque formation. HDL on the other hand, is assumed to be protective against CHD; and responsible for carrying cholesterol from peripheral tissue including the arterial walls and back to the liver where it is metabolized and excreted (Nile, 2007).

Besides HDL and LDL, very low density lipoprotein cholesterol (VLDL) and plasma triglycerides (TG) also need to be considered. Although the atherogenic effecte of VLDL and TG are not firmly established, both are assumed to be risk factors for CHD. It is further assumed during exercise, fatty acids are freed from their storage sites to be burned for energy production(Nile, 2007).

Lipids provide structural integrity for all tissues, and major source of energy for metabolism,physical activity, and storage. Lipids are necessary precursors for hormones. Steroid hormones are drived from cholesterol, while eicosanoids are drived from essential fatty acids (FA). Reproduction, growth, development, and neural functions, all depend on appropriate supplies of lipids (Dupont, 1998).

The major function of lipoproteins is to transport the water in-soluble lipids in the blood,particularly TG,cholesterol, and cholesterol esters(CE). Lipoproteins are dynamic molecules in a constant state of synthesis and degradation, actively exchanging certain lipids and proteins with each other (Marentti, 1991). Lipoproteins can be classified on the bassis of their density, molecular size, and electrophoretic mobility. Using all these methods, four distinct classes of lipoproteins have been identified that are important physiologically and clinically (Mayes, 2000).

Lipoprotein subclasses differ in size and density , in the ralative proportions of TG and CE in the core, and in the nature of the Apo proteins on their surfsce. On the basis of density, these classes include chylomicrons, VLDL-C,LDL-C, and HDL-C (Pronk, 1993).

## 2.4. Benefits of Aerobic Exercise

Regular exercise causes your body to make adjustments that result in improved health and physical functioning. Continuing with regular exercise enables your body to maintain these benefits. Regularly doing the right types of aerobic exercise at the correct intensity, and for an appropriate duration, results in the most benefit. The benefits of aerobic exercise can be broadly categorized as either ‘fitness’ (physical capacity) or ‘health’. Fitness and health are linked, and most forms of aerobic exercise will help you achieve both (Mathewos, 2013).

Regular aerobic exercise improves your cardiovascular fitness by increasing your capacity to use oxygen. It does this by increasing your heart’s capacity to send blood (and hence oxygen) to the muscles. This is mainly achieved through an increase in the size of the heart’s pumping chambers (ventricles), which means that your heart doesn’t have to beat as fast to deliver the same amount of blood. This is evident in a slower resting heart rate, and a slower heart rate for the same exercise intensity (Mathewos, 2013).

The exercise intensity of an activity or movement indicates how much power or force is used in performing that exercise. The intensity of an activity determines how much and what type of fuel is needed to provide the energy required for that exercise. Any activity that burns 3.5 to 7 kcal /min or the equal end of 3 to 6 metabolic equivalents and results in achieving 60 to 73 percent of peak heart rate. Example moderate physical activities include walking briskly, moving the lawn, dancing, swimming, or bicycling a level terrain (Mc Donald, 2010).

Regular aerobic exercise has been shown to reduce the risk of heart disease, high blood pressure, type 2 diabetes, colon cancer and breast cancer. It can lower blood pressure and improve your blood cholesterol by reducing the levels of LDL-cholesterol (so-called ‘bad’ cholesterol) and increasing the amount of HDL-cholesterol (so- called ‘good’ cholesterol). It can also reduce anxiety, stress and depression, as well as instilling a general sense of well-beings. Regular aerobic exercise has been shown to have the potential to increase your lifespan (Mathewos, 2013).

A person should be some excretion but should be able to carry and a conversation comfortably during the activity. Any activity that burns more than 7kcal/min or the equivalent of 6 or more metabolic equivalent and results in achieving 74 to 88 percent of peak heart rate. An estimate of

person’s peak heart rate can be obtained by subtracting the person’s ages obtained by subtracting the person’ age from 220 (Mc Donald, 2010).

Example of vigorous physical activity includes jogging moving. The lawn with a no motorized push mover, chopping wood, participating in high impact aerobic dancing, swimming continuous laps, or bicycling uphill. Vigorous intensity physical activity may be intense enough to represent a substantial challenge to an individual and results in a significant increase in heart and breathing rate. Vigorous activity full of physical or mental strength or active force carried out forcefully and energetically (Mc Donald, 2010).

## 2.5. Physical Exercise and Lipids

Consumed from foods of animal origin, including meat, fish, poultry, egg and dairy products, plant food, such as grains, fruits and vegetables and oils from these sources contain no dietary cholesterol. Serum Cholesterol Travels in the blood in district particles containing both lipid and proteins. Three major classes of lipoproteins are found in the serum of a fasting individual, low density lipoprotein (LDL) high density lipoprotein (VLDL). Another lipoprotein class, intermediate density lipoprotein (IDL) reseed between VLDL and LDL in clinical practice, IDL is included in the cholesterol not a fat but rather a lipid, which is a classification of molecules that includes fats. Cholesterol is vital to life and is found in all membranes (Durstine *et al*., 2002).

It is necessary for the production bile acids and steroid hormones. Dietary cholesterol is found only in animal foods. Abundant in organ meals and egg yolks, cholesterol is also continued in meals and poultry. Vegetable oils and shortenings are cholesterol free. Cholesterol high blood cholesterol is a risk factor in the development of coronary heart disease (Durstine *et al*., 2002).

Most of the cholesterol that is found in the blood is manufactured by the body in the liver at a rate of about 800 to 1,500 milligrams a day in the form of lipoproteins. The most abundant lipoproteins include low density, high density and very low density lipoproteins LDL seems to be the culprit in coronary heart disease and is popularly known as the bad cholesterol by contrast, HDL is increasingly considered desirable and known as the good cholesterol (Durstine *et al*., 2002).

### 2.5.1. Resting Heart Rate

While the normal resting heart rate for adult's ranges from 60 to 100 beats per minute. Conditioned athletes and other highly fit individuals might have normal resting heart rates of 40 to 60 beats per minute. The basic formula for calculating maximum heart rate is to subtract your age from 220. For moderate intensity physical activity, a person's target heart rate should be 50 to 70% of his maximum heart rate (Edward, 2010).

### 2.5.2. Blood Pressure

Blood pressure is important because the higher your blood pressure is, the higher your risk of health problems in the future. If your blood pressure is high, it is putting extra strain on your arteries and on your heart.

Blood pressure is the force that blood exerts against blood vessel walls. The pumping action of the heart generates blood flow. Blood pressure results when the flow is met by resistance from vessel walls (Disabled world.com, 2012).

## 2.6. Studies on Aerobic Training

Padmanathan, (2011), conducted a study on the effect of low impact aerobic exercises on selected health related physical fitness variables such as muscular endurance, cardio respiratory endurance, and flexibility and Body mass index of male adolescents. Their age ranged from 12 to 15 years.

They were divided in to two groups and designed as Experimental group 'A' and Control group 'B' The Experimental group-A was given aerobic and calisthenics exercises for a period of twelve weeks, both morning and evening for five days in a week, whereas control group-B is not involved any specific exercise programme other than their regular physical activities programme as per their school curriculum. The result of this study indicated that muscular endurance and cardio respiratory endurance were significantly improved and also it was observed that Body mass Index significantly reduced.

Ramesh and Subramaniam (2010), suggested that effect of physical activity and aerobic fitness on health related physical fitness variables of overweight and obese adolescents. The selected variable includes muscular endurance flexibility, cardio-respiratory endurance, and body composition (body mass index).

For the purpose of the study thirty obese boys in the age groups of 12 to 15 years and they were selected at random from Tirunelveli district higher secondary schools. They were divided into two equal groups and assigned as experimental group and control group. The experimental groups were given physical activity and aerobic exercise for a period of twelve weeks, both morning and evening on five days a week.

Control group did not participate in physical activity and aerobic exercise training programme. The collected data was statistically analyzed by using analysis of covariance (ANCOVA). The Experiment group had a significant Improvement on the health related physical fitness variables of overweight and obese children than the control group. The authors conclude that the experimental group has achieved significant improvement on muscular endurance, flexibility, cardio-respiratory endurance, and body mass index in significantly on due to the physical activity and aerobic exercise training programme.

Ramesh and Subramaniam (2011) conducted a study on the effect of aerobic and calisthenics exercise on health related physical fitness variables such as muscular strength, muscular endurance, flexibility, cardio respiratory endurance and body mass index (BMI) of obese adolescents. Their age ranged from 12 to 18 years. They were divided into two groups and designed as the experimental group and control group.

The Experimental group was given aerobic and calisthenics exercise for a period of three months, both morning and evening for five days in a week. However, the control group was not allowed to participate in aerobic and calisthenics exercise training programme. The result of this study indicated that muscular strength, muscular endurance, cardio respiratory endurance were significantly improved, and also it was observed that Body mass Index significantly reduced.

Saremil *et al.,* (2010) examined the effects of 12 weeks of aerobic training on serum chemerin levels in association with cardiovascular risk factors in overweight and obese males. Twenty-one overweight and obese subjects [44.3 (±4.1 yrs., body mass index (BMI) 25 kg/m2) were assigned to exercise training (obese EX, n= 11) and control (obese CON, n= 10) groups. The obese EX group participated in 12 weeks of progressive aerobic training 5 days a week.

Serum chemerin, insulin resistance, lipid profiles, blood pressure, and body composition were all measured before and after the training. After the aerobic training, waist circumference (P=0.009), fat percent (P=0.03), visceral fat (P=0.03), subcutaneous fat (P=0.01), fasting glucose (P=0.01), insulin resistance (P=0.03), triglyceride (P=0.05), total cholesterol (P=0.04), low-density lipoprotein cholesterol (P=0.05) and systolic blood pressure (P=0.04) of participates were significantly decreased.

Concurrently, serum chemerin concentrations were significantly decreased after aerobic program (P=0.02). Aerobic training caused an improvement in cardio metabolic risk factors in obese subjects, and this improvement was accompanied by decreased chemerin levels.

Chaudhary *et al*., (2010) evaluated the effects of aerobic and strength training on cardiac variables such as blood pressure, heart rate (HR), and metabolic parameters like cholesterol, high density lipoprotein (HDL), triglycerides and anthropometric parameters of obese women of Punjab. This study was performed as an experimental study, in which subjects were randomly selected. There were thirty obese women, aged between 35-45yrs with body mass index (BMI) of above 30. Subjects were grouped into control (n=10), aerobic training (n=10) and resistance training (n=10). Aerobic training was given for three days a week at 6 0-70% of maximum HR for 6 weeks. Resistance training (Delorme and Watkins Technique) was given for alternate days for 6 weeks.

HR and blood pressure were measured before and after the exercise. Recovery HR was also measured. The findings of the study indicate statistically significant differences in recovery heart rate [Pre exercise: 97.40± 5.378 (mean ± standard deviation (SD)), post-exercise: 90.70±4.599, t=8.066, P<0.001] and in post-diastolic blood pressure [Pre-exercise: 85±3.265, post-exercise: 86.20±2.820, P<0.001] in aerobic training and in systolic blood pressure [Pre- and post-exercise] in both training groups (P<0.001).

Significant differences were observed in very low-density lipoprotein [pre-exercise: 28.10±1.415, post exercise: 26.86±0.760, t=5.378] and HDL [pre-exercise: 45.40±3.533, post exercise: 53.60±3.134, t=6.318] levels in aerobic training group with P<0.001. BMI and body fat percentage showed significant improvements in both training groups. Aerobic training is more beneficial and

can be used as a preventive measure in patients who are at risk of developing cardiovascular diseases due to obesity.

Shenbagavalli and Mary Recthammal,(2008) studied the effect of aerobic training on body mass index on sedentary obese men. 30 obese men were selected randomly and divided into two groups 15 subjects in each group. Group I as experimental group and Group II as control group. The experimental group had been in aerobic training programme five days in a week for a period of 8 weeks. The control group did not involve in any fitness programme or training programme. Once in 2 weeks the load was increased.

The body mass index was selected as variable. The collected data were analyzed by using‘t’ ratio. From the findings it is quite interesting to know that the sedentary obese men have positive influence upon their body mass index due to the training programme given. The results shown aerobic training helps the subjects to decrease the weight, maintains body mass index and also it helps to increase the heart rate, improve the breathing for a sustained time.

Gökhan *et al*., (2013) studied the effect of a community based exercise and health education program to improve cardiovascular fitness and body composition. Twenty five subjects were participated in 12 weeks aerobic training programme. Resting Heart Rate, blood pressure, body composition (skin folds), and maximal exercise capacity were measured before and after training.

There were significant reductions in Resting Heart Rate, blood pressure, body composition percent of body fat and increased maximal exercise workload. These results indicate that a community based exercise and health education program result in beneficial changes in fitness and body composition.

Aranga Panbilnathan and Kulothungan studied effect of different intensity aerobic exercise on body composition variables among middle aged men. Sixty male subjects were selected randomly divided four groups and each group consists of fifteen subjects each. The age ranged from 35 to 45. Group 1 underwent as low intensity aerobic exercise, group II underwent moderate intensity aerobic exercise, group III underwent high intensity aerobic exercise and group IV acted as control group. The experimental groups underwent their intensity aerobic exercise programme three days per week for twelve weeks.

Control group did not undergo any training programme rather than their routine work. The body composition are percentage body fat and lean body mass were measured by using skin fold caliper. Prior to and after end of practice period all subjects were tested. The results of pre-test and post-test were compared with using Analysis of Co-variance. The results shows that high intensity aerobic exercises were significantly better than low and moderate aerobic exercises in percentage body fat. The moderate and high intensity aerobic exercises significantly influenced lean body mass of middle age men.

Wang *et al*., (2007) studied the effects of aquatic exercise on physical fitness (flexibility, strength and aerobic fitness), self-reported physical functioning and pain in adults with osteoarthritis of the hip or knee. Two-group randomized controlled trial with a convenience sample was used. Participants were recruited from community sources and randomly assigned to a 12-weeks aquatic programme and a non-exercise control condition.

Data for 38 participants were collected at baseline, week 6, and week 12 during 2003 and 2004. Instruments were a standard plastic goniometer, a hand held dynamometer, the 6-minute walk test, the multidimensional Health Assessment Questionnaire, and a visual analogue scale for pain. Repeated measures analysis of variance showed that aquatic exercise statistically significantly improved knee and hip flexibility, strength and aerobic fitness, but had no effect on self-reported physical functioning and pain.

## 2.7. Effects of Aerobic Exercise on Health Related Physical Fitness Components

### 2.7.1. Effects of Aerobic Exercise on Cardiovascular Endurance

Cardiovascular endurance (CVE) is one of the most important measures of overall health. A person's level of cardiovascular endurance helps predict probability of disease, quality of life, and ability to react to acute and physical and mental stress. For healthy individuals, higher cardiovascular endurance also indicates an elevated level of physical fitness (Corbett, 2009).

Aerobic exercise use large muscle group to increase heart rate. This causes faster and deeper breathing which maximize the oxygen in the blood. There are many studies which prove that

cardiovascular endurance improved after aerobic exercise. Correctly performed aerobic exercise causes positive change in the body's cardiorespiratory system (Probart *et al*, 1991).

During maximum aerobic exercise the trained individual has increased maximum oxygen consumption and is better able to process oxygen and fuel can provide more energy to working muscle. Aerobic capacity is the most widely accepted single indicator of one's cardiorespiratory fitness level and it is one of the best types of activity for training and maintaining a low percentage of fat (Probart *et al.*, 1991).

### 2.7.2. Effect of Aerobic Exercise on Body Composition

Regular aerobic exercises reduce the body fat percentage without the loss of the muscle as well as important effect on anthropometric and hematologic level of obese and overweight women (Evrim *et al.,* 2010).

Aerobic exercise including walking, running, and swimming has been proven to be an effective way to lose weight; body composition changes for over fat or border line over fat people, regular aerobic exercise reduces body mass and fat. Increases in fat free body mass also accompany a regular program of resistance training. Exercise only, or exercise combined with calorie restriction, reduces body fat more than fat lost with only dieting because conserves the body's lean tissue mass (katch *et al*., 2011).

Skoumas *et al*.(2003) reported that exercise affected blood cholesterol and other lipids in a positive way by regulating the metabolism of all lipids in the blood. Other studies reported significant improvements in lipids and lipoproteins among both men (Kelly and Kelly, 2006) and women (Kelly *et al*., 2004) as a result of aerobic exercise on lipids and lipoproteins. Several studies demonstrated that moderate intensity exercise raises HDL cholesterol in blood.

# 3. MATERIALS AND METHODS

## 3.1. Description of the Study Area

Mekelle is the capital city of Tigray regional state, and it is located at about 780 kms North of the Ethiopian capital city Addis Ababa, at a latitude and longitude of 13°29′N 39°28′E with an elevation of 2084 meters above sea level. Mekelle University was found in 1984 at the town of Mekelle in Tigray regional state of Northern Ethiopia (Endale, 2017).

## 3.2. Study Design

In this study the informal or pre-post experimental design was applied. The layout for this study would be as follows (Best and Khan, 2006).

Table 1. Study design layout

| Treatment | aerobic exercise program |
|---|---|
| Frequency | 3 days/week |
| Total duration | 12 weeks |
| Duration/session | 40- 60 minutes |
| Intensity | moderate (55-69HRmax) |
| Exercise days | T, TH, and SAT |
| Time of training | Morning(12:00AM,local time) |

(ACSM, 2008)

The participants of this study were 20 (twenty) male students, and the age of these participants was between 19 and 22 years old.

The pre and posttests on selected health related physical fitness parameters such as cardiovascular endurance, flexibility, body composition, physiological parameters and lipid profile were administrated for selected subjects.

The participants were engaged in designed program of 12 weeks aerobic exercise such as aerobic dance, rope jumping, cycling, brisk walking, slow running, jumping jacks, step up, treadmill

running and jogging including warming up, stretching and cooling down exercise with moderate intensity for three days per week (Tuesday, Thursday and Saturday) for 40 minutes for the first month, 50 minutes for the second month, and 60 minutes (one hour) for the third month per day.

## 3.3. Study Period

The study was carried out for three consecutive months (December, 2018, and January, and February 2019). In the beginning of the first month (December) pretest was given and at the end of the third month (February) posttest was administrated.

## 3.4. Experimental Materials

The materials, such as running treadmill, stationary bicycle, weight machines, exercise mats, marking cones, stopwatch, jumping ropes, meter tape and whistle were used during the training as well as in the tests for physical fitness components. In addition, constant temperature incubator set at (37˚C), tubes, pentra 400 and digital tabletop were used for laboratory tests.

## 3.5. Source of Data

For this study primary data were used. The primary data were obtained from experimental variables according to the designed parameters.

## 3.6. Source of Population

The source of the population were consisted of Mekelle University sport science first year 35 male students. The participants were from different socioeconomic background, family and homogeneous in their academic status. The participants of the study were selected depending on their interest and the informed consent to participate in aerobic training program.

## 3.7. Sample Size and Sampling Technique

The purposive sampling technique was used to select 20 (twenty) participants for the study from 35 male students. Participants were filled the medical history questionnaire. The questionnaires were prepared to identify whether the participants were free from chronic diseases (heart problem, diabetes, hypertension and etc.). Additionally, injury status was also used as selection criteria.

## 3.8. Inclusion Criteria

According to medical checkup that was undertaken by the physician, those individuals with normal range of BMI, volunteers, being free from any illness, nonsmoking, free from any disabilities, etc. were some of the criteria to include study subjects. Those individuals who fulfilled the above requirements were selected.

## 3.9. Exclusion Criteria

Recent injury status, students with heart attack history, students from diabetes affected family, below or above normal BMI from the medical checkup, previous involvement of special exercise trainings and recurrent incidences of illness in between exercises were some of the exclusion criteria in this study.

## 3.10. Variables

Health related physical fitness, physiological and lipid parameters are the ideal indicators of healthy life style of an individual. Good healthy life style is merely the product of health related fitness and lipid parameters prerequisites possessed by an individual (V. Ramesh, 2011).

Components of physical fitness, physiological parameters and lipid profile were the major dependent variables. Physical fitness components are divided into two, such as health related components of physical fitness and skill related components of physical fitness. Health related physical fitness components comprises five components such as cardiovascular endurance, muscular strength, muscular endurance, flexibility, and body composition.

From those five components flexibility, body composition and cardiovascular endurance were selected in addition to the lipid profile (TC, TG, LDL-C and HDL-C) and the physiological parameters like systolic blood pressure, diastolic blood pressure and resting heart rate. The selected types of aerobic exercises (aerobic dance, treadmill running, rope jumping, jogging, strain running) were the independent variables of this study.

## 3.11. Definition of Variables

**Cardio-Respiratory Endurance:**

It is the ability to perform dynamic exercise involving large muscle groups at moderate to high intensity for prolonged periods (Heyward, 2002)

**Flexibility:**

It is most frequently given as “the range of movement about a joint” (Mathews, 1958)

**Body Composition**

It is the physical makeup of the body including weight, lean weight, and percent fat (Morrow, 2005)

**High-Density Lipoprotein**

HDL (high-density lipoprotein) cholesterol, known as "good" cholesterol because elevated levels decrease coronary heart disease risk, should account for at least 25 percent of one’s total cholesterol. HDL transports cholesterol from the cells back to the liver so it can be excreted (V. Ramesh, 2011)

**Low-Density Lipoprotein**

Low-density lipoprotein (LDL) cholesterol can deposit cholesterol on artery walls, lowering blood flow, and is considered "bad" cholesterol (V. Ramesh, 2011).

**Total Cholesterol**

The total cholesterol is defined as the sum of HDL, LDL and VLDL (V. Ramesh, 2011)

**Triglycerides**

Cholesterol and triglycerides are two forms of lipid, or fat. Both cholesterol and triglycerides are necessary for life itself. Triglycerides, which are chains of high-energy fatty acids, provide much of the energy needed for cells to function (V. Ramesh, 2011)

## 3.12. Data Quality Control

Data were collected by the investigator and two assistances (degree holders in sport science) for the field tests and laboratory technicians for the lipid and physiological variables. To avoid errors, training was given for the assistance data collectors on how to use the data collecting instruments and measurements during data collection. Only standardized materials were used to keep the quality of the data. Additionally, all the mentioned tests were recorded on score sheet. Finally the data were coded and fed to software twice to avoid error in data feeding.

## 3.13. Methods and Procedures of Data Collection

Quantitative data were collected through standardized appropriate physical fitness tests, physiological and lipid profile variables. All tests were performed at the same time of day for each subject to reduce the effect of any diurnal variations.

### 3.13.1. Physical Fitness Tests

#### 3.13.1.1. Test for Cardiovascular Endurance

**Twelve minute run/walk test:** The objective of the test was to measure the maximum distance covered by the individual during the 12-minute period and is usually carried out on a running track by placing cones at various distances to enable measuring of the distance. For this test the participants run/walk for 12 minutes and the total distance covered was recorded. The materials used during the twelve minutes run/walk were stopwatch, whistle, meter tape and marking cones.

### 3.13.1.2. Test for Flexibility

**Sit and reach test:** The objective of this test was to measure the flexibility of lower back and hamstring muscles. It involves sitting on the floor with legs out straight ahead. Feet (shoes are placed with the soles flat against the box, shoulder-width apart. Both knees were held flat against the sit and reach apparatus by the tester. With hands on top of each other and palms facing down, the subject reaches forward along the measuring line as far as possible.

After three practice reaches, the fourth reach was held at least two seconds while the distance was recorded. There was no jerky movements, and that the fingertips remain level and the legs flat. The score was recorded to the nearest centimeter as the distance before (negative) or beyond (positive) the toes. During the test ruler, box with 30 centimeters height were used.

### 3.13.1.3. Test for Body Composition

**Body mass index (**BMI**)**: Body mass index was used to measure body fat based on height and weight that applies to both men and women between the ages of 18 and 65 years. It combines a person's weight with their height. The results of a BMI measurement can give an idea about whether a person has the correct weight for their height. BMI is a screening tool that can indicate whether a person is underweight or if they have a healthy weight, excess weight, or obesity .weight machine and meter tape were used while testing the students (Mathewos, 2013).

$$\text{BMI} = \frac{\text{weight}}{\text{height (m2)}}$$

### 3.13.2. Physiological Parameters

**Purpose**. The purpose of non-invasive blood pressure measurement is to detect any changes from normal values, which may indicate disease. Measurement is also performed to monitor the effectiveness of medication and other methods used to control elevated blood pressure.

The measures of physiological variables such as resting systolic blood pressure, diastolic blood pressure and resting heart rate were taken by using digital tabletop upper arm blood pressure monitor. The measurements were taken in sitting position after the subjects rested for about 10 minutes.

For this test the subjects were asked to seat in comfortable position quietly on chair with their hands supported on table at heart level and both their feet in contact with the floor. The blood pressure cuff was wrapped to the upper arm approximately 2 cm above the elbow. The two hoses from the calibrated blood pressure monitor was positioned over the biceps muscle (brachial artery). Mean of three measurement tested at 2 minutes interval was recorded. All cardiac variable measurements were measured three times (ACSM, 2008).

### 3.13.3. Laboratory Test Procedures

The purpose of the laboratory test was to investigate the effect of twelve weeks moderate exercise on the lipid profile of the students. Once enrolled, all students were expected to attend a laboratory test two times early in morning after a long night fasting and 48 hours absence from exercise. A sample of 5mL of venous blood was collected before the participants have taken any meal and done any exercises. In addition to this, blood chemistry analysis was conducted. Three milliliters (3ml) of blood sample was taken into test tube from sample collected and prepared for the process using pentra 400. This blood sample allowed to settle for 30 minutes and centrifuged after 30 minutes. Then the blood serum was selected. After blood serum was selected from blood sample the respective reagents and materials for each parameters were prepared and the following procedures were used (Mulugeta, 2013).

#### 3.13.3.1. Analysis of Total Cholesterol and Triglyceride

The total cholesterol was determined after enzymatic hydrolysis and oxidation. The indicator quinoneimine would form hydrogen peroxide and 4- aminophenazone in the presence of phenol and peroxide. And for triglyceride, enzymatic colorimetric methods was used on the enzymatic hydrolysis of serum or plasma triglyceride to glycerol and free fatty acids by lipoprotein lipase.

The materials used for the process were photometer or colorimeter, constant temperature incubator set at (37 ˚C) and pipettes was used in laboratory. To execute the analysis of serum total cholesterol and triglyceride in laboratory; reagents and blood serum were brought to room temperature, pipettes was labeled into tubes, sample was mix and the tubes were allowed to stand for 15 minutes at room temperature (16-25˚C) or 5 minutes at temperature 37˚c and absorbance (A) of the serum

and standard at 500nm against reagent blank was recorded for total cholesterol and triglyceride, respectively (Mulugeta, 2013).

#### 3.13.3.2. Analysis of LDL and HDL

Both HDL and LDL cholesterol were determined after enzymatic colorimetric methods used on the enzymatic hydrolysis of serum or plasma HDL and LDL to quinoneimine indicator by lipoprotein lipase. The materials used for the process were photometer or colorimeter, constant temperature incubator set at (37 ˚C) and pipettes was used in laboratory (Mulugeta, 2013).

To execute the analysis of serum HDL and LDL in laboratory; reagents and blood serum were brought to room temperature, pipettes were labeled into test tubes, sample was mix and the tubes were allowed to stand for 15 minutes at room temperature (26-25 ˚C) or 5 minutes at temperature 37˚C and absorbance (A) of serum and standard at 500nm against reagent blank was recorded for high density lipoprotein and low density lipoprotein, respectively (Mulugeta, 2013).

## 3.14. Training Protocol

The purpose of this training program was to investigate the effect of aerobic exercise on health related physical fitness components, physiological parameters and lipid profile of Mekelle University students, Ethiopia. The 20 participants were selected from the total population of 35 Mekelle University male first year sport science students purposely.

The participants were engaged for consecutive three months (12 weeks) of aerobic exercise three days per week, and 40-60 minutes for each training session. From the beginning of the training program up to the end the intensity of the training was moderate (55-69HRmax), this intensity was calculated from their maximum heart rate by taking both the minimum and maximum value (ACSM, 2008).

The duration of the training for the first, second, and third month was 40, 50, and 60 minutes respectively. All the sessions included warming up, stretching, and cooling down exercises. Some of the aerobic exercises that were used in the training were walking, jogging, slow running, brisk walking, rope skipping, running, aerobic dance, stair running, step up, cycling (stationery),

jumping jacks, treadmill running, etc. Starting from the first month to the third month the duration and type of exercises were varied in order to apply the principles of training such as, principle of over load (frequency, intensity, time, and type), principle of variety.

## 3.15. Methods of Data Analysis

In analysis of the data, SPSS (version 21) computer program was used. Age, height and weight values of the research participants were given as averages (mean) and standard deviations, and in the comparison of pre-test and post-test values Paired- Sample T test was used. The statistical significance level was $P \leq 0.05$.

## 3.16. Ethical Issues and Code of Conduct

The study deals with the ethical issues; it cares for the privacy of research participants and make guarantees and confidentiality in risk of harm as a result of their participation. Therefore the study was conducted according to Mekelle University rules, regulations, policies and codes of ethics relating to research ethics. Ethical standards require that researcher should not impose participants in a situation where they might be at risk of physical or psychological harm as a result of their participation.

# 4. RESULTS AND DISCUSSION

In this chapter the analysis of the data and the results of the study were discussed. The purpose of the pretest and posttest were to find out the effect of aerobic exercise on health related physical fitness components, physiological parameter and lipid profile in the first year male sport science students of Mekelle University.

To achieve the objective of this study, 20 male first year students were selected purposely. The age of the subjects were ranged between 19 and 22 years. The selected subjects underwent aerobic exercise for twelve weeks.

Participants were tested on selected criterion measures namely, health related physical fitness (flexibility, body composition and cardiovascular endurance), physiological parameters (Diastolic blood pressure, Systolic blood pressure and resting heart rate), and lipid profiles (Total cholesterol, Triglyceride, High density lipoprotein, and Low density lipoprotein) prior to and after the twelve weeks of the training period.

The data pertaining to the variables in this study were statistically examined by using paired “T” test. The level of significance was fixed at $P \leq 0.05$.

Prior to data analysis the difference in each variable were checked for normality and none of them grossly deviate from the normality. Hence, Paired t-test was used to establish comparisons of after and before interventions for each variable.

The effect of the independent variable on selected dependent variables was determined through the collected data by using appropriate statistical techniques SPSS version 21 and results were presented below.

## 4.1. Anthropometric Measurements

Table 2. Anthropometric measurement of the participants

| Variables | Mean | SEM | SD | Min | Max | P Value |
|---|---|---|---|---|---|---|
| Age | 20.35 | 0.15 | 0.67 | 19 | 22 | |
| height before exercise | 172.65 | 1.37 | 6.13 | 160 | 183 | 0.083 |
| height after exercise | 172.8 | 1.34 | 6.01 | 160 | 183 | |
| body mass before exercise | 59.65 | 1.14 | 5.11 | 52 | 71 | 0.000 |
| body mass after exercise | 55.05 | 0.91 | 4.08 | 50 | 63 | |

**SEM= standard error of mean *SD=standard deviation *Min= Minimum *Max= Maximum *p value=significance level*

Table 2 indicated that the mean and standard deviation of age, height, and body mass of the participants. According to the above data the mean and standard deviation result of the age of the participants were 20.35±0.67. The pretest and post test results for height and body mass were also 172.65 ± 6.13 to 172.8 ± 6.01, and 59.65 ± 5.11 to 55.05 ± 4.08, respectively.

### 4.1.1 Height

The pre and posttest average mean and standard deviation value of body height of the subjects were 172.65 ± 6.13 and 172.8 ± 6.01, respectively.

After implementing the intervention aerobic training program for twelve weeks (40, 50, 60 minutes moderate training sessions, three days a week), there was no statistically significant change found in body height. The reason why significant change did not seen on height may be because of the fact it is totally depend on genetic endowment of an individual, and due to the short duration (twelve weeks) of the study.

The result of the current study was line with the study conducted by Radmila Kostić *et al.* (2005) who conducted a study on the effects of aerobic dance on the cardiovascular fitness and body composition on overweight women. They were concluded that aerobic dance exercise utilized 12 week 3 days per week for one hour of period may not affect height positively in overweight women.

This finding was also collaborated with the finding of Kusuma C *et al.,* (2016) who conducted a study on the impact of aerobic dance exercise on anthropometric measurements among college Woman.

The current result of the study was also supported by (Fisseha, 2016) who conducted a study on effect of aerobic training on selected physiological, biochemical and anthropometric variables in overweight male students of Mekelle University and he conclude in his study finding height was not significantly changed in both groups.

**4.1.2 Body Mass**

The result of the study (table 2) showed that there was a significant improvement take place on body mass due to twelve weeks aerobic training. The pre and posttest average mean and standard deviation of body mass of the subjects were 59.65 ± 5.11 and 55.05 ± 4.08, respectively.

This positive significant change may be due to the following reasons:

An adaptation response to aerobic exercises may be caused increasing of fat oxidation, resting metabolic rate, total energy expenditure and reduction of body fat. Aerobic exercise causes further reduction in fat mass. Aerobic exercise adds up the exercise capability of your body to use fat as a substrate increases and total fat oxidation during exercise (Fisseha, 2016).

The finding of the present study was well supported by Wong *et al.,* (2008) examined 12 week exercise program on aerobic fitness, body composition, blood lipids in obese adolescents. Results showed that exercises significant reduction in BMI, body mass index, net TG levels, and body weight is effective comparing to the control group.

This present finding was also supported by Everim Cakmak *et al*., (2012**)** conducted a study on the effects of aerobic dance exercise on body composition changes associated with weight change in sedentary women. There were significant differences between pretest and posttest for weight, body mass index, waist circumference, waist hip ratio, metabolic and body composition parameters in exercise group ($p<0,05$). Besides there were significantly decreased body weight, Lean Body Mass, Basal Metabolic Rate and fat percentage ($p<0,05$).

But, the current finding was in contrary with the study conducted by Higuchi et al., (1984) conducted a four week training programme for five healthy and mildly active males aged 28 to 31 years. They run on a treadmill at 140 to 160 m/min at 0% grade for 50 min, five times a week, equivalent to an energy expenditure of 9 kcal/kg body weight/day. They maintained their body weights by increasing calorie intake to match increased energy expenditure. No changes were observed in mean body weight, skinfold thickness, basal metabolism and maximal oxygen uptake after the training programme.

## 4.2. Health Related Physical Fitness Variables

The result of the study on health related fitness variables, body composition (BMI), flexibility (sit and reach), and cardiovascular endurance (twelve minutes run) reveals that the participants significantly ($p<0.001$) improved after 12 weeks of aerobic training (Table 3). The alternate hypothesis was accepted and null hypothesis was rejected.

Table 3. Health related physical fitness variables

| Variables | Mean | SEM | SD | Min | Max | P Value |
|---|---|---|---|---|---|---|
| flexibility before exercise | 9.05 | 1.25 | 5.62 | 0 | 19 | 0.000 |
| flexibility after exercise | 13.25 | 1.13 | 5.08 | 4 | 21 | |
| BMI before exercise | 20.02 | 0.25 | 1.15 | 17.04 | 23.99 | 0.000 |
| BMI after exercise | 18.44 | 0.22 | 0.99 | 16.12 | 20.95 | |
| CVE before exercise | 2770.75 | 82.25 | 367.86 | 2000 | 3207 | 0.000 |
| CVE after exercise | 3093.15 | 61.51 | 275.09 | 2500 | 3450 | |

**SEM= standard error of mean *SD=standard deviation *Min= Minimum *Max= Maximum*
**p value=significance level*

The above table 3 shows the pretest and post test results of the participants on health related physical fitness variables. Based on the above data the mean and standard deviation of the participants before and after the aerobic exercise on health related physical fitness such as flexibility, body composition (BMI), and cardiovascular endurance variables was 9.05 ± 5.62 to 13.25 ± 5.08, 20.02 ± 1.15 to 18.44 ± 0.99, and 2770.75 ± 367.86 to 3093.15 ± 275.09 respectively.

### 4.2.1 Flexibility (sit and reach test)

The result of this study shows that there was a significant improvement take place on flexibility due to twelve weeks aerobic training. The pre and post mean score of results changed from9.05 ± 5.62 to 13.25 ± 5.08 respectively.

Reason for positive significant change might be due to;

As we engage in regular aerobic exercise program we tend to use fat as a source of energy and this causes to decrease the amount of fat found in our body. This decrement of fat results in lowering the blood pressure, and this lowering of our blood pressure helps the blood vessels (found in our joints) to move (to be flexible) through their full range of motion.

The results of the study was in accordance with the result conducted by Ramesh and Subramaniam (2010**)** suggested that effect of physical activity and aerobic fitness on health related physical fitness variables of overweight and obese adolescents. The selected variable includes muscular endurance, flexibility, cardio-respiratory endurance, and body composition (body mass index).

The experimental group had a significant Improvement on the health related physical fitness variables of overweight and obese children than the control group. The authors conclude that the experimental group has achieved significant improvement on muscular endurance, flexibility, cardio-respiratory endurance, and body mass index in significantly on due to the physical activity and aerobic exercise training programme.

This study was also in agreement with the study conducted by Korsten *et al*., (2007), investigated that 12 weeks of aerobic training improved flexibility, sit-ups, hand grip for both hands, VO2max and impaired LDL, total cholesterol in obese girls. These results were also in line with the previous literature that found improvements in health related parameters of obese participants as a result of regular exercise participation. Moreover, similar results have been reported in adults.

### 4.2.2 Body Composition (Body mass index)

The result of this study showed that there was a significant improvement take place on body composition (BMI) due to twelve weeks aerobic training. The pre and post mean and standard deviation score of the results were changed from 20.02 ± 1.15 to 18.44 ± 0.99 respectively.

Reason for positive significant change might be due to;

An adaptation response to aerobic exercises may be caused increasing of fat oxidation, resting metabolic rate, total energy expenditure and reduction of body fat. Aerobic exercise causes further reduction in fat mass. Aerobic, adds up the exercise capability of your body to use fat as a substrate increases and total fat oxidation during exercise (Fisseha, 2016).

Aerobic exercise including walking, running, and swimming has been proven to be an effective way to lose weight; body composition changes for over fat or border line over fat people, regular aerobic exercise reduces body mass and fat. Increases in fat free body mass also accompany a regular program of resistance training. Exercise only, or exercise combined with calorie restriction, reduces body fat more than fat lost with only dieting because conserves the body's lean tissue mass (katch *et al*., 2011).

This finding was in line with the study conducted by Padmanathan, (2011), conducted a study on the effect of low impact aerobic exercises on selected health related physical fitness variables such as muscular endurance, cardio respiratory endurance, and flexibility and Body mass index of male adolescents. Their age ranged from 12 to 15 years. The result of this study indicated that muscular endurance and cardio respiratory endurance were significantly improved and also it was observed that Body mass Index significantly reduced.

The finding of the current study was also supported by Ramesh and Subramaniam (2011) conducted a study on the effect of aerobic and calisthenics exercise on health related physical fitness variables such as muscular strength, muscular endurance, flexibility, cardio respiratory endurance and body mass index (BMI) of obese adolescents. The result of this study indicated that muscular strength, muscular endurance, cardio respiratory endurance were significantly improved, and also it was observed that Body mass Index significantly reduced.

The finding of the study was also in agreement with Shenbagavalli and Mary Recthammal, (2008) studied the effect of aerobic training on body mass index on sedentary obese men. 30 obese men were selected randomly and divided into two groups 15 subjects in each group. The experimental group had been in aerobic training programme five days in a week for a period of 8 weeks. The body mass index was selected as variable. The results shown aerobic training helps the subjects to decrease the weight, maintains body mass index and also it helps to increase the heart rate, improve the breathing for a sustained time.

The result of the study was also supported by Wong *et al*., (2008) examined 12-week exercise program on aerobic fitness, body composition, blood lipids in obese adolescents. Results showed that exercises significant reduction in BMI, body mass index, net TG levels, and body weight is effective comparing to the control group.

The result of the current study was line with the study conducted by Marandi *et al.,* (2013). Reports in the application data protocol a sport applied regardless of the type of aerobic activity, per exercise reduces body fat. Increasing physical activity and weight control program to prevent young people it supports.

### 4.2.3 Cardiovascular Endurance (Twelve minutes run)

The result of this study showed that there was a significant improvement take place on cardiovascular endurance due to twelve weeks aerobic training. The pre and post mean results changed from 2770.75 ± 367.86 to 3093.15 ± 275.09 respectively.

Reason for positive significant change might be due to;

Regular aerobic exercise improves your cardiovascular fitness by increasing your capacity to use oxygen. It does this by increasing your heart's capacity to send blood (and hence oxygen) to the muscles. This is mainly achieved through an increase in the size of the heart's pumping chambers (ventricles), which means that your heart doesn't have to beat as fast to deliver the same amount of blood. This is evident in a slower resting heart rate, and a slower heart rate for the same exercise intensity. (Mathewos, 2013)

The result of the above data was in line with the study conducted by Padmanathan, (2011), conducted a study on the effect of low impact aerobic exercises on selected health related physical fitness variables such as muscular endurance, cardio respiratory endurance, and flexibility and Body mass index of male adolescents. The result of this study indicated that muscular endurance and cardio respiratory endurance were significantly improved and also it was observed that Body mass Index significantly reduced.

The current result was also supported by Ramesh and Subramaniam (2011) conducted a study on the effect of aerobic and calisthenics exercise on health related physical fitness variables such as muscular strength, muscular endurance, flexibility, cardio respiratory endurance and body mass index (BMI) of obese adolescents. The result of this study indicated that muscular strength, muscular endurance, cardio respiratory endurance were significantly improved, and also it was observed that Body mass Index significantly reduced.

## 4.3. Physiological parameters

The result of the study on physiological variables, systolic blood pressure, diastolic blood pressure, and resting heart rate reveals that the participants significantly ($p<0.001$) improved after 12 weeks of aerobic training (Table 4). The alternate hypothesis was accepted and null hypothesis was rejected.

Table 4. Physiological parameter variables

| variables | Mean | SEM | SD | Min | Max | P Value |
|---|---|---|---|---|---|---|
| Diastolic blood pressure before exercise | 68.9 | 1.40 | 6.28 | 57 | 79 | 0.000 |
| Diastolic blood pressure after exercise | 65.3 | 1.12 | 5.02 | 55 | 74 | |
| Systolic blood pressure before exercise | 122.85 | 2.20 | 9.84 | 107 | 137 | 0.000 |
| Systolic blood pressure after exercise | 114.1 | 1.19 | 5.35 | 105 | 121 | |
| Resting heart rate before exercise | 71.35 | 1.50 | 6.72 | 60 | 89 | 0.000 |
| Resting heart rate after exercise | 64.05 | 1.31 | 5.88 | 54 | 72 | |

**SEM= standard error of mean* **SD=standard deviation* **Min= Minimum* **Max*= Maximum
**p value=significance level*

Table 4 indicated the mean and standard deviation results of physiological variables before and after the twelve weeks aerobic exercise. Accordingly the pre and post test results for physiological variables were 68.9 ± 6.28 to 65.3 ± 5.02, 122.85 ± 9.84 to 114.1 ± 5.35, and 71.35 ± 6.72 to 64.05 ± 5.88 for diastolic blood pressure, systolic blood pressure, and resting heart rate respectively.

### 4.3.1. Resting heart rate

The changes to resting heart rate took place under the influence of the twelve weeks aerobic exercise program, and resulted positive significant changes in the participants. The pre and posttest of the mean and standard deviation was from 71.35 ± 6.72 to 64.05 ± 5.88 respectively.

Reason for positive significant change might be due to;

It is observed that the activity of heart of any individual can be measured under 3 different conditions, namely resting, sub maximal and maximal work. As a result of aerobic training the SV

of an individual can be increased during rest and most probably during sub maximal work. As with some load of work the SV increase can easily manage to supply quantum of blood to active muscle of body with reduction in HRsub, moreover endurance training help to generate higher cardio respiratory efficiency by increased availability of oxygen at the level of lung, by greater transportation of oxygen via hemoglobin, By higher excretion of power of oxygen (oxygen utilization) at sea level (Fisseha, 2016).

Regular aerobic exercise improves your cardiovascular fitness by increasing your capacity to use oxygen. It does this by increasing your heart's capacity to send blood (and hence oxygen) to the muscles. This is mainly achieved through an increase in the size of the heart's pumping chambers (ventricles), which means that your heart doesn't have to beat as fast to deliver the same amount of blood. This is evident in a slower resting heart rate, and a slower heart rate for the same exercise intensity (Mathewos, 2013).

The current study was in line with Chaudhary *et al*. (2010) evaluated the effects of aerobic and strength training on cardiac variables such as, blood pressure, heart rate (HR), and metabolic parameters like cholesterol, high density lipoprotein (HDL), triglycerides and anthropometric parameters of obese women of Punjab.

The above finding was also supported by Wong *et al*., (2008), the effects of a 12-week exercise training on some health parameters of 13 to 14 years old obese boys was examined. In addition to typical physical education sessions, subjects participated in a combination of circuit based resistance and aerobic exercises 2 times in a week to monitor changes in aerobic fitness, body composition and serum C-reactive protein (CRP) and lipid levels.

The results indicated that exercise training significantly improved lean muscle mass, body mass index, fitness, resting HR, systolic blood pressure and triglycerides in the exercise group. Similar results were also found in this present study (Fisseha, 2016).

### 4.3.2. Diastolic blood pressure

The changes to diastolic blood pressure took place under the influence of the twelve weeks aerobic exercise program, and resulted positive significant changes in the participants. The pre and posttest result of the mean and standard deviation was from 68.9 ± 6.28 to 65.3 ± 5.02 respectively.

Reason for positive significant change might be due to;

Regular aerobic exercise has been shown to reduce the risk of heart disease, high blood pressure, type 2 diabetes, colon cancer and breast cancer. It can lower blood pressure and improve your blood cholesterol by reducing the levels of LDL-cholesterol (so-called 'bad' cholesterol) and increasing the amount of HDL-cholesterol (so- called 'good' cholesterol). It can also reduce anxiety, stress and depression, as well as instilling a general sense of well-beings. Regular aerobic exercise has been shown to have the potential to increase your lifespan (Mathewos, 2013)

Other reasons for positive significant changes was may be aerobic exercise is essential for developing cardio vascular system. Aerobic exercise is activity that can be sustained for extended period of time without building oxygen dept. in the muscle. Aerobic exercise is the type in which the amount of oxygen taken into the body is slightly more than or equal to the amount of oxygen by the body (Charls A Bucher, 1983)**.**

Lower heart rate at rest the production of less lactic acid, as exercise reduces blood pressure and changes blood chemistry. And such aerobic exercise results increasing the size of coronary artery and myocardium muscle thus assisting the flow of blood to the heart, if artery narrowed athrescloresis will occur (Charls A Bucher, 1983)**.**

The findings of the present study was supported by Lang *et al*., (2003). In this present study was found Positive significant change results on selected physiological variables (THR, RHR, HRR, SBP, and DBP) and the results that were obtained in this study are compatible with and well supported by: Glass., *et al*., (2002), of his study was found out in that aerobic exercises put in good shape the body mass region, these exercises also causes positive significant change in HRR, THR, SBP, DBP, weight cholesterol and Triglyceride levels ($p<0.05$).

The above result was in agreement with the study conducted by King and Jennings (1993), conducted study on the effect of physical activity on arterial blood pressure .The experimental program lasted for four weeks. The author concluded that moderate intensity biking lead to greatest decrease in blood pressure, by 5/3(systolic/diastolic ),and that smaller changes were noted in the case of subjects who realized low intensity walking exercise (3/2mmHg(systolic/diastolic).

This study was also well-suited with the findings of Zaros *et al*., (2009) investigated the effects of 6 months of dynamic exercise training (ET) on blood pressure and plasma nitrate/nitrite concentration (NOx-) in hypertensive postmenopausal women. Eleven volunteers were submitted to the ET consisting in 3 days a week, each session of 60 minutes during 6 months at moderate intensity (50% of heart rate reserve). Anthropometric parameters, blood pressure, NOx- concentration were measured at initial time and after ET.

A significant reduction in both systolic and diastolic blood pressure values was seen after ET which was accompanied by markedly increase of NOx- levels (basal: 10 +/- 0.9; ET: 16 +/- 2 microM). Total cholesterol was significantly reduced (basal: 220 +/- 38 and ET: 178 +/- 22 mg/dl), whereas triglycerides levels were not modified after ET (basal: 141 +/- 89 and ET: 147 +/- 8 mg/dl).

### 4.3.3. Systolic Blood Pressure

The changes to systolic blood pressure took place under the influence of the twelve weeks aerobic exercise program resulted positive significant changes in the experimental group. The pre and posttest result of the mean and standard deviation was from 122.85 ± 9.84 to 114.1 ± 5.35 respectively.

Reason for positive significant change might be due to;

Regular aerobic exercise has been shown to reduce the risk of heart disease, high blood pressure, type 2 diabetes, colon cancer and breast cancer. It can lower blood pressure and improve your blood cholesterol by reducing the levels of LDL-cholesterol (so-called ‘bad’ cholesterol) and increasing the amount of HDL-cholesterol (so- called ‘good’ cholesterol). It can also reduce anxiety, stress and depression, as well as instilling a general sense of well-beings. Regular aerobic exercise has been shown to have the potential to increase your lifespan (Mathewos, 2013).

Other reasons for positive significant changes is may be aerobic exercise is essential for developing cardio vascular system. Aerobic exercise is activity that can be sustained for extended period of time without building oxygen dept. in the muscle. Aerobic exercise is the type in which the amount of oxygen taken into the body is slightly more than or equal to the amount of oxygen by the body.

Lower heart rate at rest the production of less lactic acid, as exercise reduces blood pressure and changes blood chemistry. And such aerobic exercise results increasing the size of coronary artery and myocardium muscle thus assisting the flow of blood to the heart, if artery narrowed athrescloresis will occur (Charls A Bucher, 1983).

The result of the current study was lined with the study conducted by; Chaudhary *et al*., (2010) evaluated the effects of aerobic and strength training on cardiac variables such as blood pressure, heart rate (HR), and metabolic parameters like cholesterol, high density lipoprotein (HDL), triglycerides and anthropometric parameters of obese women of Punjab.

This study was performed as an experimental study, in which subjects were randomly selected. There were thirty obese women, aged between 35-45yrs with body mass index (BMI) of above 30. Subjects were grouped into control (n=10), aerobic training (n=10) and resistance training (n=10). Aerobic training was given for three days a week at 60-70% of maximum HR for 6 weeks. Resistance training (Delorme and Watkins Technique) was given for alternate days for 6 weeks.

HR and blood pressure were measured before and after the exercise. Recovery HR was also measured. The findings of the study indicate statistically significant differences in recovery heart rate [Pre exercise: 97.40± 5.378 (mean ± standard deviation (SD)), post-exercise: 90.70±4.599, t=8.066, P<0.001] and in post-diastolic blood pressure [Pre-exercise: 85±3.265, post-exercise: 86.20±2.820, P<0.001] in aerobic training and in systolic blood pressure [Pre- and post-exercise] in both training groups (P<0.001).

Significant differences were observed in very low-density lipoprotein [pre-exercise: 28.10±1.415, post exercise: 26.86±0.760, t=5.378] and HDL [pre-exercise: 45.40±3.533, post exercise: 53.60±3.134, t=6.318] levels in aerobic training group with P<0.001. BMI and body fat percentage showed significant improvements in both training groups. Aerobic training is more beneficial and

can be used as a preventive measure in patients who are at risk of developing cardiovascular diseases due to obesity.

This study was also supported by George, *et al*., (2007) conducted a study on Aerobic Exercise and Resting Blood Pressure: A Meta-Analytic Review of Randomized, Controlled Trials. In this study the authors used the meta-analytic approach to examine the effects of aerobic exercise on resting systolic and diastolic blood pressure in adults.

Statistically significant exercise-minus-control decreases were found for changes in resting systolic and diastolic blood pressure in both hypertensive (systolic, −6 mm Hg, 95% CI, −8 to −3; diastolic, −5 mm Hg, 95% CI, −7 to −3) and normotensive (systolic, −2 mm Hg, 95% CI, −3 to −1; diastolic, −1 mm Hg, 95% CI, −2 to −1) groups.

The differences between groups were statistically significant (systolic, p=0.008; diastolic, p=0.000). Relative decreases were approximately 4% (systolic) and 5% (diastolic). It was concluded that aerobic exercise reduces resting systolic and diastolic blood pressure in adults.

This finding study was in agreement with Glass., *et al*., (2002), of his study was found out in that aerobic exercises put in good shape the body mass region, these exercises also causes positive significant change in HRR,THR,SBP,DBP, weight cholesterol and Triglyceride levels ($p<0.05$).

## 4.4. Lipid profile variables

The result of the study on lipid profile variables, total cholesterol, triglyceride, high density lipoprotein, and low density lipoprotein reveals that the participants significantly ($p<0.001$) improved after 12 weeks of aerobic training (Table 5). The alternate hypothesis was accepted and null hypothesis was rejected.

Table 5. Biochemical (Lipid profile) variables

| Variables | Mean | SEM | SD | Min | Max | P Value |
|---|---|---|---|---|---|---|
| TC before exercise | 116.6 | 4.01 | 17.94 | 85 | 143 | 0.000 |
| TC after exercise | 102.45 | 3.42 | 15.32 | 79 | 123 | |
| TG before exercise | 91.6 | 3.41 | 15.28 | 70 | 125 | 0.000 |
| TG after exercise | 82.25 | 3.01 | 13.49 | 66 | 117 | |
| HDL before exercise | 38.2 | 1.46 | 6.56 | 26 | 51 | 0.000 |
| HDL after exercise | 41.05 | 0.84 | 3.79 | 35 | 49 | |
| LDL before exercise | 59.9 | 3.38 | 15.14 | 35 | 86 | 0.000 |
| LDL after exercise | 45.25 | 3.00 | 13.45 | 25 | 66 | |

**SEM= standard error of mean* **SD=standard deviation* **Min= Minimum* **Max=* Maximum
**p value=significance level*

Table 5 showed the mean and standard deviation results of lipid profile of the participants before and after the aerobic exercise. Based on the above data the pre and posttest results of Total cholesterol, Triglyceride, High density lipoprotein, and Low density lipoprotein of the participants were 116.6 ± 17.94 to 102.45 ± 15.32, 91.6 ± 15.28 to 82.25 ± 13.49, 38.2 ± 6.56 to 41.05 ± 3.79, and 59.9 ± 15.14 to 45.25 ± 13.45, respectively.

### 4.4.1. Total Cholesterol

The changes to total cholesterol took place under the impact of twelve weeks aerobic exercise program, and resulted positive significant changes in the participants. The mean and standard deviation result of pre and posttest of total cholesterol was from 116.6 ± 17.94 to 102.45 ± 15.32, respectively.

Reason for positive significant change might be due to;

Lipid profile contains cholesterol LDC, VDLC, TRI, HDL and TC. Everyone has these elements. HDL contains almost 50% protein and less than quarter cholesterol while LDL contains almost 50% protein and less than quarter protein. HDL is not harmful they do NOT collect harmful because they do not adhere or collect to the artery. In fact they actually help to break down of fatty deposit already present. The fatty arthrosclerosis deposits are deposits of LDL and fractions then exercise causes to increase HDL and decreasing LDL ,this because fat accumulation break down by exercise (Fox *et al*.,1981**)**.

The HDL-c- may appear to act as type of shuttle and it may be taken up cholesterol from the blood and body cells and transfers it to the liver. Where it may be used to form bile acids. The bile acids all in digestion process. With some of them passing out, thus providing the body the major route of excretion of cholesterol. The long duration progressive aerobic exercise may increase the utilization of fats. Which in turn increases the catabolism of bile in the liver, which may result increment of HDL-C- in the body of the training group (Fox *et al*., 1981**)**.

The VLDL-C-c is comprises of TRI and TC which require for reproduction of HDL. Due to increment of HDL-C-c production and increment of fat as fuel for working muscle may be the main reason for significant decreases of LDL-c of the participants.

The liver is primarily organ for cholesterol syntheses and catabolism. Cholesterol protein complexes circulate by way of lymphatic and veins back in to the blood. By increasing physical activities metabolism speed up the process of cholesterol excretion and prevent syntheses of sterol ,physical activities also causes in greater metabolisation and alimentary assimilation of cholesterol. And these lowers it in the blood (Edgers Gorden, 1959).

Lowering this cholesterol may be due to generation of metabolic fuel, striated muscles which tend to suppress cholesterol syntheses (Edgers Gorden, 1959).

The finding of the present study was well-suited with and well supported by: Özcan Saygın and Mehmet Ali Öztürk, (2011), investigate the effects of 12 week aerobic exercise program on health related fitness components and blood lipids in obese girls. There was positive Significant differences from pre-test to post-test measurements in the EG and CG for TC test results were changed from pre (110.07 mg/dl ±39.48) to post (95.78 mg/dl ±33.04 ) and control group from pre(113.96 mg/dl ±23.78 ) to post(117.14 mg/dl ±24.39 ) respectively.

The finding was also collaborated with Ozcan Saygın and Mehmet Ali ozturk (2011) conducted a study on the effect of twelve week aerobic exercise programmed on health related physical fitness components and blood lipids in obese girls. The aim of this study was to investigate the effects of 12 week aerobic exercise program on health related fitness components and blood lipids in obese girls.

Participants joined sessions for 60 min per day, 3 days per week for 12-week. There were significant differences in total cholesterol and triglyceride between pre-test and post test scores in the exercise group ($p<0.05$). It was concluded that regular aerobic exercise may affect health related fitness components and blood lipids positively.

This study was also supported by Marandi *et al.*, (2013) investigated the effect of combined exercise program on indices of body composition, physical fitness and lipid profiles of mentally retarded young people and observed that the exercise group compared with the control group decreased their weight, BMI, waist circumference, fat mass, levels of LDL, TG, and cholesterol, while HDL levels significantly increased.

The current finding was also in agreement with findings conducted by Marandi *et al.*, (2013) conducted a study the effects of extreme and moderate aerobic exercise on lipid profile and paraoxonase activity in healthy non-athletes male.

The results suggest the existence of significant differences in levels of HDL-C, the ratio of HDL-C to LDL-C as well as its ratio TG, diastolic blood pressure, $VO_{2max}$, resting heart rate and indexes

of body composition between the control group and the group with aerobic exercise was so high and there was a significant difference between groups in the amounts of LDL-C, TC, and TG.

The results of the study was also in line with the study conducted by Korsten *et al*., (2007), investigated that 12 weeks of aerobic training improved flexibility, sit-ups, hand grip for both hands, VO2max and impaired LDL, total cholesterol in obese girls. These results were also in line with the previous literature that found improvements in health related parameters of obese participants as a result of regular exercise participation. Moreover, similar results have been reported in adults.

Narayani and Sudhan (2010), also found that the result of their study indicated that the body fat percentage and total cholesterol decreases and increase HDL cholesterol in obese women after 6 weeks of endurance training. Low-calorie diet plus exercise can reduce body fat through a small cell size but does not change the number of cells.

The findings of the study was also supported by the study conducted by Marandi *et al.,* (2013) investigated the effect of exercise intensity on cardiovascular risk factors - vascular of non-athlete male students in the two different intensity aerobic training on blood lipid profile concentrations were measured in 47 sedentary male students.

Comparing the results of the exercise group and control group, significant effect of moderate intensity exercise on cholesterol levels, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and low-density lipoprotein (VLDL) while aerobic training. Although intense exercise had significant effect on some factors such as HDL-C, LDL-C, and had high cholesterol.

Two months aerobic exercise for 60 minutes, three times a week, has a desirable effect on body composition and blood lipid profile of young women. Body weight and BMI are factors that are directly associated with heart disease have vascular connections. The researchers found that aerobic exercise reduces fat mass and decreased body weight that followed.

Time needed to change some parameters are based on: 2 weeks for the levels of tumor associated glycoprotein (TAG), 4 weeks for $VO_{2\ max}$, 6 weeks, and 8 weeks for body weight and BMI, body

fat mass, and to change HDL levels in blood. Regular exercise may be a gradual reduction of TG, TC, LDL, BMI, body mass, body fat and increase HDL, body mass, and BMR is the net.

But also the result of the current study was against the study conducted by Thomas *et al*., (2007), investigated a study on effects of exercise are on HDL-C and triglyceride levels). In the present study, as in several others before it, lipid profile was improved after exercise, with a 10.6% increase in HDL levels in the experiment group. Conversely, there were no significant changes in TC, LDL-C or TG levels after our 12-week training program. This non-improvement may be due to the reduced number of individuals in both groups. However, other studies that in addition to physical exercise, also used nutritional guidance, found no differences in TC, LDL-C and TG.

The result of the study was also in contrary with the findings conducted by Gilliam and Burke analyzed the effect of exercise on serum lipids a six-week study involving 14 female ages 8-10 years. The subjects participated in various aerobic activities for 35 minutes per session.

The results showed that a significant increase in HDL-C levels with no change in TC levels. The main flaw in this study was a lack of a control group. Additionally, intensity was described as “strenuous” but was not quantified, the length of the study was short (six weeks) and the frequencies of the exercise sessions were not reported.

### 4.4.2. Triglyceride

The changes to Triglyceride took place under the influence of twelve weeks aerobic exercise program, and resulted positive significant changes in the experimental group. The pre and posttest results of the mean and standard deviation was from 91.6 ± 15.28 to 82.25 ± 13.49 respectively.

Reason for positive significant change might be due to;

The low production of triglyceride leads to decreased circulation of triglyceride in the blood. Exercise affects in an increased up take of triglyceride by working muscle. This increases the turnover of plasma triglyceride during exercise. This additional removal of triglyceride from the circulation could be enhancing to the triglyceride lowering effect (Endale, 2017).

The liver is primarily organ for cholesterol syntheses and catabolism. Cholesterol protein complexes circulate by way of lymphatic and veins back in to the blood. By increasing physical activities metabolism speed up the process of cholesterol excretion and prevent syntheses of sterol ,physical activities also causes in greater metabolization and alimentary as simulation of cholesterol. And these lowers it in the blood (Fisseha, 2016).

The current result of the study was in line with the study conducted by Stefanick M.L *et al*., (1998) conducted a study of Exercise in low density along with loss weight can both lower lipoprotein cholesterol (LDL) concentrations and control the decrease in HDL-C. Excess body fat produces severe adverse consequences on health, such as high blood pressure and changes in lipid profile constituents, including total cholesterol (TC), high-density lipoprotein (HDL) cholesterol low-density lipoprotein (LDL) cholesterol), and triglycerides (TGs)).

Hong and Lien, (1984) also studied 11 men and five women athletes averaging 21 years of age, before and after four weeks of daily exhaustive exercise (six days a week) during an endurance training course. In comparing blood chemistries before and after training, concentrations of blood glucose, total serum lipids, serum triglycerides and serum cholesterol were significantly reduced; serum free fatty acid level was significantly increased and serum protein and serum phospholipid concentrations remained unchanged.

It was concluded that exhaustive training produces reduced blood glucose but not clinically significant hypo glycemia with increased fat utilization as a result of depletion of carbohydrate storage. Such training reduces the resting levels of serum cholesterol and serum triglycerides.

This study was supported by Sacakli *et al*. (1997) observed 16 obese females for a month of cycling exercise at the intensity of 60-70 % of their heartbeat, they found out that the pre-training fat percentage of 37.8 fell down to 33.27 after the training.

This finding supports the results of the study when the BMI values of the 16 female participants are examined, it is seen that they are above their normal weight and close to obesity. It is widely reported that physical activity can reduce the risk of heart diseases and cause positive changes in the antioxidant/pro-oxidant balance. Physical activity is also accepted to change the lipid and lipoprotein profiles.

The findings was also in agreement with study conducted by Barbara *et al*., (2009) conducted a study of the combined effect of resistance exercise on body composition and lipid profiles of older women and found a significant reduction in TG, HDL, in combination with aerobic exercise and concluded that a combination of aerobic exercise training is more effective than resistance training in improving body composition and lipid profiles.

The current finding of the study was dissimilar with the finding conducted by Linder et al., 21 examined the effect of an eight-week walk/jog program at heart rate (HR) intensity of 80 % of peak HR on 29 boys, ages 11-17 years. No effect was observed for TC, TG, HDL-C, or LDL-C. The inherent problem in this study was the inclusion of boys who are at differing maturational stages.

### 4.4.3. High density lipoprotein

The changes to high density lipoprotein took place under the influence of twelve weeks aerobic exercise program, and resulted positive significant changes. The pre and posttest results of the mean and standard deviation was from 38.2 ± 6.56 to 41.05 ± 3.79 respectively.

Reason for positive significant change might be due to;

The HDL-c- may appear to act as type of shuttle and it may be taken up cholesterol from the blood and body cells and transfers it to the liver. Where it may be used to form bile acids. The bile acids all in digestion process. With some of them passing out, thus providing the body the major route of excretion of cholesterol. The long duration progressive aerobic exercise may increase the utilization of fats. Which in turn increases the catabolism of bile in the liver, which may result increment of HDL-C- in the body of the training group (Fox *et al*., 1981).

The result of the current study was well-suited with the study conducted by Sasaki *et al*., (1987) conducted a study to find out if a long term aerobic exercise programme decreases the obesity index and increases the high density lipoprotein cholesterol concentration in obese children and concluded that a long term supervised aerobic exercise programme in obese children is beneficial and resulted in significant weight reduction with concomitant improvement of lipoprotein metabolism.

The finding of the study was also in line with the finding conducted by Gilliam and Burke, 1980 analyzed the effect of exercise on serum lipids a six-week study involving 14 female's ages 8-10 years. The subjects participated in various aerobic activities for 35 minutes per session. The results showed that a significant increase in HDL-C levels with no change in TC levels. The main flaw in this study was a lack of a control group. Additionally, intensity was described as "strenuous" but was not quantified, the length of the study was short (six weeks) and the frequencies of the exercise sessions were not reported.

The current result of the study was supported by the study conducted by Stefanick M.L *et al*., (1998) conducted a study of Exercise in low density along with loss weight can both lower lipoprotein cholesterol (LDL) concentrations and control the decrease in HDL-C. Excess body fat produces severe adverse consequences on health, such as high blood pressure and changes in lipid profile constituents, including total cholesterol (TC), high-density lipoprotein (HDL) cholesterol low-density lipoprotein (LDL) cholesterol), and triglycerides (TGs)).

The finding of the study was also in agreement with the study conducted by Blessing and Williford, (1995) done an experimental study for 16 week training on Blood lipid and Physiological responses in adolescents of the longest to date, their subjects were 25 males and females who ranged in age from 13-18 years.

The results showed that a positive alteration in TC, HDL-C, LDL-C, TC/HDL-C levels after the 16 weeks of exercise training. The inherent problem with this study was the inclusion of both males and females in the same study. Additionally, the age range of 13-18 years was too broad due to the differing maturational stages of this group.

The result study was in line with the study conducted by Barbara *et al*., (2009) conducted a study of the combined effect of resistance exercise on body composition and lipid profiles of older women and found a significant reduction in TG, HDL, in combination with aerobic exercise and concluded that a combination of aerobic exercise training is more effective than resistance training in improving body composition and lipid profiles.

Narayani and Sudhan, (2010) also supported the finding of the study on their study, the result of their study indicated that the body fat percentage and total cholesterol decreases and increase HDL

cholesterol in obese women after 6 weeks of endurance training. Low-calorie diet plus exercise can reduce body fat through a small cell size but does not change the number of cells.

The study was also supported by Thomas *et al*., (2007), in their investigated study lipid profile was improved after exercise, with a 10.6% increase in HDL levels in the experiment group. HDL-C is considered a major mediator of reverse cholesterol transport, a process whereby free cholesterol from peripheral tissues (such as arterial walls) moves back to the liver (Shah *et al*., 2001).

### 4.4.4. Low Density Lipoprotein

The changes to low density lipoprotein took place under the influence of twelve weeks aerobic exercise program, and resulted positive significant changes. The pre and posttest results of the mean and standard deviation was from 59.9 ± 15.14 to 45.25 ± 13.45 respectively.

Reason for positive significant change might be due to;

The HDL-c- may appear to act as type of shuttle and it may be taken up cholesterol from the blood and body cells and transfers it to the liver. Where it may be used to form bile acids. The bile acids all in digestion process. With some of them passing out, thus providing the body the major route of excretion of cholesterol. The long duration progressive aerobic exercise may increase the utilization of fats. Which in turn increases the catabolism of bile in the liver, which may result increment of HDL-C- in the body of the training group (Fox *et al*., 1981).

The LDL-C-c is comprises of TC and TG, which require for reproduction of HDL. Due to increment of HDL-C-c production and increment of fat as fuel for working muscle may be the main reason for significant decreases of LDL-C-of the experimental group (Fox *et al*., 1981).

The result of the study was supported by the study conducted by Blessing and Williford, (1995) done an experimental study for 16 week training on Blood lipid and Physiological responses in adolescents of the longest to date, their subjects were 25 males and females who ranged in age from 13-18 years. The 16-week training program involved 40 minutes of various aerobic activities at an intensity that was to approach 90% of previously determined peak work capacity.

Intensity was measured by the subjects obtaining a radial pulse. The results showed that a positive alteration in TC, HDL-C, LDL-C, TC/HDL-C levels after the 16 weeks of exercise training. The inherent problem with this study was the inclusion of both males and females in the same study. Additionally, the age range of 13-18 years was too broad due to the differing maturational stages of this group.

The finding was also line with the study conducted by Mathewos, (2013) Regular aerobic exercise has been shown to reduce the risk of heart disease, high blood pressure, type 2 diabetes, colon cancer and breast cancer. It can lower blood pressure and improve your blood cholesterol by reducing the levels of LDL-cholesterol (so-called 'bad' cholesterol) and increasing the amount of HDL-cholesterol (so- called 'good' cholesterol). It can also reduce anxiety, stress and depression, as well as instilling a general sense of well-beings. Regular aerobic exercise has been shown to have the potential to increase your lifespan.

The finding was in agreement with De Souza e Silva *et al*., (2009) studied Effects of two types of aerobic exercise on body fat content and lipid profiles in 45 university male-students. And the results showed significant decrease in body fat content, waist circumference, and LDL levels in both aerobic training and military exercises of the experimental group.

Marandi *et al*., (2013) also supported the findings of the study on their study investigated the effect of combined exercise program on indices of body composition, physical fitness and lipid profiles of mentally retarded young people and observed that the exercise group compared with the control group decreased their weight, BMI, waist circumference, fat mass, levels of LDL, TG, and cholesterol, while HDL levels significantly increased.

The result of the study was also in agreement with the findings conducted by Marandi *et al*. (2013) conducted a study the effects of extreme and moderate aerobic exercise on lipid profile and paraoxonase activity in healthy non-athletes male.

The results suggest the existence of significant differences in levels of HDL-C, the ratio of HDL-C to LDL-C as well as its ratio TG, diastolic blood pressure, $VO_{2max}$, resting heart rate and indexes of body composition between the control group and the group with aerobic exercise was so high and there was a significant difference between groups in the amounts of LDL-C, TC, and TG.

This study was also supported by Thompson, P.D., *et al*., (2004) ,study found that aerobic exercises of 8-week aerobic training cause LDL cholesterol levels to go down while increasing HDL cholesterol values, as a result, significant decrease in TRI, TC,FBS and LDL cholesterol levels was observed at the end of the 8-week aerobic training . According to the related literature, aerobic training increases HDL cholesterol and decreases LDL cholesterol levels.

The current result of the study was in line with the study conducted by Stefanick M.L *et al*., (1998) conducted a study of Exercise in low density along with loss weight can both lower lipoprotein cholesterol (LDL) concentrations and control the decrease in HDL-C. Excess body fat produces severe adverse consequences on health, such as high blood pressure and changes in lipid profile constituents, including total cholesterol (TC), high-density lipoprotein (HDL) cholesterol low-density lipoprotein (LDL) cholesterol), and triglycerides (TGs)).

But the result of the study was also different with findings conducted by Fisseha, (2016) investigated a study on effects of exercise on HDL-C and triglyceride levels. In the present study, as in several others before it, lipid profile was improved after exercise, with a 10.6% increase in HDL levels in the experiment group.

Conversely, there were no significant changes in TC, LDL-C or TG levels after our 12-week training program. This non-improvement may be due to the reduced number of individuals in both groups. However, other studies that in addition to physical exercise, also used nutritional guidance, found no differences in TC, LDL-C and TG.

The result of the study was also dissimilar with findings conducted by Stoedefalke Kerstin, (2007) examined the effect of an eight-week walk/jog program at heart rate (HR) intensity of 80 % of peak HR on 29 boys, ages 11-17 years. No effect was observed for TC, TG, HDL-C, or LDL-C. The inherent problem in this study was the inclusion of boys who are at differing maturational stages.

# 5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## 5.1. Summary

The purpose of this study was to investigate the effect of aerobic exercise on health related physical fitness components, physiological parameters and lipid profile of Mekelle University students. To achieve the objective of this study 20 male students were selected purposely from total population of 35, and aged between 19 and 22. Informal (pre-posttest) experimental design was used to conduct this study.

The exercise training was designed for twelve weeks, three days per week, and the duration was 40, 50, 60 minutes per session with moderate intensity (55-69HRmax). Each session had warming up, stretching exercise, main part (aerobic exercises), and cooling down. Throughout the study jumping ropes, stop watch, sphygmanometer, tread mill, colorimeter, test tube, stationery cycle bike, ruler, tape meter materials were used during test and training.

The collected data was analyzed using SPSS version 21 software, and paired "T" test was used to compare the pre and post results. The level of significance was fixed at $P \leq 0.05$.

Based on the analysis made, it was observed that twelve weeks aerobic exercise directed to positive significant change in measurement value of body mass, flexibility, body composition, cardiovascular endurance, diastolic blood pressure, systolic blood pressure, resting heart rate, total cholesterol, triglyceride, high density lipoprotein ,and low density lipoprotein ($p<0.001$).

Whereas there was no significant change on height of the students. As a result of the paired sample "T" test statistically significant differences were found in pretest to posttest mean comparison on the selected variables.

## 5.2. Conclusions

Based on the results of the study the following conclusions were made;

1. Twelve weeks aerobic exercise reveals significant improvement on the health related physical fitness components such as flexibility and cardiovascular endurance.
2. The result of the study showed that 12 weeks moderate aerobic exercise significantly reduced the body mass and body composition of the students.
3. The 12 weeks moderate aerobic exercise did not significantly changed the height of the students
4. The 12 weeks moderate aerobic exercise showed significant improvement in systolic blood pressure, diastolic blood pressure, and resting heart rate
5. 12 weeks of moderate aerobic exercise significantly reduced the total cholesterol, triglyceride, and low density lipoprotein.
6. 12 weeks moderate aerobic exercise significantly increased high density lipoprotein
7. Twelve weeks moderate aerobic exercise training was a suitable (appropriate) training system to improve the health related physical fitness components, physiological parameters, and lipid profile of the students.

## 5.3. Recommendations

Based on the conclusions of the study the following recommendations were made on the basis of this study.

- The students should exercise moderate aerobic exercise to improve their health related physical fitness components
- Students should exercise moderate aerobic exercise to reduce or minimize their blood pressure and resting heart rate
- Students should engage in moderate aerobic exercise to reduce their total cholesterol, triglyceride, and low density lipoprotein
- Students should engage in moderate aerobic exercise to increase their high density lipoprotein
- Similar studies can be conducted with the same variables by selecting the subjects from other environmental aspects

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# 7. APPENDICES

# APPENDICES A

## Information sheet and informed consent form for participants.

**Research title**; Effect of aerobic exercise on health related physical fitness components, physiological parameters and lipid profile of Mekelle University students, Ethiopia

You are being asked below to participate in this research study as described below. This research study will be carried out and governed by the regulations for research on human beings. These regulations require that the researcher should obtain a signed agreement from the participants of male first year sport science students. You can discontinue at any time from the study, if you choose to do so.

**Purpose of the study**

The purpose of this study is to examine the effect of twelve weeks aerobic training on health related physical fitness components and lipid profile of Mekelle university first year sport science male students. The finding of this study can contribute for human beings. More over the aim of this study is to write a thesis for the partial fulfillment of master program in sport medicine for principal investigator.

**Procedure and duration**

The experiment of the study period will take three months (twelve weeks). This study will involve 15 subjects from Mekelle university sport science first year male students. You will participate in moderate intensity training three days per week for twelve weeks. Participation in the study will not exceed sixty (60) minutes per day. Subjects will also participate on health related components of physical fitness and lipid profile two times at the beginning and at the end of 12 weeks aerobic training.

**Risks and Benefits**

If physical activity is performed during abnormal physiological condition, it would result in pain, eventually it may cause death. Therefore, you will not perform any physical activity if you feel one of the following signs: abnormal heart rate, too fast or too slow breathing rate, coughing etc. incase if face injury or pain, the researcher will give first aid treatment for the injured participants. If it is severe, the researcher will cover every cost for them to recover.

There is no payment for you because of the participation for this study. However, it is hoped that the society will be beneficial from this study by understanding the effect of twelve weeks aerobic training on health related physical fitness components and lipid profile and adjusting their life style in doing their daily routine.

**Confidentiality**

Your test result and other related personal informations will be kept confidential. The findings of the study will be general for the study subjects and will not reflect anything particular of individual persons. The data/results that are collected from students will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the research.

**Rights**

You have the right to declare to participate or not to participate in this study. If you provide a permission to participate, you have a full right to withdraw from the study at any time.

**Contact Address**

If there is any question or enquires about the study or procedure at any time please contact:

Student: Ashenafi Mengstu (0914371010)
Email:mengstuashenafi94@gmail.com
Major advisor: Desta Enyew (PhD) (0938310940)
Co. advisor: Negussie Bussa (Bpharm, PhD) (0910275526)
Any problem and complain can be addressed to IRERC (institution research ethics review committee) +2512566618997

**Declaration of informed voluntary consent:**

I read the participant information sheet. I clearly understood the purpose of the study, the procedures, the risks and benefits, issues of confidentiality, the right of the team on participating and the contact address for any queries. I have informed as I have the right to withdraw from the study at any time. Therefore, I declare my voluntary consent for the team to participate in this study with my signature as indicated below.

| Participant (student) | Investigator |
|---|---|
| Name: _____ | Name: _____ |
| Signature: _____ | Signature: _____ |
| Date: _____ | Date: _____ |

# APPENDICES B

## Health History and Physical Readiness Questionnaire for the Participants

For most people physical activity should not pose any problems or hazard. This physical readiness questionnaire (PAR-Q) has been designed to identify the small number of adults for whom physical activity might be in appropriate or those who should have medical advice concerning the type of activity most suitable for them. In order to identify Mekelle university male first year sport science students, filling all questions presented below will be vital for future progress.

For participants: please read the following questions carefully and indicate your correct response to each question by encircling it on the choice letter given.

1. Do you have a recent physical injury such as bone, muscle and joint which will be aggravated by physical exercise?

A. Yes B. No

If yes indicate the type of injury that you had_____

2. Do you have suffered with heart condition?

A. Yes B. No

3. Do you have any of the following risks for heart disease: for example High blood pressure, High blood cholesterol and any close relatives (father, mother, brother etc..?

A. Yes B. No

4. Have you ever felt pain in your chest when you do physical exercise?

A. Yes B. No

5. Have you ever suffered from shortness of breath at rest or with mild exercise?

A. Yes B. No

6. Is there any history of coronary heart disease within your family?

A. Yes B. No

7. do you ever feel feint, have spells of dizziness or have you ever lost consciousness?

A. Yes B. No

8. Do you currently smoke?

A. Yes B. No

9. Do you currently exercise regularly (at least 2 times per week) and/or work in a job that is physically demanding?

A. Yes B. No

10. Do you know any reason why you should not participating in a program of physical exercise?

A. Yes B. No

If yes indicate the reason that you know_____

I here by state that I have read, understand and answered honestly the questions above. I also state that I wish to participate in activities, which are aerobic exercise.

Client's full name: _____ trainer's name: _____

Client's signature: _____ trainer's signature: _____

Date: _____ Date: _____

(Mathewos, 2013.)

# APPENDICES C

## a) Twelve minute run/walk

Table 1 standard value of 12 minute run/walk test in meter

| Age | Excellent | Above average | Average | Below average | poor |
|---|---|---|---|---|---|
| Male 20-29 | >2800m | 2400-2800m | 2200-2399m | 1600-2199m | <1600m |
| Female 20-29 | >2700m | 2200-2700m | 1800-2199m | 1500-1799m | <1500m |
| Male 30-39 | >2700m | 2300-2700m | 1900-2299m | 1500-1999m | <1500m |
| Female 30-39 | >2500m | 2000-2500m | 1700-1999m | 1400-1699m | <1400m |
| Male 40-49 | >2500m | 2100-2500m | 1700-2099m | 1400-1699m | <1400m |
| Female 40-49 | >2300m | 1900-2300m | 1500-1899m | 1200-1499m | <1200m |
| Male 50 | >2400m | 2000-2400m | 1600-1999m | 1300-1599m | <1300m |
| Female 50 | >2200m | 1700-2200m | 1400-1699m | 1100-1399m | <1100m |

Cooper, (1968)

## b) Sit and reach test

Table 2 Standard value of sit and reach test in centimeter (cm)

| | Men | | Women | |
|---|---|---|---|---|
| | Cm | Inches | Cm | Inches |
| Super | >+27 | > +10.5 | >+30 | > +11.5 |
| Excellent | +17 to +27 | +6.5 to +10.5 | +21 to +30 | +8.0 to + 11.5 |
| Good | +6 to +16 | +2.5 to +6.0 | +11 to +20 | +4.5 to +7.5 |
| Average | 0 to +5 | 0 to +2.0 | +1 to +10 | +0.5 to +4.0 |
| Fair | -8 to -1 | -3 to -0.5 | -7 to 0 | -2.5 to 0 |
| Poor | -20 to -9 | -7.5 to -3.5 | -15 to -8 | -6.0 to -3.0 |
| Very poor | <-20 | -8.0 | <-15 | <-6.0 |

Wells and Dillon, (1952)

## c) Body mass index standard

Table 3 Standard value of Body mass index (BMI) in $kg/m^2$

| BMI (kg/m2) | Classification |
|---|---|
| <18.5 | Under weight |
| 18.5-24.9 | Healthy weight or normal |
| 25.5-29.9 | Over weight |
| 30.0-39.9 | Obesity |
| ≥40.0 | Extreme obesity |

(WHO, 2012)

## d) Normative data for blood cholesterol levels

Table 4 blood cholesterol level standards

| Parameter | Norm (mmol/L) | Norm (mg/DL) |
|---|---|---|
| | | |
| TC | Desirable: <5.2 | Low risk :<200 |
| | Borderline high:5.2-6.2 | Moderate risk:200-240 |
| | High :>6.2 | High risk:>240 |
| TG | Desirable:<2.3 | Desirable :<200 |
| | Borderline high:2.3-4.5 | Borderline high:200-400 |
| | High :4.5-11.3 | High risk:>400 |
| | Very high:>11.3 | |
| LDL-C | Desirable: <3.4 | Low:<100 |
| | | Desirable:100-129 |
| | Border line:3.4-4.1 | Borderline:130-159 |
| | High :>4.1 | High risk:160-189 |
| | | Very high risk:>190 |
| HDL-C | Men: desirable :>0.9 | Very low risk:75 |
| | Low:<0.9 | Average (1.0 risk ratio):45(men) 55(women) |
| | Women desirable:>1.42 | |

(Williams, 2002 as cited in Mulugeta Mekonen, 2013)

## e) Heart (pulse) rate (HR) range

Resting heart rate: while the normal resting heart rate for adult's ranges from 60 to 100 beats per minute. Conditioned athletes and other highly fit individuals might have normal resting heart rates of 40 to 60 beats per minute. The basic formula for calculating maximum heart rate is to subtract your age from 220. For moderate intensity physical activity, a person's target heart rate should be 50 to 70% of his maximum heart rate (Edward, 2010).

## f) Blood pressure standard

Blood pressure is the force that blood exerts against blood vessel walls. The pumping action of the heart generates blood flow. Blood pressure results when the flow is met by resistance from vessel walls. (Disabled world.com, 2012).

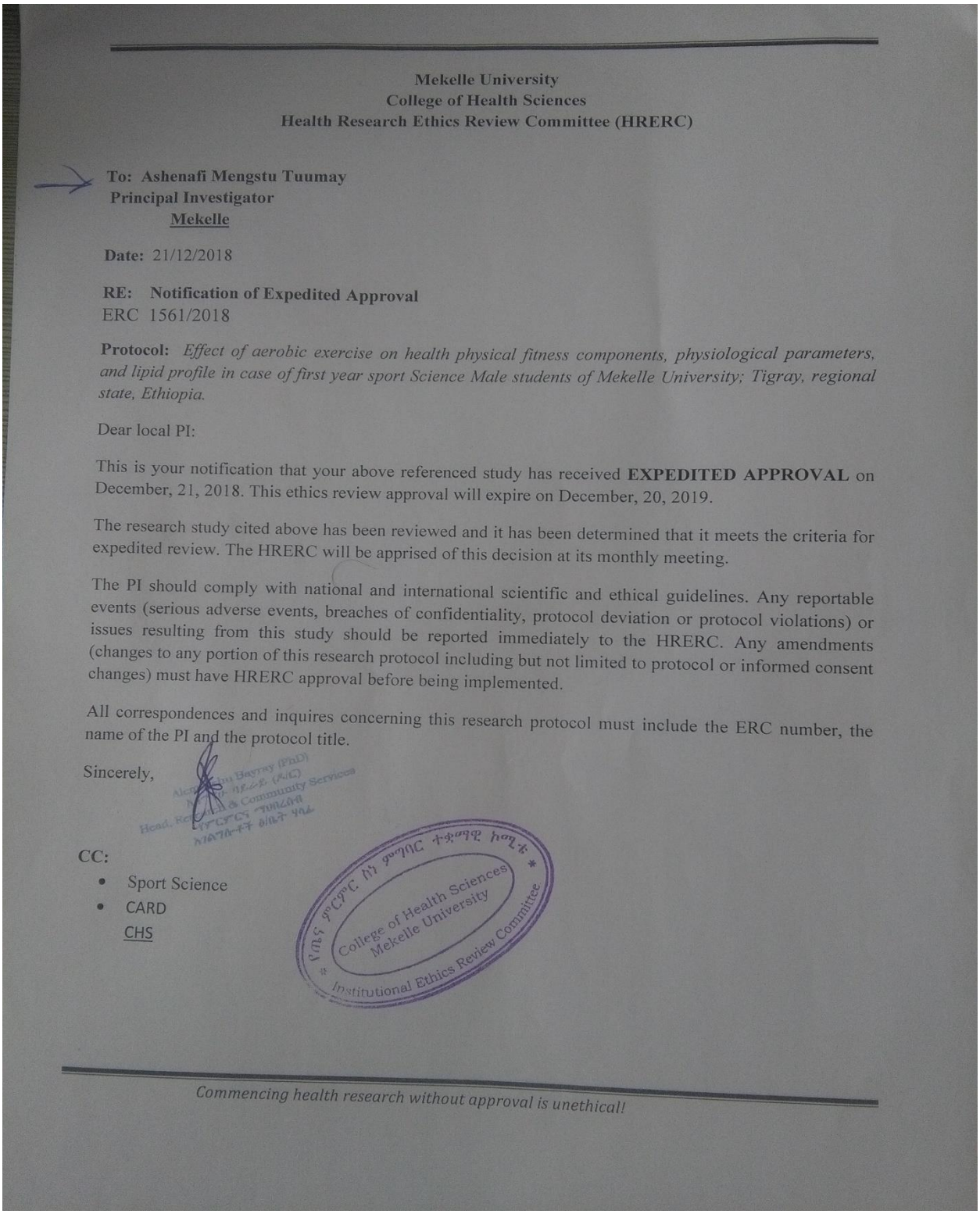
Table 5 Blood pressure standard

| Blood Pressure category | Systolic blood pressure (mmHg) (upper number) | Diastolic pressure (mmHg) (lower number) |
|---|---|---|
| Normal | less than 120 | less than 80 |
| Elevated | 120-129 | less than 80 |
| High Blood Pressure(Hypertension Stage 1) | 130-139 | 80-89 |
| High Blood Pressure(Hypertension Stage 2) | 140 or higher | 90 or higher |
| Hypertensive Crisis(Consult your doctor immediately) | higher than 180 | higher than 120 |

(Harvard Medical School, April, 2018)

# APPENDICES D

## Ethical clearance



**Mekelle University**
**College of Health Sciences**
**Health Research Ethics Review Committee (HRERC)**

**To: Ashenafi Mengstu Tuumay**
**Principal Investigator**
**Mekelle**

**Date:** 21/12/2018

**RE: Notification of Expedited Approval**
ERC 1561/2018

**Protocol:** *Effect of aerobic exercise on health physical fitness components, physiological parameters, and lipid profile in case of first year sport Science Male students of Mekelle University; Tigray, regional state, Ethiopia.*

Dear local PI:

This is your notification that your above referenced study has received **EXPEDITED APPROVAL** on December, 21, 2018. This ethics review approval will expire on December, 20, 2019.

The research study cited above has been reviewed and it has been determined that it meets the criteria for expedited review. The HRERC will be apprised of this decision at its monthly meeting.

The PI should comply with national and international scientific and ethical guidelines. Any reportable events (serious adverse events, breaches of confidentiality, protocol deviation or protocol violations) or issues resulting from this study should be reported immediately to the HRERC. Any amendments (changes to any portion of this research protocol including but not limited to protocol or informed consent changes) must have HRERC approval before being implemented.

All correspondences and inquires concerning this research protocol must include the ERC number, the name of the PI and the protocol title.

Sincerely,

Head, Research & Community Services

**CC:**

- Sport Science
- CARD
  CHS

College of Health Sciences
Mekelle University
Institutional Ethics Review Committee

*Commencing health research without approval is unethical!*

# APPENDICES E

## a) Training schedule for month one (December, 2018)

Table 6 Training schedule for month one (December, 2018)

| Day | Type of aerobic exercise | Time (minute) | Repetition | Rest | Duration | Intensity |
|---|---|---|---|---|---|---|
| TUESDAY | warming up | 5 | 1×5 | 30 seconds between each exercise | 40 minutes | moderate intensity (55-69HRmax) |
| | stretching exercise | 4 | 1×4 | | | |
| | jogging | 4 | 1×4 | | | |
| | aerobic dance | 4 | 2×4 | | | |
| | rope skipping | 4 | 2×4 | | | |
| | step up | 3 | 2×3 | | | |
| | cooling down | 5 | 1×5 | | | |
| THURSDAY | warming up | 5 | 1×5 | 30 seconds between each exercise | 40 minutes | moderate intensity (55-69HRmax) |
| | stretching | 4 | 1×4 | | | |
| | brisk walking | 3 | 1×3 | | | |
| | cycling | 4 | 2×4 | | | |
| | aerobic dance | 4 | 2×4 | | | |
| | step up | 3 | 1×3 | | | |
| | cooling down | 5 | 1×5 | | | |
| SATURDAY | warming up | 5 | 1×5 | 30 seconds between each exercise | 40 minutes | moderate intensity (55-69HRmax) |
| | stretching | 4 | 1×4 | | | |
| | jumping jacks | 3 | 2×3 | | | |
| | slow running | 4 | 1×4 | | | |
| | aerobic dance | 5 | 1×5 | | | |
| | cycling | 5 | 1×5 | | | |
| | step up | 3 | 1×3 | | | |
| | cooling down | 5 | 1×5 | | | |

## b) Training schedule for month two (January, 2019)

Table 7 Training schedule for month two (January, 2019)

| Day | Type of aerobic exercise | Time(minute) | Repetition | Rest | Duration | Intensity |
|---|---|---|---|---|---|---|
| TUESDAY | warming up | 5 | 1×5 | 30 seconds between each exercise | 50 minutes | moderate intensity (55-69HRmax) |
| | stretching exercise | 4 | 1×4 | | | |
| | jogging | 4 | 1×4 | | | |
| | aerobic dance | 4 | 2×4 | | | |
| | rope skipping | 4 | 2×4 | | | |
| | step up | 3 | 2×3 | | | |
| | treadmill run | 5 | 1×5 | | | |
| | cooling down | 5 | 1×5 | | | |
| THURSDAY | warming up | 5 | 1×5 | 30 seconds between each exercise | 50 minutes | moderate intensity (55-69HRmax) |
| | stretching | 4 | 1×4 | | | |
| | brisk walking | 3 | 1×3 | | | |
| | slow running | 4 | 1×4 | | | |
| | cycling | 4 | 2×4 | | | |
| | aerobic dance | 4 | 2×4 | | | |
| | step up | 4 | 2×4 | | | |
| | cooling down | 5 | 1×5 | | | |
| SATURDAY | warming up | 5 | 1×5 | 30 seconds between each exercise | 50 minutes | moderate intensity (55-69HRmax) |
| | stretching | 4 | 1×4 | | | |
| | jumping jacks | 3 | 3×3 | | | |
| | slow running | 4 | 1×4 | | | |
| | rope skipping | 4 | 1×4 | | | |
| | aerobic dance | 5 | 1×5 | | | |
| | cycling | 5 | 1×5 | | | |
| | step up | 4 | 1×4 | | | |
| | cooling down | 5 | 1×5 | | | |

## c) Training schedule for month three (February, 2019)

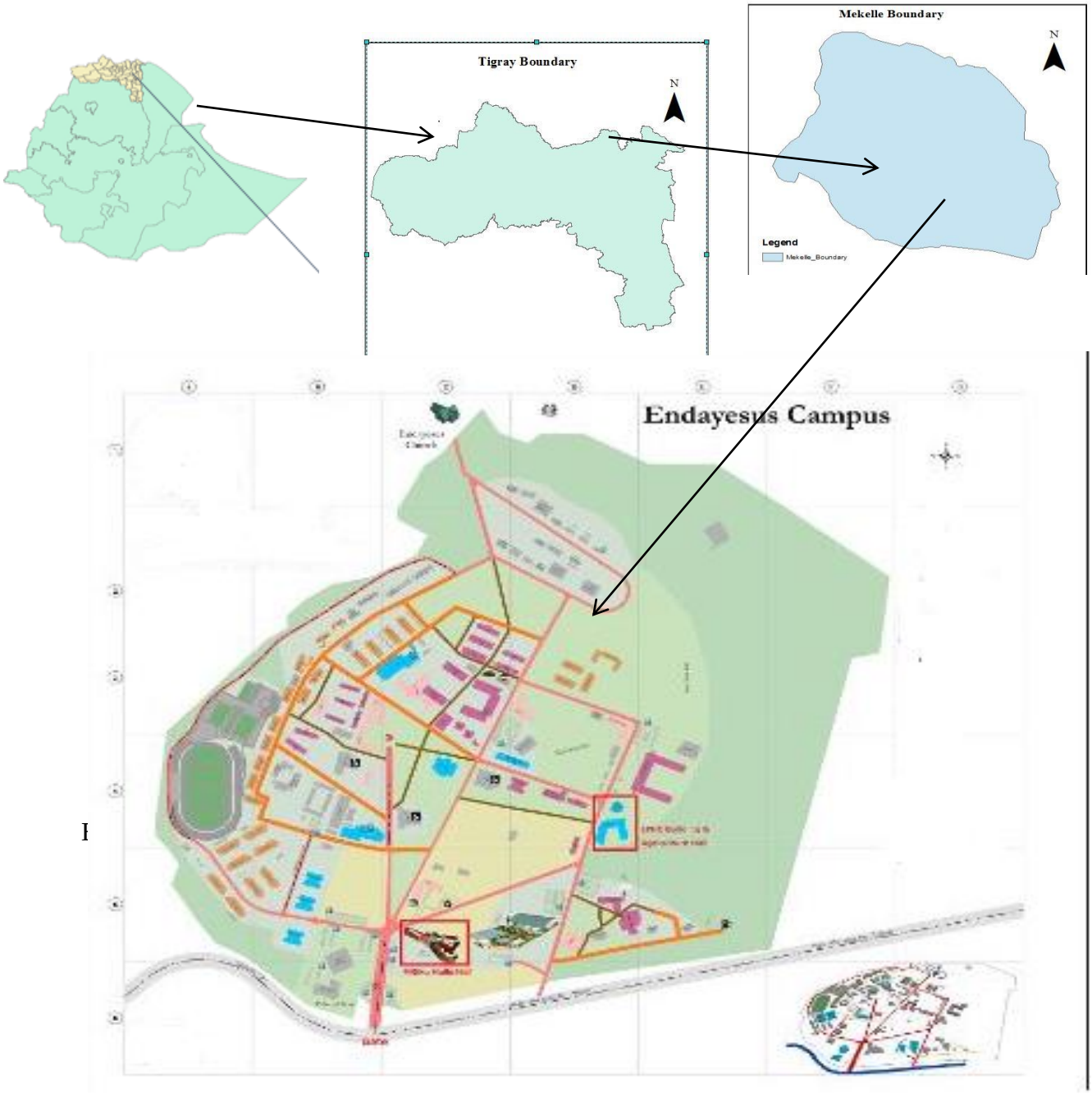
Table 8 Training schedule for month three (February, 2019)

| Day | Type of aerobic exercise | Time(minute) | Repetition | Rest | Duration | Intensity |
|---|---|---|---|---|---|---|
| TUESDAY | warming up | 6 | 1×6 | 30 seconds between each exercise | 60 minutes | moderate intensity (55-69HRmax) |
| | stretching exercise | 5 | 1×5 | | | |
| | jogging | 5 | 1×5 | | | |
| | aerobic dance | 6 | 2×6 | | | |
| | rope skipping | 4 | 2×4 | | | |
| | step up | 3 | 2×3 | | | |
| | treadmill run | 8 | 1×8 | | | |
| | cooling down | 5 | 1×5 | | | |
| THURSDAY | warming up | 6 | 1×6 | 30 seconds between each exercise | 60 minutes | moderate intensity (55-69HRmax) |
| | stretching | 4 | 1×4 | | | |
| | brisk walking | 3 | 1×3 | | | |
| | slow running | 4 | 1×4 | | | |
| | rope skipping | 4 | 2×4 | | | |
| | cycling | 4 | 2×4 | | | |
| | aerobic dance | 4 | 2×4 | | | |
| | step up | 4 | 2×4 | | | |
| | cooling down | 5 | 1×5 | | | |
| SATURDAY | warming up | 6 | 1×6 | 30 seconds between each exercise | 60 minutes | moderate intensity (55-69HRmax) |
| | stretching | 5 | 1×5 | | | |
| | jumping jacks | 5 | 2×5 | | | |
| | slow running | 5 | 1×5 | | | |
| | rope skipping | 5 | 2×5 | | | |
| | aerobic dance | 5 | 1×5 | | | |
| | cycling | 5 | 1×5 | | | |
| | step up | 4 | 1×4 | | | |
| | cooling down | 5 | 1×5 | | | |

# APPENDICES F

## Map of Study Site

Figure 1 map of the study site




Source; (Endale, 2017)