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Comparative Study on The Effect of Eight Week Of Aerobic and Combined Exercise on Selected Physiological Variables Among Female University

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SPORT ACADEMY

DEPARTMENT OF SPORT SCIENCE

COMPARATIVE STUDY ON THE EFFECT OF EIGHT WEEK OF AEROBIC AND COMBINED EXERCISE ON SELECTED PHYSIOLOGICAL VARIABLES AMONG FEMALE UNIVERSITY STUDENTS

BY

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TESFAYE DESALEGN (PhD)

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF BAHIR DAR UNIVERSITY SPORT ACADEMY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTERS OF SCIENCE IN EXERCISE PHYSIOLOGY.

JULY 2024

BAHIRDAR, ETHIOPIA

DECLARATION

This is to certify that the thesis entitled “Comparative Study on the Effect of Eight Weeks of Aerobic and Combination of Aerobic with Resistance Exercise on Selected Physiological variables. Submitted in partial fulfillment of the requirements for Master of **Exercise Physiology** in Department of Sport science, Bahir Dar University.it is a record of original work carried out by me and has never been submitted to this or any other institution to get any other degree or certificates. The assistance and help I received during the course of this investigation have been duly acknowledged.

Name of the candidate Date Place

_____ _____ _____

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APPROVAL OF THESIS FOR DEFENSE

I hereby certify that I have supervised, read, and evaluated the thesis entitled **"**Comparative Study on the Effect of Eight Weeks of Aerobic and Combination of Aerobic with Resistance Exercise on Selected Physiological Variables Among female university students**"** by Zemenu Desalegn prepared under my guidance. I recommended that the thesis be submitted for oral defense.

Advisor's name	**Signature**	**Date**
Department Head	**Signature**	**Date**

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APPROVAL OF THESIS FOR DEFENSE RESULT

We hereby certify that we have examined this thesis entitled Comparative Study on the effect of eight weeks of aerobic and combination of aerobic with resistance exercise on selected physiological variables. We recommend that it is accepted as fulfilling the thesis requirement for the degree of master of science in exercise physiology**.**

Board of Examiners

Name of External Examiner	**Signature**	**Date**
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Name of internal Examiner	**Signature**	**Date**
_____	_____	_____
Name of chairperson	**Signature**	**Date**
_____	_____	_____

DEDICATION

I dedicate this research to my father Mr. Desalegn Wube and the people who help me live in Addis Ababa. My father Mr. Desalegn Wube is the one who had great contributions to my life from childhood to this stage his constant encouragement and curiosity is great. He is my role model in all aspects of life. My friends and families in Addis Ababa for their continuous physical, emotional, and financial support throughout my educational career and life were great.

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Abstract

Regular physical activity is widely recognized as a crucial component of a healthy lifestyle. Mainly aerobic and combined exercises have wide-range of health benefits. This study aims to compare the effects of 8 weeks of aerobic (MIAE) and a combination of aerobic with resistance exercise (CEX) on selected physiological variables among female university students. The study involved 32 non-athlete female students' age of MIAE (22.188 ± 0.8342) and CEX (22.13 ± 0.719) years who participate 3 days/week for 8-week in MIAE and CEX training. The study design was a true experimental pre post design, and comprehensive sampling technique applied to select participants. The measured variables were blood pressure, resting heart rate, body fat percentages, and lean body mass. Finally, the data analyzed through a pair sample t-test and MANOVA with 95% confidence interval. The finding confirms that MIAE group found significant decreases in BP, RHR, and BF%, $p<0.05$ but no significant change on LBM ($p=0.729$). In CEX group demonstrated that reductions in BP, RHR and BF%, and increase in LBM ($p < 0.05$). CEX group was found better significance mean changes than MIAE in BP, BF%, and LBM. There was a statistically significant difference between MIAE and CEX on the combined set of physiological variables, $F(10, 21) = 3.003$;$p =0.016$; Wilks' Lambda (λ)=0.411;partial eta squared(η^2)=0.589. The Univariate contrast effect for each measure variable shows a significant effect on RHR: $F (1, 30) = 6.182$; $p = .019$ with (partial $\eta^2 =.171$) and LBM also statistically significant, $F (1, 30) = 4.755$; $p =.037$; (partial $\eta^2 =.137$). In conclusion, CEX was shown great statistical significant difference than MIAE on LBM, SBP, DBP and, BF% whereas MIAE showed a more significant reduction in RHR than CEX. Moreover, there were significant differences between MIAE and CEX groups only on RHR and LBM. Whereas there was insignificant difference between MIAE and CEX groups on SBP, DBP, and BF % on multivariate analyses results.

Keywords: physiological variables, Aerobic exercise, combined exercise

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Acronyms

AT - Aerobic training

BDU -Bahir Dar University

BF % - Body fat percentages

BP - Blood pressure

CEX - Combined exercise

CS - College students

DBP - Diastolic blood pressure

HRPF - Health-related physical fitness

RHR - Resting heart rate

LBM - Lean body mass

MHR - Maximum heart rate

MIAT - Moderate intensity aerobic training

PA - Physical activity

RT - Resistance training

SBP - Systolic blood pressure

VC - **Vital** Capacity

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

The amount of physical activity decreases from high school to college, and activity patterns among college students are typically insufficient to enhance fitness and health. Cardiovascular fitness in adults decreases with age. This decline is not linear as after the age of 45, fitness declined at an accelerated rate compared to adults and adolescence and university students were less active (Red et al., 2019).

Sedentary lifestyles are common in the modern world and represent a major contributor to many chronic non-communicable diseases. One of the biggest issues facing world health today is physical inactivity (WHO, 2018a). College students (CS) are at risk because of a sharp decline in physical activity (PA), which is particularly noticeable in youth (15–19 years old) and young adulthood (20–25 years old (Osmani & Perić, 2023).

Suhaimi et al.(2022) describes that if sedentary people start incorporating physical activity or exercise programs into their lifestyles, they can improve their overall health and prevent diseases. Exercise is beneficial because it lowers the risk of chronic disease, helps manage weight, and maintains fitness levels and anthropometric body indices. Peak oxygen consumption, respiratory exchange ratio, heart rate, body composition, and muscle strength all improved in sedentary individuals by exercise. Several levels of aerobic exercise may have varying effects on sedentary students' body composition and cardiovascular responses.

As Rather and Jain (2020) conducted a study on 30 adults their age ranging between 18 to 25 years get positive significant results. The study delimited to physical fitness variables i.e. cardio-vascular endurance, vital capacity, and Body Mass Index. After six weeks of training programmed workout that increases perspiration, forces you to breathe more forcefully, and quickens your heartbeat considered an aerobic exercise. Moreover, it fortifies your heart and

lungs and teaches your circulatory system to distribute and manage oxygen throughout your body more rapidly and effectively.

According to Mathewos Hosiso and Sangeeta Rani (2013), conducted study on health-related physical fitness variables in moderate-intensity aerobic exercise for 12 consecutive weeks, i.e. days per week 60-minute duration per day. Results show that Moderate aerobic exercise has a positive effect on the improvement of health-related physical fitness components of sedentary female communities. For any age group, regular aerobic exercise that adapts to the individual's level of fitness will have positive consequences. Exercise places additional demands on the body's systems beyond those of daily living, causing the systems to adapt physically and physiologically.

The results of the study Talebi (2021) found three training methods endurance, resistance, and concurrent training. Each Group performed its protocol for 8 weeks, 3 times per week with specified intensity and duration. Results show that for variables of aerobic fitness and body composition parameters, concurrent training was more effective than two other exercises. Exercise is a key factor in changing body composition, and in previous studies, the workout of exercise in concurrent exercises was not more than the workout of exercise in other groups of exercise. In addition, the participants had found more positive even though endurance and strength training result in specific, different, and sometimes may be opposite physiological adaptations.

Additionally, the study of (Schumann, 2019) demonstrates that exercise and health professionals as well as sports practitioners are similarly concerned about the optimal concurrent training mode in an attempt to maximize both aerobic and muscular adaptations. Endurance and strength create the foundation of sports performance and they are considered basic elements of physical fitness and health. In addition, global exercise recommendations strongly recommend both aerobic and strength training for improvements in physical fitness and health as well as the prevention of chronic diseases across the lifespan.

Songcharern et al.(2022) noted that adults with norm tension and hypertension who exercise aerobically experience less arterial stiffness. In this demographic data, cardiovascular risk

decreased by exercise since it may have cardiac protective qualities. Furthermore, several studies have shown that engaging in an aerobic exercise program enhances the cardiac autonomic function of young and early middle-aged healthy adults.

While in the study of Zhang and Min (2022), there is some uncertainty regarding the effects of resistance training (RT) on arterial stiffness and HR in normotensive and hypertensive adults. However, previous trials measuring RT's effect on these parameters have produced inconsistent results. For hypertensive patients, both aerobic and resistance exercises are advised by the American College of Cardiology/American Heart Association (Arnett et al., 2019). Research has shown that combining aerobic and RT can lower blood pressure more than either type of exercise alone.

Furthermore Pacholek et al. (2021) describe that combined training programs yielded benefits that were nearly identical to those of implementing each program separately. American College of Sports Medicine advises mixing aerobic and resistance training. Concurrent training remains largely unexplored and raises numerous unanswered problems. The impact of this training is a complex phenomenon that depends on a wide range of physiological and non-physiological variables, including the kind of exercise, training history, the muscle groups used, and inter-individual variances.

In the study of Mendonça et al. (2022) the training sessions were performed twice weekly for 12 weeks on body composition and muscular and cardiorespiratory fitness. Results indicate intervention groups had a significant reduction in body fat percentage and improvement in abdominal repetitions and VO2peak after 12 weeks of a combined exercise program. Research has indicated that CEX (aerobic plus resistance exercise) produces the biggest gains in overall strength and fitness when compared to any exercise modality done alone. MICT training in conjunction with the RT training technique applied in the recommendation of workouts for youth. Additionally, no study has examined the effects of two types of combined training on HRPF components of adolescents.

Therefore, based on previous literature evidence, this study investigating the effects of different types of exercise on physiological variables is important to provide evidence-based

recommendations for improving the health of university students. By comparing the effects of aerobics and a combination of aerobic with resistance exercise, the study aims to contribute to the existing knowledge and provide insights into the most effective exercise regimen for university students. Moreover, it is crucial to promote and encourage exercise among university students. However, there is a need to compare the effects of these two types of exercise and their combination to determine the best exercise regimen for improving physiological variables among university students.

1.2 Statement of the Problem

The primary intention of the investigator was not solely to investigate the effects of aerobic and combined exercise. However, the investigator is motivated to compare different physiological outcomes between these two distinct exercise interventions within the context of female college students.

There are studies, conducted on the effect of aerobics and the combination of aerobic with resistance exercise on cardiovascular fitness, blood pressure, and body composition among adults. Among those, Sivaraman (2014),Kumaravelu,(2019) Methenitis (2018)and Mustedanagić et al.(2016) conducted an aerobic exercise on physiological parameters as follows.

Sivaraman (2014) carried out on college students in the age of the subjects ranged from 18 to 25 years aerobic exercises given for three days per week for eight weeks. There was a significant change in aerobic training on selected physical and physiological variables like cardiovascular endurance and resting pulse rate. In addition, it has a significant improvement in selected criterion variables on cardio-respiratory endurance. Therefore, there was a significant decrease in resting pulse rate after aerobic training.

Likewise, Kumaravelu (2019) argue that aerobic exercises three days per week for eight weeks on cardiovascular adaptations. Because of endurance training regular participation in aerobic exercise often results in a decrease in resting heart rate. The finding of the study shows that significant changes exist in aerobic training endurance, cardio vascular endurance, resting heart rate, and vital capacity.

While in the study Mustedanagić et al.(2016) changes were noted in female students aged from 22 to 25. The exercise model realized three times a week, for 8 weeks in the variables of cardiorespiratory fitness, precisely systolic arterial blood pressure and heart rate. Results from the findings in the case of body composition, a reduction in skinfolds and Body Fat occurred, and a significant increase in Lean Body Mass. The result realized that aerobic exercise shall be recommend as a part of the program for the reduction of body mass of female college students.

There are also studies on the effect of combined exercise such as those (Schroeder et al., 2019)Tan et al.(2023), Zhang and Min (2022) and Park et al.(2020) carried out as follows.

According to Schroeder et al.(2019) a combination of aerobic and resistance exercise benefits exist in all three exercise groups had an equal total exercise time, 3 days/week (aerobic: 60 minutes/session vs. resistance: 60 minutes/session vs. combination: aerobic 30 minutes/session plus resistance 30 minutes/session). Combined training provided significant reductions in peripheral (-4 mmHg) and central diastolic BP (-4 mmHg and an increase in lean body mass (0.8 kg). The combination of aerobic and resistance exercise could have an additive effect and further decrease the risk of CVD risk factors.

Topsakal et al. (2019) investigated that the intervention applies for 8 weeks, 3 days per week, and 1 hour per day on aerobic and combined exercise. However, in numerical terms, the development of the combined training group was at a higher level than the aerobic training group. Additionally, aerobic training was more effective for decreasing body fat and body mass while strength training was more effective to increase fat-free body mass or preserve existing body mass.

Whereas, Tan et al. (2023) found that both aerobic exercise and resistance exercise are beneficial for increasing muscle mass, strength, and function. The question remains whether combining these two types of exercise yields superior results compared to performing either exercise modality alone or not. Aerobic training consisted of 30-minute aerobic interval training sessions three times a week with a total of 60 min work bouts in each at 60–70% of heart rate reserve (HRR) intervention training program lasted for eight weeks. Some recent studies indicated no interference effect of aerobic training when combined with strength training. In addition, there is

limited research on the effects of combining aerobic and resistance exercise on change in physiological changes.

In contrast, Zhang and Min (2022) conducted study on combined resistance- and aerobic-exercise interventions on female college students. They concluded compensatory or additive effects on cardiovascular and muscular function, which are greater than either operating alone. Resistance exercise has beneficial effects on enhancing skeletal muscle mass, strength, and power. However, the impacts of resistance exercise training on blood pressure (BP) and arterial stiffness remain ambiguous since the exercise intervention-mediated outcomes are inconsistent with different exercise intensities, ages, and health conditions.

In the study of Methenitis (2018) carried out that individuals/athletes experience strength adaptations that are negatively affected after combined training, while others experience significant gains with CT. However, there are still a lot of unresolved problems regarding the reasons for the participants' differing responses and adaptations following CT. CT is a complex phenomenon that influences a range of physiological and non-physiological factors, including the type of exercise, training history, targeted muscle areas, inter-individual differences, etc.

The results mentioned above demonstrate that there were inconsistencies or controversial results regarding to benefits of aerobic and combination workouts. Some studies have concluded that the combination does not provide any additional benefits beyond either aerobic or resistance training alone. However, other researchers found that the combination of aerobic and resistance exercise does offer more benefits compared to either type of exercise alone.

Most studies support the added benefits of the aerobic-resistance combination, while other researchers have not found any extra advantages. So investigator was motivated to do more high-quality studies to determine the comparative effects of these exercise modalities when performed together versus separately.

Even though certain scholars have focused on a comparative effect of an intervention, however, they conducted on patients, men, and middle-aged individuals, so investigators were interested in filling this gap and monitoring changes in healthy, inactive adult female students who are normotensive and healthy.

Students often exhibit low levels of physical activity, placing them at an increased risk for chronic health conditions later in life. Similarly, in Bahirdar University most students have a poor culture for participation in regular physical exercise. Therefore, investigator starts looking into this topic, to address this knowledge gap, by comparing the outcomes of two intervention programs.

1.3 Objective of the Study

1.3.1 General Objective

The general objective of this study was to investigate the comparison effect of 8 weeks of aerobics and a combination of aerobic with resistance exercise on selected physiological variables among university students.

1.3.2 Specific Objectives

In addition, this study has the following specific objectives.

1. To examine the effects of 8 weeks of aerobic versus combined exercise on resting blood pressure among university students.
2. To determine the effects of 8 weeks of aerobic versus combined exercise on resting heart rate among university students.
3. To evaluate the effects of 8 weeks of aerobic versus combined exercise on body fat percentage among university students.
4. To assess the effects of 8 weeks of aerobic versus combined exercise on lean body mass among university students.
5. To compare 8 weeks of aerobic versus combined exercise on multivariate effect of combined physiological variables.

1.4 Hypothesis

The study aims to test the following hypotheses regarding the effects of 8 weeks of aerobic exercise versus combined aerobic with resistance exercise on physiological parameters among university students:

1. There is a significant difference in the effects of 8 weeks of aerobic vs. combined exercise on resting blood pressure among university students.

2. There is a significant difference in the effects of 8 weeks of aerobic vs. combined exercise on resting heart rate among university students.

3. There is a significant difference in the effects of 8 weeks of aerobic vs. combined exercise on body fat percentage among university students.

4. There is a significant difference in the effects of 8 weeks of aerobic vs. combined exercise on lean body mass among university students.

5. There is a statistically significant effect difference on 8 weeks of aerobic versus combined exercise on multivariate effect of combined physiological variables.

1.5 Significance of the Study

This study has the following significance.

First, the study looks at how these exercise modalities affect physiological variables and offers insightful information about how effective each is in terms of improving cardiovascular health in this age group.

Secondly, the study offers vital information on the potential additive benefits of combining resistance training with aerobic exercise by directly comparing the changes in blood pressure, cardiovascular fitness, and body composition that resulted from aerobic and combined exercise interventions. Planning and carrying out efficient exercise programs to address the cardiovascular health and body composition of sedentary university students and adults would be significantly impacted by the evidence presented here.

Thirdly, this study offers valuable insights for fitness instructors on exercise recommendations. The findings can assist fitness instructors in creating more successful intervention plans to motivate college students and young people and other to engage in regular physical exercise. Finally, it served as an important resource for those researchers who want to pursue similar studies.

1.6 Delimitation of the Study

Conducting the study in all physiological variables including cardiorespiratory, cardiovascular fitness lactate, and vo2 max was challenging, complex, time restrictions, and could face financial challenges and unmanageable for the investigators. Therefore, to make the study more specific and manageable this study mainly focuses on body composition (body fat percentages &lean body mass), blood pressure, and cardiovascular fitness (resting heart rate).

The study designed to investigate a comparison study on the effect of Change in the effect of eight weeks of aerobics and a combination of aerobic with resistance exercise on selected physiological variables among university students. The study involved 32 female students from Bahirdar University's main Campus College of Science students.

The reason the investigator was interested in studying this physiological variable is non-athlete populations these parameters are good health indicators of lifestyle and impacted by exercise habits. Non-athletes are frequently concerned about factors like muscle mass, body fat percentage, and overall body weight. Finally, the effects of exercise tend to be more noticeable and visible in beginners compared to those who are already highly trained. As individuals start an exercise regimen, the initial adaptations in cardiorespiratory fitness, body composition, and other markers can be quite dramatic.

1.7 Operational Definition of Key Terms

An operational definition is the description of the core /basic/ words found in the study.

- **Aerobic exercise**: refers to exercise that involves oxygen consumption by the body in the body's metabolic or energy-generating process (Ahmad & Amravati, 2016).
- **Blood pressure**: The force exerted by your blood against the walls of your arteries as it circulates through your body (Yue & Hong, 2023).
- **Body fat percentage**: Refers to a measurement of the amount of fat mass a person has relative to their total body mass (Jha et al., 2018).
- **Combined exercise**: Refers to a workout that incorporates both cardio and strength training exercises within the same training session (Mendonça et al., 2022).

- **Lean body mass (LBM):** is a component of your body composition that refers to the weight of everything in your body except for fat tissue (Shiotsu & Yanagita, 2018).
- **Resting heart rate**: refers to the number of times the heart beats per minute (bpm) when at complete rest, in a relaxed state (Reimers et al.,2018).
- **Young adulthood**: The ages range of 19-24years characterized by significant transitions and developments across various aspects of life (Sivaraman ,2014).

1.8 Organizational structure

This experimental research organized into six chapters. The first chapter deals with an introductory part of the background of the study, a statement of the problem, research objectives, and a hypothesis on selected physiological parameters. In addition, significance, delimitation, limitation, the definition of operational terms, and the organization of the study are also included.

The study conceptualized the review of related literature in which basic terms and related ideas deal with the second chapter. The concern of chapter three is on the methods of the study, particularly, the description of the study area, research design, population, sampling and sampling technique, source of data, instruments of data collection, method of data analysis, and research ethics, privacy and confidentiality were discussed. Chapter Four presents the results of the study, which presents the study data analysis, Chapter Five deals with discussion and implication, and the last chapter six studies about summary, conclusion, and recommendation part of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 An Overview of Regular Exercise for Health

Alves et al.(2021) described although widespread reports of the positive health consequences of physical activity, there is still a significant percentage of physical inactivity in the world. The current worldwide exercise recommendations state that to improve physical fitness and health significantly, participants should engage in either vigorous or moderate-intensity physical activity for a total of 150 to 300 minutes per week or 75 to 150 minutes per week, respectively. Regretfully, new research indicates that the majority of people worldwide do not exercise to the recommended levels, which causes 38.5% of men and 39.2% of women to be overweight.

The study of Topsakal et al.(2019) found that the results of aerobic and combined training were similar, and both aerobic and combined training positively affected body weight, body mass index, body fat percentage, and aerobic capacity values. The intervention applies for 8 weeks, 3 days per week, and 1 hour per day. Certain ailments (such as posture issues, obesity, hypertension, and others) that have been around for a while but have received little attention have become more prevalent because of immobility. In addition to societal issues, immobility can lead to personal issues. In addition, participating in sports encourages people to live more active and high-quality lives. Moreover, it believes that Immobility is one of the most important general health problems of the 21st century.

It is common knowledge that leading an active lifestyle is crucial to overall health. Exercise is one of the most important things a person can do to lower their risk of sickness, along with maintaining a healthy diet. Physical activity plays a major role in a healthy lifestyle. The evidence clearly shows that regular physical activity improves physiological and psychological health (Kilpatrick, Hebert, & Bartholomew, 2005). People of all ages, both male and female, benefit from regular activity (Manley, 1997). The role of physical activity for the promotion of health is globally recognized Frequent exercise lowers the chance of developing conditions like

diabetes, cancer, stroke, obesity, osteoporosis, liver and kidney disease, and mental illnesses like depression and dementia (Red et al., 2019).

Overall health can improve and diseases prevented if sedentary people start changing their physically inactive lifestyles by involving physical activity or exercise programs. Exercise is good for improving health and subsequently reduces the risk of chronic disease, weight management, maintenance of fitness level, and anthropometric indices of the body. (Ismail, et al., 2013) Exercise helps to improve peak VO2, respiratory exchange ratio, heart rate, body composition, and muscular strength among sedentary people. Different intensities of aerobic exercise can have varying effects on enhancing cardiovascular responses and decreasing body composition in inactive students (Suhaimi et al., 2022).

2.2 Impact of Regular Exercise on Health for Young Adulthood College Students

The physiological parameters of adolescents and young adults might not always be in the best of health. According to a study, when comorbidities are present, identifying physiological parameter risk factors at a younger age is a better predictor of the development and severity of possible chronic diseases. Because they participate in unhealthy habits that differ from those of the general adult population, like binge drinking and physical inactivity, college students are more likely to develop chronic illnesses. Higher incidence of chronic illnesses, such as elevated blood pressure, elevated blood serum cholesterol, and increased body mass index (BMI), are associated with college students (Black et al., 2017).

Aerobic exercise helps the function of body organs, especially the heart will be better so that it can improve the degree of individual health. Aerobic exercise done regularly and continuously also with the right intensity will make improvements to the function of the body's organs, especially the heart such as a decrease in pulse rate. Aerobic exercise leads to the efficiency of the heart's work so that the heart will beat less than the untrained heart. Aerobic exercises which carried out continuously and regularly would increase the degree of fitness when done 3 times a week. The exercise can be done for 30-60 minutes each time with the intensity of the exercise is 60-85% of the maximum pulse rate(Agus et al., 2021).

2.3 The Concept of Aerobic Exercise

Aerobic is the term coined by Dr. Kenneth H Cooper M.D. in 1968 who was an exercise Physiologist in U.S. Air Force, HE did his first research in the 1960s on over 5000 U.S. Air Force personnel. He has since written 18 books and was named “the father of aerobics”. Aerobic exercises (also known as cardio) are physical exercises of relatively low intensity that depend primarily on the aerobic generating process. Aerobic means “living in air” and refers to meeting energy demands during exercise via aerobic metabolism. Long periods are spent participating in light to moderate-intensity activities that are adequately sustained by aerobic metabolism. The range of intensity to aim for is 60-85% of the maximum heart rate (Ahmad & Amravati, 2016).

Aerobic is a complex system of body supply and demand that is, the body needs energy to perform any type of action, and the food we eat fuels this requirement. Exercise regimens improve lung function, strengthen the heart muscle, and have many other positive effects. Aerobic exercise is any type of physical activity that increases heart and lung activity for a length of time that is long enough to cause positive changes in the body. Exercises classified as aerobics or endurance involve the extended usage of large muscular groups in a rhythmic, repeated manner. There was a significant improvement in selected criterion variables namely muscular endurance and cardio-respiratory endurance. There was a significant decrease in resting pulse rate between the aerobic training group and the control group (Sivaraman, 2014).

Any physical activity that increases perspiration forces you to breathe more forcefully, and quickens your heartbeat is considered aerobic exercise. It fortifies your heart and lungs and teaches your circulatory system to distribute and manage oxygen throughout your body more rapidly and effectively. Large muscular groups worked during aerobic activity, which has a rhythmic quality and may be sustained for at least ten minutes. Your heart and the blood vessels that carry blood throughout your body, such as veins, arteries, and capillaries, make up your cardiovascular system. When you exercise, your body uses oxygen to meet energy demands during exercise and This process is known as aerobic exercise(Rather & Jain, 2020).

2.4 Combined Exercise and Its Health Benefits

Robert C. initially described the concept of combined training (CT), or the simultaneous training of strength and endurance, in 1980. The definition of endurance sport is the capacity to sustain or replicate a specific force or power output. Strength is defined as the ability to exert force; it is a skill that has a magnitude range of 0 to 100%. Together, these different activity modes are used in several sports, including football, rugby, swimming, and decathlon. In the past two decades, concurrent programs have received much attention as a form of training (Spencer et al., 2016).

Independent of age or gender, combining resistance and endurance exercise in a training program produces better adaptations in health-related and body function variables, such as lipid emic profile, body composition, insulin sensitivity, glucose/lipid metabolism, and basal metabolic rates. Research shows compelling evidence that adaptation to resistance training is not repressed but rather strengthened during CT. Moreover, it appears that the athletes' capacity for endurance increases more following CT than it does when endurance training is done alone. Nonetheless, there has been new speculation that long-term CT programs can hinder well-trained runners' adaptations to endurance training (Methenitis, 2018).

According to studies conducted by Jha et al. (2018), there are still disagreements among coaches about the value of strength training for endurance athletes. Resistance and endurance training are training approaches with different adaptations that are at opposite ends of a continuum. Concurrent exercise in prior research is beneficial for preserving and maximizing fitness levels. Long-term consequences change the human body's physiology and body composition. The outcomes of a combination of aerobic and resistance training programs were studied in the American College of Sports Medicine.

According to Nader (2016) Strength and endurance training produce widely diversified adaptations, with little overlap between them. Strength and muscle mass usually increase with strength training. On the other hand, increases in maximal oxygen absorption and metabolic adaptations brought about by endurance training result in a higher exercise capacity. Strength and endurance training must be combined in many sports to increase performance; however, when strength and endurance training are done at the same time, there may be interference with the development of strength, which makes this combination seem incompatible.

Adolescents ought to engage in combination training (CT), which combines resistance and aerobic exercise in a single session. Research has indicated that when comparing any exercise modality done alone to CT (aerobic plus resistance training), the most gains in overall strength and fitness were seen. The bulk of combined training treatments for young people are created in a sporting environment, according to a systematic review by Gabler et al. There is insufficient data about the effect of CT on HRPF components. Additionally, no study has examined how two combined training approaches affect HRPF components in youth (Mendonça et al., 2022).

2.5 Role of Aerobic Exercise for Health Improvement

(Kumaravelu, 2019) states that aerobic exercises improve lung function, strengthen the heart muscle, and have many other positive effects. Exercises classified as aerobics or endurance involve the extended usage of large muscular groups in a rhythmic, repeated manner. The heart can constantly pump enough blood that is rich in oxygen to the muscles, allowing them to use fat and glycogen for aerobic energy production. Because it improves heart, circulation, and muscle function, aerobic exercise is the most important type of exercise for health. The foundation of fitness is aerobic exercise, which expands the body's capillary network.

According to Esleman et al. (2022) aerobic exercise causes positive changes in the body and mind and stimulates the heart, lungs, and all muscle groups. Regular aerobic exercise can reveal many physiological changes. More blood vessels are created to transport the oxygen that is flowing through the body and into the muscles during aerobic exercise, allowing the physiological processes to continue without undue tiredness. Additionally, it causes blood vessels to enlarge. These blood artery modifications increase the amount of nutrients and oxygen that reach the muscles and subsequently remove waste.

Significant changes in the cardiovascular reactions to exercise in aerobic training. A roughly 20% increase in plasma volume is what causes the cardiovascular alterations. There is a slight rise in red blood cell mass as well, which lowers the hematocrit. Improved oxygen transmission is possible by the reduced blood viscosity and increased red cell concentration. Because of a higher end-diastolic volume and an increase in venous return, the increase in total blood volume permits an increase in stroke volume. Secondly, a lower total peripheral resistance and

myocardial hypertrophy lead to an increase in left ventricular contractility, which in turn lowers the end-systolic volume. A reduction in heart rate, which can happen at rest or during submaximal activity at the same power output, is linked to an increase in stroke volume(Physician, 2015).

2.6 Physiological Effect of Exercise

Physiologic age- and gender-specific health parameters identified and examined in adults for several decades, especially regarding the development of chronic diseases such as cardiovascular, diabetes, cholesterol, and hypertension. Primarily physiologic health outcomes are due to a myriad of complex factors, such as health-related behaviors, which vary by age and gender. Developing physiologic parameters for a specific homogenous segment of a population would enhance the sensitivity, specificity, and accuracy of screening measures for that population segment (Black et al., 2017).

Harsoda (2018) carried out for 12 weeks Interventions with the supervision of the physical trainer. Evidence confirms that from the study regular physical work not only increases the functional capacity of organisms but also decreases the risk of various diseases in women. Exercise has been a means of evaluating the physical capabilities, form the basis of good health and welfare and it develops the ability to tolerate, withstand stress, and keep on in circumstances where an unfit person cannot continue. Which includes walking, jogging, running, skipping, dancing, swimming and bicycling. Exercise training is important for the improvement of cardiorespiratory efficiency, work performance, and the functioning of other systems and is known to reduce morbidity and mortality from numerous chronic ailments.

In the study of Ayaleneh et al.(2016) male and ten female students participated in different physical training programs of varying intensities for 3 consecutive months, i.e. That is, three days a week for an entirety of sixty minutes a day. Based on the findings, concluded that intensified physical training had a positive effect on the performance and physiological changes of the subjects. The Most beneficial effects of physical activity on cardiovascular disease mortality are attained through moderate-intensity activity (40% to 60% of maximal oxygen uptake depending on age.

Exercise offers several physiological advantages, two of which are enhanced muscle function and strength as well as an increase in the body's capacity to take in and utilize oxygen (also known as maximal oxygen consumption or aerobic capacity). With improved oxygen transmission and utilization, one can carry out daily tasks with less weariness. Patients with cardiovascular disease, whose ability to exercise is usually lower than that of healthy individuals, should pay special attention to this. Additionally, there is proof that exercise training enhances the blood vessels' ability to dilate in response to hormones or activity, which is associated with greater vascular wall function and an enhanced capacity to supply oxygen to the muscles during exercise(Whiteley et al., 2012).

According to (Topsakal et al., 2019) study was conducted on 32 participants who continued their training and health fitness. Participants were divided into 2 groups: an aerobic group (16 people) and a combined group (16 people). This study applied for 8 weeks, 3 days per week, and 1 hour per day. Results showed that the results of aerobic and combined training were similar, and both aerobic and combined training positively affected body weight, body mass index, body fat percentage, and aerobic capacity values. People who do not participate in sports are more likely to develop hypokinetic illnesses like heart disease, hypertension, obesity, and disorders of the muscles and bones that are associated with an immobile lifestyle. Whereas being physically active is the simplest method to prevent these illnesses. In addition, it helps to avoid heart disease, diabetes, high blood pressure, anxiety, depression, osteoporosis, and even some types of cancer and early death.

Regular physical activity or exercise may cause a reduction in RHR, and RHR appears to be positively correlated with cardiovascular and all-cause mortality and inversely related to life expectancy. Studies on relationships concluded that the total number of heartbeats in a lifetime is surprisingly consistent. Additionally, he computed the mathematical expression of the inverse relationship between RHR and life expectancy in mammals, finding that an average lifetime would involve $7.3 \pm 5.6 \times 108$ heartbeats (Reimers et al., 2018).

Whereas the study by Suhaimi et al. (2022) describe training given 3 times per week for 4 weeks 60% of HRR concluded that four weeks of different exercise intensities revealed no effects on

the decrease in blood pressure responses, but it might also have an impact on a lower RHR. Exercise is good for improving health and subsequently reduces the risk of chronic disease, weight management, maintenance of fitness level, and anthropometric indices of the body. Exercise helps to improve peak respiratory exchange ratio, heart rate, body composition, and muscular strength among sedentary people. Aerobic exercise with several intensities may have different effects in improving cardiovascular responses and lowering body composition among sedentary students.

2.7 Study of the Effect of Aerobic Exercise on Some Physiological Variables

2.7.1 Effect of Aerobic Exercise on Blood Pressure (SBP, DBP)

Cardiopulmonary endurance and physical fitness are particularly important for the physical health of college students. College students' physical well-being is ensured if these two metrics successfully rise. This research establishes the efficacy of aerobics training in raising the physical fitness and cardiovascular endurance of college students through numerous studies. Specifically, it has the potential to greatly enhance the five measures of resting heart rate, systolic blood pressure, and diastolic blood pressure in college students (Yue & Hong, 2023).

As Wen and Wang (2017) carried out a study on meta-analysis conducted in 8- and 12-week findings acknowledged that aerobic exercise might play a crucial role in the reductions of SBP and DBP. Aerobic exercise is one of the non-pharmacological treatment methods and it is recommended by European and American hypertension guidelines to reduce blood pressure. Moderate-intensity aerobic exercise has been shown to lower systolic and diastolic blood pressure (SBP and DBP, respectively) in patients with essential hypertension in pre- or stage 1 who are male or female.

In people with high blood pressure, a suitable exercise regimen has shown to be just as effective at lowering blood pressure as most antihypertensive drugs. Moreover, compared to medication, exercise has few negative effects. Research suggests that moderately intense aerobic exercise can lower both SBP and DBP in hypertensive individuals. The American College of Sports Medicine's most recent recommendations state that most people with hypertension should engage

in moderate-intensity aerobic activity for 30 to 60 minutes per day. Aerobic exercise is an effective non-pharmacological therapy for lowering blood pressure in patients with hypertension, according to accumulating evidence from randomized control trials (RCTs) (Jabbarzadeh Ganjeh et al., 2023).

2.7.2 Study on the Effects of Aerobic Exercise on Heart Rate

Kemi and Wisløff (2010) Point out to compare the effects of endurance training with endurance strength training on the anthropometric, body composition, physical capacity, and circulatory parameters in women. Exercise given for 3 months, 3 times/week, for 60 min. Results show that Significant decreases in body mass, BMI, total body fat, total body fat mass, and waist and hip circumference were observed after both types of intervention. Marked increases in total body lean and total body fat-free mass were documented in a combined group. Training for chronic endurance produces many physiological changes that are advantageous to the entire body, but especially to the heart and systemic circulation. Training in endurance exercises enhances the skeletal locomotor muscles' work capacity and raises blood perfusion by elevating the ratio of muscle fibers to capillaries.

According to Reimers et al.(2018) numerous studies have demonstrated that life expectancy and disability-adjusted life expectancy can be increased by engaging in regular physical activity and exercise throughout one's lifespan. The mediating role of resting heart rate (RHR) is one potential mechanism explaining gains in life expectancy with physical activity and exercise: RHR appears to be favorably correlated with cardiovascular and all-cause mortality and negatively correlated with life expectancy. Regular exercise and/or physical activity may contribute to a decrease in RHR.

Kumaravelu (2019) carried out when engaging in aerobic exercise, the heart rate rises significantly but never reaches its peak. The heart can constantly pump enough blood that is rich in oxygen to the muscles, allowing them to use fat and glycogen for aerobic energy production. Because it improves heart, circulation, and muscle function, aerobic exercise is the most important type of exercise for health. It also helps athletes develop their stamina. The foundation of fitness is aerobic exercise, which expands the body's capillary network. Aerobics is a gradual

physical conditioning program designed to increase breathing activity for a duration of time that is long enough to yield positive physiological effects.

College students' resting heart rates can lower and their reflexive cardiac output can increase through aerobic activity. The study's findings demonstrated that cardiac function improved and resting heart rate dropped following jogging aerobic activity. The state of an athlete's heart and lungs is a crucial sign of their physical health. The impact of various fitness regimens on lung and heart function varies. Numerous domestic and international researchers have tested various populations under stress in numerous ways. According to the findings, exercise with a moderate load had the greatest impact on heart rate during aerobic exercise (Ec et al., 2023).

Large muscular mass is used in aerobic or endurance exercise training, which aims to improve aerobic endurance performance. This raises the body's VO2 max above resting levels, which raises heart rate and energy expenditure. Aerobic training does not cause skeletal muscle hypertrophy, in contrast to resistance training. Training in aerobic exercise raises myoglobin levels in skeletal muscle, capillary density, and cardiac output—the volume of blood the heart pumps out in a minute—all of which help to increase VO2 max (Pal et al., 2013).

2.8 Effect of Combined Exercise on Physiological Variables

In (Methenitis, 2018) experimental settings evaluate the effects of a 4-week program of combined resistance and aerobic training on physical fitness in twenty-eight males' young sedentary adults. Regardless of age or gender, the general public responds better to training programs that incorporate both resistance and endurance exercise because the variables connected to health and body function are better adapted. For example, increases and/or improvements of basal metabolic rates, insulin sensitivity, glucose/lipids metabolism, lipid emic profile, and body composition, while both muscular hypertrophy/strength/power and endurance capacities are increased. These findings indicate that combined resistance and aerobic training are more effective in improving aerobic endurance. This program can effectively apply to university students with a predominantly sedentary lifestyle.

Empirical data suggests that AE plays a role in improving established cardiovascular disease risk factors, such as blood cholesterol levels, hemodynamics, and cardiorespiratory fitness. A finding from earlier research on people with metabolic dysfunction indicates that doing both AE and RE exercises together is more beneficial to metabolic health than doing either exercise alone. The majority of research on CVD biomarkers, particularly in healthy adults, has, however, been limited by factors such as short intervention durations (8–12 weeks), sample sizes of less than 30 per group, absence of a control group, or twice as long exercise group workouts as AE- or RE-only groups (Brellenthin et al., 2020).

Pal et al. (2013) conducted a study on persons with norm tension or mild hypertension; both aerobic exercise and resistance training appear to lower blood pressure in a comparable way as compared to baseline. The two categories of exercise therapies do not appear to differ from one another, though. In overweight/obese people with normal or slightly increased blood pressure, thirty minutes of aerobic exercise for at least three days a week and three sets of ten repetitions of resistance exercise can both lower blood pressure in a similar way.

2.8.1 Study on the Effect of Combined Exercise on Body Compositions

As Jha et al. (2018) reported that reduction in the fat percentage and an increase in fat-free mass as post-CT outcomes in young healthy and older men. Other reports indicated contradictory results, where body composition did not change after the three months of the training program. Recent research has shown that CT can improve body composition, especially in middle-aged diabetics.

Concurrent training is used to reduce one's percentage of body fat by directly reducing adipocyte mass, increasing fat-free mass, or a combination of both. The percentage of body fat indicates how much fat is stored with the overall mass of the body. This means that, regardless of changes in lipid stores, an increase in skeletal muscle mass can lead to a decrease in the percentage of fat. Given that long-term CT may result in gains in muscle mass and concurrent decreases in fat mass, this type of training might be the best option for lowering body fat %. (Pinto, Strength and Concurrent Aerobic, 2019)

Metabolic profiles, inflammatory state, body composition, and physical performance of obese people after three months of endurance strength training, women with abdominal obesity showed significant reductions in body mass, body mass index, total body fat, total body fat mass, and waist and hip circumference (Skrypnik et al., 2015).

Activity recommendations must be found on clear evidence of particular relationships between activity mode and changes in body mass and fat mass, given the need to lower obesity rates. Moreover, comparable levels of AT and RT were not specifically examined in any of the previous research. Therefore, it is still unclear whether RT will significantly reduce fat mass in adults who are overweight or obese, whether RT or AT is more effective at reducing fat mass when exposure (time) is held constant, and whether RT combined with aerobic training will improve body composition additively (Willis et al., 2012).

Lean body mass, reductions in body fat mass, and bone mineral density improved by resistance training. Adolescent mental health, improvements in the cardiometabolic profile, and decreases in body fat mass linked to aerobic exercise. Adolescents should undergo combination training (CT), which combines resistance and aerobic exercise in a single session. Research has indicated that as compared to any exercise modality used alone, CT (aerobic plus resistance training) produced the biggest gains in total strength and fitness (Mendonça et al., 2022).

2.8.2 Combined (Aerobic Plus Resistance Exercise) and Blood Pressure

While some epidemiological studies have found no evidence of a substantial independent association between blood pressure and physical activity or fitness, others have found that people who are fit or active have lower blood pressure. Some research found no significant correlations, whereas others found that people who were fitter and more active had lower blood pressure. Furthermore, there is proof that a reduced incidence of hypertension is linked to a higher degree of fitness or physical activity. However, due to the numerous confounding variables that cannot or have not been taken into account, it is still challenging to attribute variations in blood pressure or the incidence of hypertension within a community to variations in levels of fitness or physical activity(Festschrift, 2006).

In a recent report, the Joint National Committee on Prevention, Detection, and Treatment of High Blood Pressure reiterated the need to manage high blood pressure (BP). Therefore, a new classification known as "pre-hypertension" was created because blood pressure readings above 120/80 mm Hg, whether systolic or diastolic, nevertheless raise the risk of cardiovascular problems. Many studies have reported Dynamic, moderately intense aerobic exercise (AE) is recommended for the prevention and treatment of high BP and it has been found to decrease SBP by 10 mm Hg and DBP by 7 mm Hg in hypertensive individuals. The reductions in BP following AE have been shown to occur after only 1–2 weeks in individuals with elevated BP (Students, 2014).

To ascertain whether there are any further benefits, recent trials combining aerobic and strength training have shown a ~ 3-mmHg drop in blood pressure. While blood pressure reduction is comparable across aerobic and resistance training alone, both types of exercise offer modality-specific advantages that are independent when it comes to cardiovascular disease risk variables. Although studies on combination training, different exercise prescriptions and timing, and few with the sole focus on blood pressure reduction cover a wide range of populations and co-morbidities, the combination of aerobic and resistance exercise may have an additive effect and further reduce the risk of CVD risk factors. Even though the exercise intervention was only 8 weeks long, a mix of aerobic and resistance exercise training led to improved diastolic blood pressure, increased lean body mass, and increased strength and cardiorespiratory fitness (Schroeder et al., 2019).

2.8.3 Effect of Combined Exercise on Resting Heart Rate

Resting heart rate (RHR) is a fundamental physiological metric that provides valuable insights into an individual's cardiovascular health and fitness. Lower RHR is often associated with better cardiovascular conditioning and a reduced risk of cardiovascular diseases. As college-aged men represent a demographic with diverse physical activity patterns and fitness levels, understanding the effects of different training modalities on RHR in this population is of paramount importance. In Concurrent Training group sessions of each type of exercise per week for 12 weeks outcome indicates a substantial drop in RHR ($p < 0.05$) was also observed in the

concurrent training group, with an average decrease of about 5 bpm. A combined approach can yield cardiovascular benefits similar to those observed in the aerobic and resistance training groups (Jat, 2023).

The training for the concurrent group was the sum of the programs for the endurance and the resistance groups in each session. The resistance training is performed before the endurance to avoid premature fatigue caused by endurance training. All of the training programs performed 3 days per week for 8 weeks. Concurrent training has important implications for the physiological adaptations of such training programs. Concurrent training produces greater cardiac hypertrophy and ventricular wall thickness than endurance and resistance training alone (Hosseini et al., 2012).

The practice of physical training has shown to be cardio-protective, preventing and limiting damage from several diseases, including cardiovascular diseases. Performed aerobic and resistance training. After 12 weeks of training, significant increases in the aforementioned structural parameters were identified in the training and simulation groups, about the control group, thereby leading to the hypothesis that both exercise and myocardial infarction can cause alterations in cardiac structural parameters (Marcelo et al., 2021).

2.9 Comparative Effectiveness of Aerobic Versus Combined Exercise on Physiological Functions

According to Talebi (2021) the results of the study indicate that there was a significant difference between the endurance, resistance, and concurrent training groups concerning aerobic fitness and body composition parameters. Furthermore, the aerobic fitness and body composition parameters obtained from concurrent training were more effective than those obtained from the other two exercise methods.

According to (Brellenthin et al., 2020) exercise groups are time-matched, meaning they work out for 60 minutes each session for a year. The study will look at each CVD risk factor separately, with a focus on blood pressure, muscular strength, cardiorespiratory fitness, and central hemodynamics (such as central blood pressure and arterial stiffness). Evaluating the independent and additive (combined) effects of RE and AE training on overall CVD risk variables is the main goal of Cardio RACE. This shows a significant information gap about the impacts of RE, either by itself or in conjunction with the well-established effects of AE. Cardio RACE will help generate more comprehensive and synergistic clinical and public health strategies to prevent CVD.

In healthy middle-aged and older individuals, combined aerobic and resistance training efficiently enhances muscle strength while reducing body mass and body fat mass in overweight or obese adults. However, distinct neuromuscular and cardiovascular changes have been seen with both aerobic and strength exercises. The "interference effect" refers to the finding of multiple research that resistance training alone yields greater strength and power increases than combined aerobic and resistance training (Shiotsu & Yanagita, 2018).

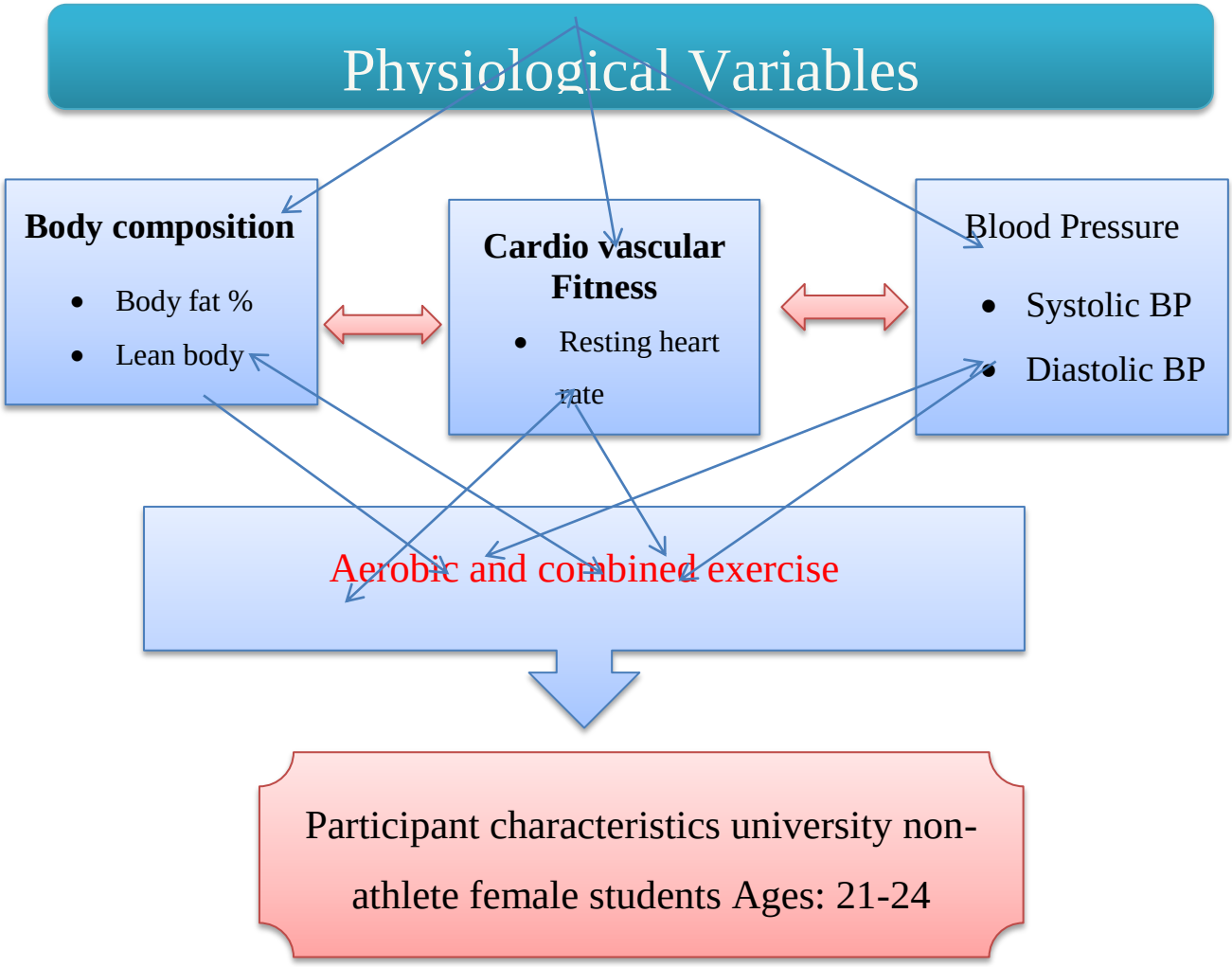
Tan et al. (2023) study on an intervention training program lasted for eight weeks and consisted of a 3-day per week. Concurrent strength and aerobic training are a crucial component of physical training intended to enhance both athletic performance and overall health. It is commonly believed that the effects of aerobic endurance exercise on muscle hypertrophy are low. According to the investigation, concurrent training can be an effective tactic to increase total lean mass and lower-body maximum strength without respect to muscle hypertrophy. This

is true regardless of the sequence in which the exercises are performed. According to the same study, traditional resistance training could help concurrent training participants get stronger.

It is unclear whether the additional benefits of combination exercise are just the result of longer exercise sessions or are the result of the independent additive benefits from each aerobic and resistance exercise. While studies on combination training have included a wide range of populations and co-morbidities, different exercise prescriptions and timing, and few with the sole focus on blood pressure reduction, the combination of aerobic and resistance exercise may have an additive effect and lower the risk of CVD risk factors (Schroeder et al., 2019).

To get the best results, exercises should be performed in a defined order. Various research investigations were conducted concerning the sequence in which the exercises were performed. For muscle strength characteristics, the strength endurance group outperformed the endurance strength group. In contrast, the results for the aerobic capacity factors were negative. Thus, to maximize training for both explosive strength and cardiorespiratory fitness, various training techniques should be taken into account (Jha et al., 2018)

This conceptual framework provides a clear visual representation of the key elements and their relationships within the study. Highlights the key physiological variables that the study which focused on and shows the two exercise interventions being compared.



Conceptual framework of the study

CHAPTER THREE

RESEARCH METHODS

3.1 Geographical Location of the Study Area

The study was conducted in Amhara regional state Bahirdar town at Bahir Dar University's main campus. Bahir Dar is located at the exit of the Abbay from Lake Tana at an altitude of 1,820 meters (5,970 ft.) above sea level. Bahir Dar University is located in the city of Bahir Dar, which is the capital of the Amhara Regional state. Bahir Dar University Sport Academy was selected area for conducting this study. Geographically the study area is located approximately 578 km north-northwest of Addis Ababa, in North Gojjam, Amhara, Ethiopia; its geographical coordinates are 11° 36' 0" North, 37° 23' 0" East.

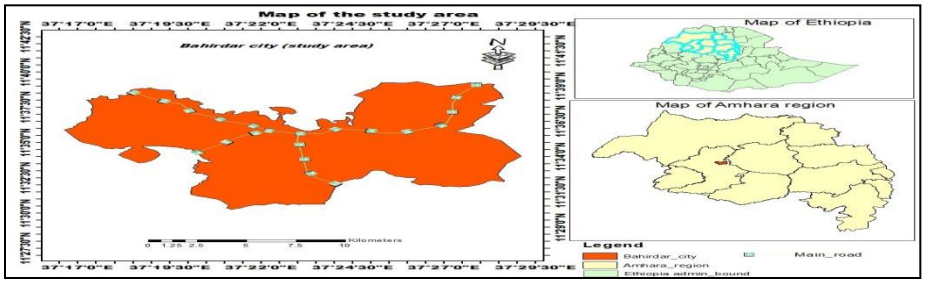
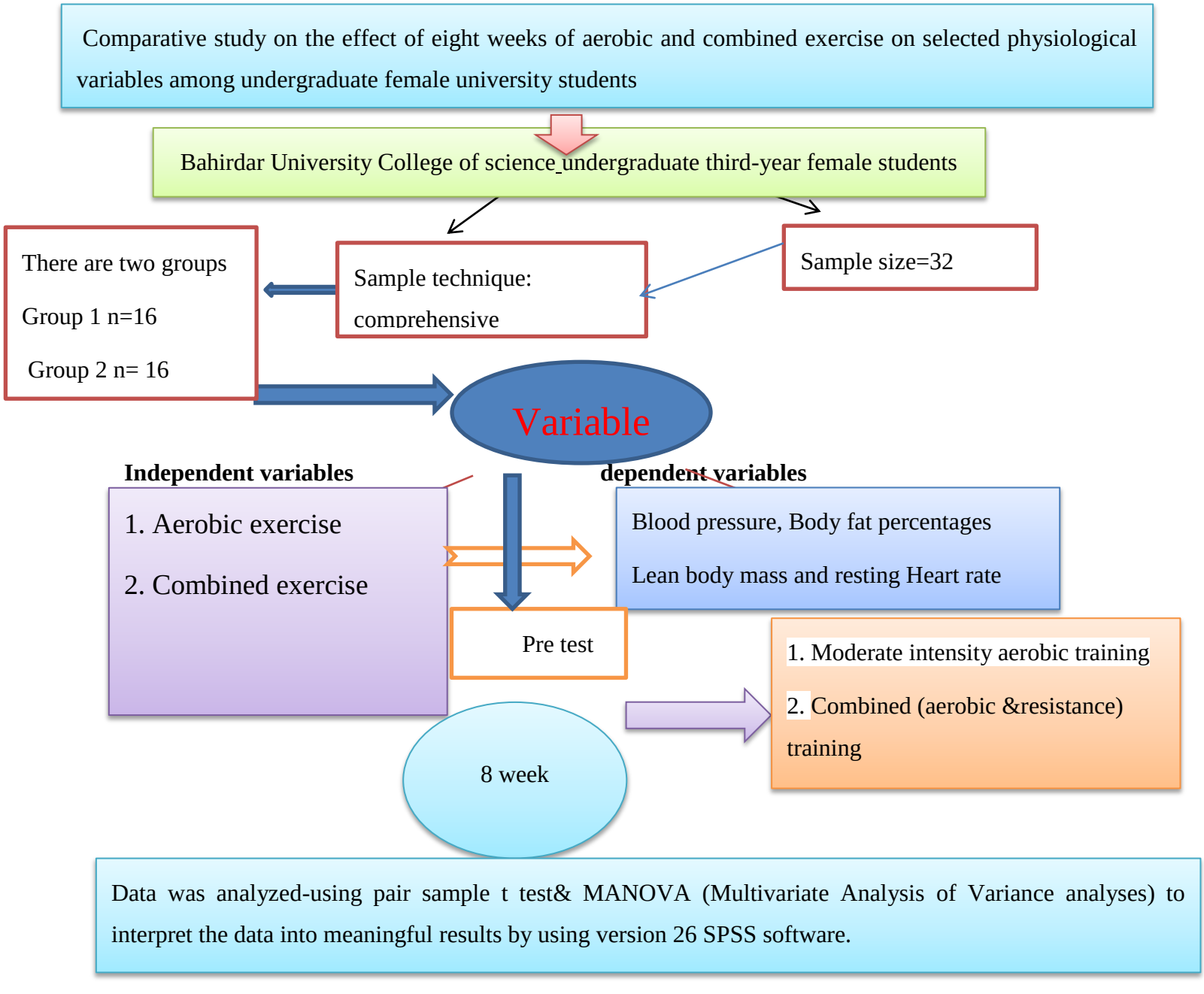


Figure 1; Map of study area:

3.2 Research Design

The research design in this study was a true experimental design specifically a pretest-posttest randomized two-group design. This design allows the investigator to establish a stronger causal relationship between the independent and dependent variables. The research approach designed in this study was experimental design since it helps to measure, assess, evaluate, and analyze the effect of independent variables on the dependent variables. Therefore, this design selected because of the many types of research that might be used the experimental design is the best way to establish cause-and-effect relationships among variables.

In general, this design involves systematic collection and presentation of the data to give a clear picture of the comparative physiological response of adults to moderate aerobic exercise VS combined exercise.



3.3 Study populations

The target group of the study focused on undergraduate third-year female main campus college of science students at Bahirdar University selected to serve as subjects for this study. They are healthy non-athlete young adults who are female and it has its own inclusion and exclusion criteria**.** The reason the investigator selects University students due that they share similar characteristics in terms of age, health status, and overall lifestyle making it easier to control for external factors during the interventions and analysis. Secondly, the effect of exercise on physiological changes and performance is more visible and noticeable to beginners. This helps isolate the specific effects of the exercise programs without the influence of major life differences.

3.3.1 Inclusion Criteria

- Healthy non-athlete female adolescents
- Students who can understand and provide informed consent to participate in the study in regular physical activity sessions will be included in the study.
- No known cardiovascular, metabolic, or musculoskeletal conditions that could contraindicate exercise participation by a healthcare professional.
- And Self-reported as sedentary or moderately active (avoid very active individuals to focus on the intervention's impact)

3.3.2 Exclusion Criteria

- Presence of any known cardiovascular, metabolic, or musculoskeletal conditions that exacerbated by exercise.
- People who have a recent history of injury or surgery that limits exercise participation.
- If currently they are pregnant or breastfeeding
- Students diagnosed with chronic health conditions that require specific management strategies (e.g., uncontrolled diabetes, severe asthma).
- Regular use of medications that could interact with the exercise intervention

3.4 Sampling Size Determination and Sampling Technique

In this study, the investigator used comprehensive sampling techniques, this is because Bahir Dar University's **third-year** Year College of Science female students hold 44 students, and then the investigator used these students who fulfilled inclusion and exclusion criteria and got (32) as whole for experimental study purposes. From 32 subjects, two equivalent groups which have 16 subjects in each group would take randomly. i.e. 16 subjects for the first experimental group (EG1) assigned to take MIAE intervention while the remaining 16 subjects for the second experimental group (EG2) participated in CEX intervention. The following charts are a Summary of sample selection criteria.

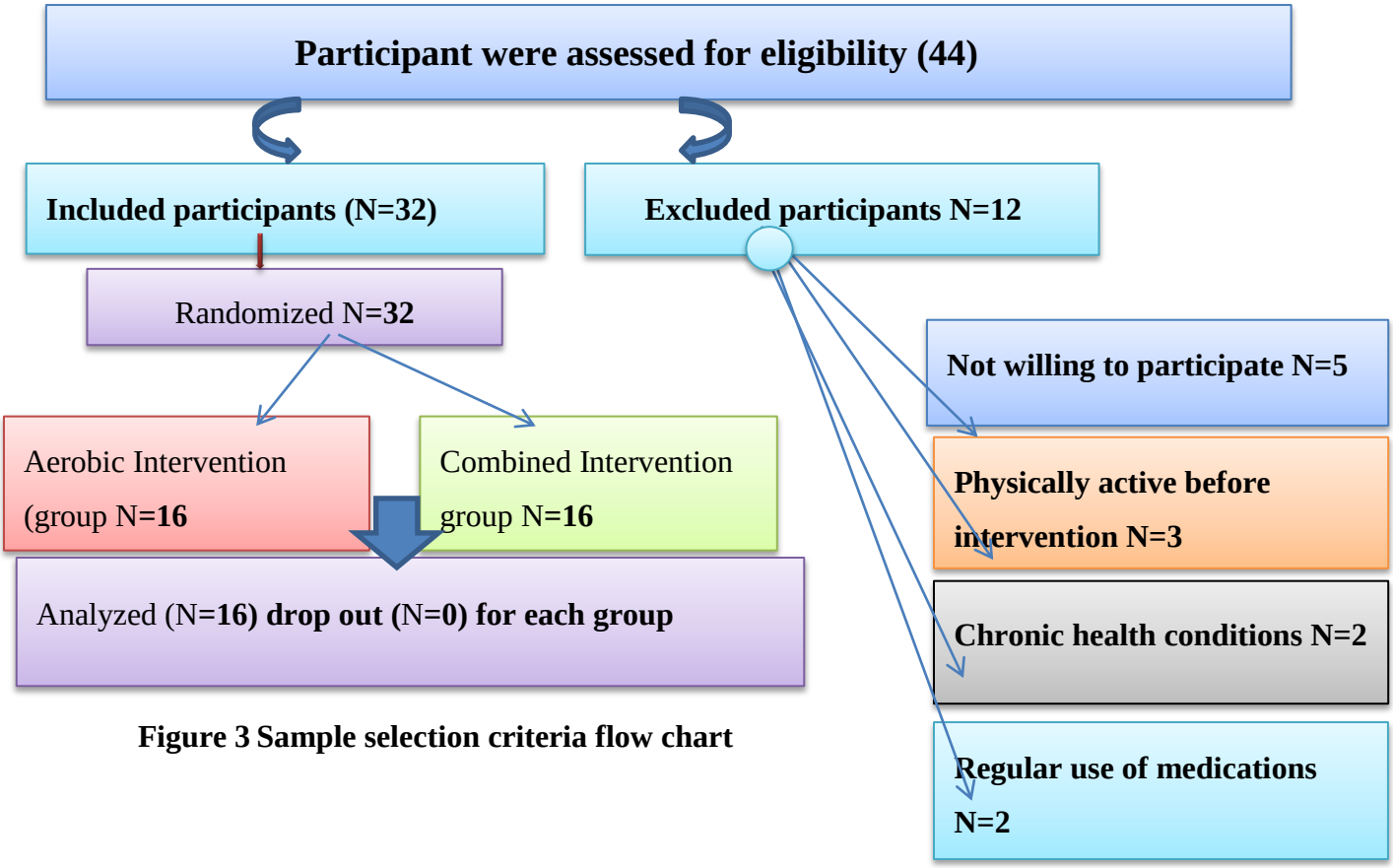


Figure 3 Sample selection criteria flow chart

3.5 Source of Data

The data collected from the results of tests given from pre-post-tests of both groups. To do this study the investigator has used primary data sources by measuring directly the participant's physiological variables. The investigator would use primary sources of data to gather available information by measuring the subject's cardiovascular (blood pressure, resting heart rate) body fat percentages and lean body mass of adolescents. The type of data was quantitative data because of the data's collected through numeric value measurement.

3.6 Data Collection Instruments and Procedures

Quantitative data collected from the subjects by using pre and post-test procedures. The investigator used the following instruments when conducting this study. The cardiovascular parameters of blood pressure and resting heart rate measured using BpTRU Blood Pressure Monitor (BpTRU Medical Devices, Coquitlam, BC, Canada. For body composition parameters: Skinfold determination of percent body fat can be by skinfold caliper (Lange skinfold caliper beta technology Santa Cruz California Skin Fold Caliper). Based on gender for females, 3- sites measured 3 times, and take the average values at the triceps, thigh, and suprailic.

Whereas, for lean body mass investigator using Omron-Body-Composition-Monitor-Scale. The measurement conducted in the study with the help of BSc holder Nurse and two sport science MSc students. After applying regular interventions to the students, the investigator measured their physiological variables in the same environmental settings. On the first day, investigator measured the physiological variables of the MIAE (Intervention A) group. Then, on the next day, CEX group participants measured their physiological variables.

3.7 Physiological Variables Test

3.7.1 Test of Body fat percentage

Taking skinfold measurement is a common method for determining body fat composition. Calipers used to measure the thickness of the skin at a range of sites around the body. Accurate measurement techniques are important. Here is the standard technique that is used.

The most accurate assessment of your ideal weight takes into account the composition of your body how much of your weight is lean body mass (muscle and bone) and how much is body fat. Measurement sites taken from Triceps, Thigh, and Suprailium based on gender. To get valid predictor of percent body fat, maintaining correct calibration of the calipers (more about calibrating calipers) is very important.

To undertake this test, you will require:

Skinfold caliper

Instrument: Skinfold Caliper
Model: Lange Skinfold Caliper
Manufacturer: Beta Technology, Inc.
Location: Santa Cruz, California, USA

Lange Skinfold Caliper is a device recommended by the American College of Sports Medicine (ACSM) for the assessment of subcutaneous body fat through skinfold thickness measurements.

According to the ACSM's Guidelines for Exercise Testing and Prescription, 11th Edition, the Lange Skinfold Caliper is a validated tool that used to estimate percent body fat by measuring skinfold thickness at specific anatomical sites on the body.

Figure 4 Measuring body fat percentages

Purpose -Estimate body fat percentage based on measurements of subcutaneous fat.

Assistant

Equipment: -caliper, ruler, score sheet, and assistant.

Scoring: in mm

Procedures:

- Ensure that all of the skinfold measurement is located on the right side of the body and that the measurements were taken in millimeters
- Pick up the skinfold between the thumb and the index finger to include two thicknesses of skin and subcutaneous fat.
- Apply the calipers about one centimeter from the fingers and at a depth about equal to the thickness of the fold.
- Very slightly, release the pressure of the fingers so the calipers exert the greater pressure.
- Repeat the procedure three times, as the measurement may vary and record the average value add the results of each measurement to get a total value in millimeters.
- Add the results of each measurement to get a total value in millimeters

The Jackson-Pollock formula is a commonly used and validated method that uses skinfold measurement to predict body fat.

The sites were; Jackson Pollock 3 Site method:

- **Triceps-** take a vertical fold parallel to the long axis of the arm midway between the shoulder and the tip of the elbow.
- **Thigh-** Midpoint of the anterior side of the upper leg between the patella and top of thigh
- **Suprailium -** Take a diagonal fold following the natural line of the iliac crest, just above the hip bone

  Method of calculating body fat percent

  Triceps =

  Suprailium =

  Thigh- =

  Age =

  Tab the option calculate body fat, we can get body fat percent

3.7.2 Test of lean body mass (fat-free mass)

The use of Omron body composition monitors provides a non-invasive method to estimate an individual's lean body mass, which is the fat-free mass of the body. This approach relies on the principle of bioelectrical impedance analysis (BIA), where a low-level electrical current is passed through the body to measure the resistance, or impedance, of the various tissues.

To undertake this test, you will require:

- **Omron body composition monitors**
- **Assistant**

Instrument: Omron Body Composition Monitor Scale

Manufacturer: Omron Healthcare, Inc.

Location: Kyoto, Japan

The Omron Body Composition Monitor Scale is a device recommended by the American College of Sports Medicine (ACSM) for estimating lean body mass as part of comprehensive body composition analysis.

According to the **ACSM's Guidelines for Exercise Testing and Prescription, 11th Edition**, this type of bioelectrical impedance analysis (BIA) device can provide reasonably accurate measurements of lean body mass when used according to the manufacturer's instructions.

Figure 5 Omron body composition monitor scale

The underlying premise is that muscles, bones, and tissues with high water content, which constitute the lean body mass, are good conductors of electricity. In contrast, fat tissue, which has a lower water content, is a poor conductor. Electrical current passes through the body, the

device can estimate the proportion of lean body mass and fat mass. To ensure accurate and reliable measurements, it is important to adhere to a standardized protocol.

Participants should have:

- Bare damp feet to optimize electrical conductivity
- Additionally, being well-hydrated
- Having an empty bladder, and avoiding recent food or fluid intake can help improve the accuracy of the measurements.

Procedure

- Involves the participant standing on the Omron body composition monitor platform
- Gripping the handles attached to the device.
- Adjust the handle height approximately shoulder level to ensure proper body positioning.
- Once the necessary personal information, such as sex, height, weight, and age, is entered,
- Then the device can skeletal mass, body fat % , visceral fat resting metabolism, and body age then calculate the individual's lean body mass from the output.

By adhering to the recommended protocols and utilizing the Omron body composition monitors, researchers can obtain reliable and valid estimates of lean body mass in their study participants. This non-invasive approach provides a practical and accessible method to assess body composition, which is valuable in a variety of sport, exercise, and health-related research contexts.

3.7.3 Test of Resting Blood Pressure

Purpose: to measure systolic and diastolic blood pressure

Equipment required table, chair, sphygmomanometer, and recording sheet.

BpTRU Blood Pressure Monitor an ACSM-recommended device manufactured by BpTRU Medical Devices in Canada.

Figure 6 sphygmomanometer

Procedure:

- The measurements of blood pressure carried out at 6:00– 7:00 AM morning
- The measurements took in a sitting position after a 10-minute rest period.
- The Blood Pressure cuff will attach to the upper arm, approximately 2 cm above the elbow.
- The two rubber hoses from the calibrated blood pressure monitor positioned over the biceps muscle (brachial artery).
- The multiple measurements with rest periods
- In addition, reporting the average of the last two readings
- Which are reasonable and typical methods used to obtain representative assessment.
- Therefore, the device measured systolic and diastolic blood pressure two times
- With a two-minute rest in between each measurement.
- For all measurements, report the average of the last two readings instead of the initial reading.

3.7.4 Resting Heart Rate Measurement

Resting heart rate is the number of times the heart beats when the body is completely at rest.

The BpTRU Blood Pressure Monitor is an automated, oscillometric device recommended by the American College of Sports Medicine (ACSM) for measuring blood pressure and resting heart rate.

According to the ACSM's Guidelines for Exercise Testing and Prescription, 11th Edition, the BpTRU Blood Pressure Monitor is one of the validated devices used to obtain accurate resting blood pressure measurements.

Device: BpTRU Blood Pressure Monitor
Manufacturer: BpTRU Medical Devices, Coquitlam, BC, Canada
Usage: Measures resting blood pressure and heart rate, as per ACSM guidelines

Purpose: To measure the resting heart rate of the students at rest conditions.

Procedures: the investigator measured the resting heart rate of a participant with the health specialization to assess their resting heart rate. The measurement conducted at the local pharmacy in Bahirdar town.

- The participants sit quietly in a private consultation room take rest
- 10 minutes to allow their heart rate to stabilize and reach a resting state
- Then carefully positioned a sphygmomanometer (blood pressure cuff) around the participant's upper arm, ensuring the cuff properly aligned over the brachial artery.
- Multi-measurement approach with a rest period in between is a recommended procedure
- Taking multiple readings helps account for natural variability in heart rate,
- While the 2-minute rest ensures the measurements are capturing true resting state
- Averaging the final two RHR readings provides an even more reliable metric,
- As it, helps smooth out any small fluctuations between the individual measurements.
- This averaging technique commonly used to derive a stable, representative resting heart rate value. Based on this measurement approach’s investigator applied this technique to get accurate and consistent results.

BpTRU Blood Pressure Monitor is an ACSM-recommended device manufactured by BpTRU Medical Devices in Coquitlam, British Columbia and Canada. There for investigator apply this device to measure resting blood pressure and heart rate as part of comprehensive fitness assessments.

3.7.5 Reliability and Validity of the Test

The investigator employed rigorous measures to ensure the reliability and validity of the data collected in this study. Reliability, which refers to the consistency of the results obtained, is a crucial prerequisite for any successful research project.

To establish reliability, the investigator utilized well-known, current techniques and instruments that applied in various sport and exercise research settings in the USA, Germany, and other areas. The use of standardized protocols and equipment across pre- and post-measurements helped to minimize potential sources of error and ensure the consistency of the data. Furthermore, the investigator took multiple measurements for each participant and calculated the average, with the assistance of trainers.

The second important research consideration is validity, which refers to the degree to which the method used measures what it is intended to measure. To ensure the validity of the data, the investigator utilized well-established, scientifically validated instruments and procedures that commonly used in sport and exercise research.

Additionally, the investigator maintained strict control over the testing environment, utilizing the same location (stadium), measurement units, materials, and timing for all pre-and post-test assessments. This standardization of the testing conditions helps to minimize the influence of extraneous variables and strengthens the validity of the findings.

In summary, the investigator made a concerted effort to obtain accurate and trustworthy data by employing appropriate, qualified medical professional tools and techniques, as well as established sport and exercise research protocols. This comprehensive approach helps the investigator to get reliable and valid data on the research findings.

3.8 Pretest Instructions Environment and Order

It is suggested that by closely observing the specific testing procedure, the validity and reliability of a subject's test results can be improved, giving youngsters a more realistic impression of the findings. The physical surroundings or setting of the testing session, any pretest instructions provided to a subject, and the test order if many tests are to be administered in a single testing

session and the information below is given following the 2010 ACSM Guidelines for Exercise Testing and Prescription (GETP).

3.8.1 General Test Environment

- The room should be at a comfortable temperature and free from drafts.
- Moderate, indirect lighting is preferred to avoid glare or distractions.
- The environment should be quiet and free from excessive noise to avoid disrupting the measurement.
- Ensure the participant has a sense of privacy during the measurement
- The participant should sit comfortably in a chair with back support, feet flat on the floor, and armrest at heart level.

3.8.2 General Pre-Test Instructions

- Wear loose, comfortable clothing that allows easy access to arms and legs for blood pressure measurement.
- Wear minimal clothing (ideally just underwear or swimwear) for body composition assessments.
- Inform the testing personnel if you are taking any medications, especially blood pressure medications.
- Get a good night's sleep before the test.
- Avoid strenuous exercise, smoking, and alcohol consumption for at least 3 hours before the test.
- Rest comfortably for 10-15 minutes before the tests begin**.** This allows your blood pressure and heart rate to return to resting levels.

3.8.3 General test order

The optimal order for measuring the students ' physiological variables is to start with the resting heart rate and blood pressure, then body fat percentage, and finally lean body mass. This sequence designed to minimize the potential for interference or confounding factors between the

different tests. Measuring the resting heart rate first is the least invasive and disruptive, as factors like stress, physical activity, and body position can influence this metric.

By following this order, it can ensure that the data collected is as accurate and reliable as possible, providing a comprehensive physiological profile of the athletes.

3.9 Training Protocol

Participants assigned randomly in to one of two groups: aerobic training or combined training. Subjects in both exercise groups had an equal total exercise time of 60 minutes, which included 10–15 minutes of warming up and dynamic stretching, 10–15 minutes of cooling down and static stretching, and 30–40 minutes for the main workout. The intensity ranged from 40-60% in the initial weeks progressing to 60–70% in the final weeks of the programs for MIAE. Whereas, for CEX group students participated for 30-minute, aerobic, and 30-minute resistance in the same session. All exercise sessions supervised by investigators and assistants to encourage participants to complete the sessions, provide feedback, and supervise the actual training. All training methods adopted for this research performed following the relevant protocol.

Facilities and Infrastructure of Participating Site: Considering the facilities and infrastructure available at the participating sites provided details about the training environment and resources. The intervention had given at Bahirdar University sport academy. Fortunately, the Academy has many small training fields as well as a larger stadium facility, which is safe for aerobic exercise by using track, stair climbing, and other ball game courts.

The main activities group one participant performs like jumping rope, running in place, high knees, jumping jacks, knee raises, punches, leg kicks, side bends, spot jumps, and stair climbing.

Table 1: The study design layout for MIAE Group

Treatment	Aerobic exercise Program
Frequency	3 days/week
Intensity	Moderate (60- 70%) HR max
Duration of whole training	8 weeks
Duration of training/session	60 minutes/session
Days of training	Monday, Wednesday and Friday (12- 1:00 a.m.)

Whereas for the combined (aerobic and resistance) training group, each session consisted of 30 minutes of resistance training and 30 minutes of aerobic exercise. In addition, they perform exercises like jumping jacks, squats, lunges, push-ups, Plank, mountain climbs, running in place, high knees, jumping jacks, and knee raises for eight consecutive weeks. In a combined training session, the students do fewer aerobic types of activity than CEX group because of the extra combined activity. First aerobics then the combined exercise approach applied during the intervention. Investigator follows performing aerobic exercise first then resistance this helps "primes" the bodies cardiovascular and metabolic systems, potentially enhancing the subsequent resistance training session.

Table 2: Training Schedule for CEX Group

Treatment	Combined (aerobic and resistance) training
Frequency	3 days/week
Duration of whole training	8 weeks
Set and repetition	2-3 sets of 8-10 repetitions
	3-4 sets of 5-6 repetitions
Duration of training/session	60 minutes/session
Days of training	Tuesday, Thursday, Saturday

3.10 Data Analysis Techniques

The data analyzed and interpreted into meaningful results using computerized statistical package software (SPSS) version 26. The significance level of the study was set at 95% confidence interval. In this research, quantitative data collected from pre- and post-training tests of the intervention on both training groups. The investigator used paired sample t-test analysis methods to examine the differences between pre and post- test changes. Whereas, MANOVA used to investigate comparative effect between two intervention groups and to explore the overall multivariate effect of the independent variable(s) on the combined set of dependent variables.

3.11 Ethical privacy and confidentiality considerations

The study protocol approved through obtaining the necessary ethical approval from BDU University Sport Academy institutional review board or ethics committee before commencing the study.

Privacy Considerations: The investigator briefly explain to the participants the collected data necessary only for the study's purpose and avoids collecting sensitive or unnecessary information. Any personal, sensitive, or identifying information privacy of individuals, such as data anonymization handled and implemented carefully by the investigator to keep the code of ethics of the research.

Confidentiality considerations: Protecting participant privacy and maintaining the confidentiality of information collected data kept strictly and confidentially including the anonymity of participants throughout the study. Ensure participants understand the study's purpose, procedures, potential risks and benefits, and their right to withdraw at any time. Ensuring the investigator does not use the trainers' names in any reports or publications and always gives great attention to participant rights and data.

Disclosure or declaration of potential conflicts of interest: To foster confidence and ethical research conduct, the investigator was to maintain any conflict in training areas issues, campus

guard, and transports during measurement throughout the research process, will disclosing or declaring any potential conflict of interest of study by the investigator.

Community Consultation for Participation: The Investigator consults with the relevant sport academy communities these consultations can help the investigator to get measurement instruments and identify any specific risks or challenges related to the training environment, activities, or participant population. The sport academy experts can provide valuable insights and recommendations on how to minimize the risks of injury during the training sessions.

CHAPTER FOUR

RESULT

4.1. Introduction

This chapter deals with the analysis of data from 32 female non-athlete undergraduate students (N=32). The data collected from the subjects by using pre and post-test procedures. Pre-tests and post-tests taken from both experimental groups before and after 8 weeks of moderate-intensity aerobic training and combined training intervention, and then scores are recorded.

Before conducting the MANOVA, the linearity between independent variables assessed to detect potential multicollinearity. Box's M test, assessed the homogeneity of covariance matrices across groups. Multivariate normality evaluated through the Shapiro–Wilk normality test, adjusted for two-way MANOVA. Levene's test assessed the assumption of homogeneity of equality of error variance among the groups.

The collected data were analyzed by using Paired sample and MANOVA descriptive statistics like mean, standard deviation, and (Multivariate Analysis of Variance) by using, Wilks' Lambda, F-statistic, p-value with 0.05 confidence intervals, and Effect size (partial eta-squared, η^2) to analyze data that involved comparing differences between the groups on a continuous outcome selected physiological variable.

4.2. Result of the Study

Table 4.1 Demographic characteristics of participants A

	N	Mean	Std. Deviation
sex of students	16	1.00	.000
age of students	16	22.188	.8342
weight of student	16	56.0000	4.22690
height of students	16	161.5000	7.58068

Key: N= number of students and SD= standard deviation, Age-Chronological age of students, Height- height of students in meters, Weight-weight of students in kilograms.

As shown in Table 4.1 the descriptive characteristics of the 32 participants from Bahirdar University main campus College of Science non-athlete age of 22.188 ± 0.8342 years, a mean weight of 56.0000 ± 4.22690 kg, and a mean height of 161.5000 ± 7.58068 cm.

Table 4.2 Demographic characteristics of participants B

	N	Mean	Std. Deviation
sex of students	16	1.00	.000
age of students	16	22.13	.719
weight of students	16	54.7500	4.86484
height of students	16	161.2500	7.17867

Similarly, experimental group two is also female active students who have a mean age of 22.13 ± 0.719 years, mean weight of 54.7500 ± 4.86484 kg and mean height of 161.2500 ± 7.17867 cm. This indicates that the selected populations were relatively similar in age, height, and weight at the beginning of the exercise program.

Table 4.3 Descriptive Statistics of pretest of physiological variables of participants

Variables	Intervention	Mean	Std. Deviation	N
SBP	MIAE	119.5000	4.06612	16
	CEX	118.8750	3.32415	16
DBP	MIAE	79.5625	2.63233	16
	CEX	79.0625	2.76812	16
RHR	MIAE	74.5625	2.30850	16
	CEX	74.8750	2.12525	16
BF%	MIAE	23.0500	1.88644	16
	CEX	23.0875	2.00794	16
LBM	MIAE	42.8000	1.08074	16
	CEX	42.5750	1.03891	16

Note: **MIAE**-moderate intensity aerobic exercise, **CEX**-combined exercise, and **std. Dev**iation: standard deviation. N: number of participants

Based on the above Table 4.3 descriptive statistical results, the table provides evidence for the similarity of pre-test variables between the two groups (moderate intensity vs. combined exercise). They have almost Similar Mean Std. Deviation in all five variables. In both intervention groups, participants have the following Mean and Std. Deviation for both aerobic and combined exercise intervention groups. Systolic blood pressure in mmHg (119.5000, 4.06612 and118.8750, 3.32415), diastolic blood pressure in mmHg (79.5625, 2.63233 and 79.0625, 2.76812) resting heart rate in bPm (74.5625, 2.30850 and 74.8750, 2.12525), body fat percentage in% (23.0500, 1.88644 and 23.0875, 1.91656) and lean body mass (42.8000, 1.08074 and 42.5750, 1.04904) respectively.

From the provided descriptive statistics, it appears that the two intervention groups (moderate-intensity aerobic exercise and combined exercise) had similar baseline characteristics in terms of systolic blood pressure, diastolic blood pressure, resting heart rate, body fat percentage, and lean body mass. The two intervention groups, moderate-intensity aerobic exercise, and combined exercise pre-tests, matched at baseline.

Table 4.4: Descriptive Statistics of multivariate analyses of pre-post-test results of two intervention groups

Physiological variables	type of intervention	Mean	Mean	Std. Deviation	Std. Deviation	N
		Pre	Post	Pre	Post	
SBP	MIAE	119.5000	116.1250	4.06612	4.48516	16
	SEX	118.8750	114.5000	3.32415	3.70585	16
DBP	MIAE	79.5625	77.0000	2.6 3233	2.52982	16
	CEX	79.0625	76.3750	2.76812	2.47319	16
	MIAE	74.5625	69.9375	2.30850	3.08693	16
RHR	CEX	74.8750	72.5000	2.12525	2.73252	16
body fat %	MIAE	23.0500	22.2438	1.88644	1.70801	16
	CEX	23.0875	21.5188	2.00794	1.83565	16
LBM	MIAE	42.8000	42.7375	1.08074	1.02168	16
	CEX	42.5750	43.5625	1.03891	1.11647	16

Note: **MIAE**-moderate intensity aerobic exercise, **CEX**-combined exercise, **SBP**-systolic blood pressure, **BBP**-diastolic blood pressure, **RHR** –resting heart rate in bpm, **body fat %**-body fat percentages and **LBM**-lean body mass.

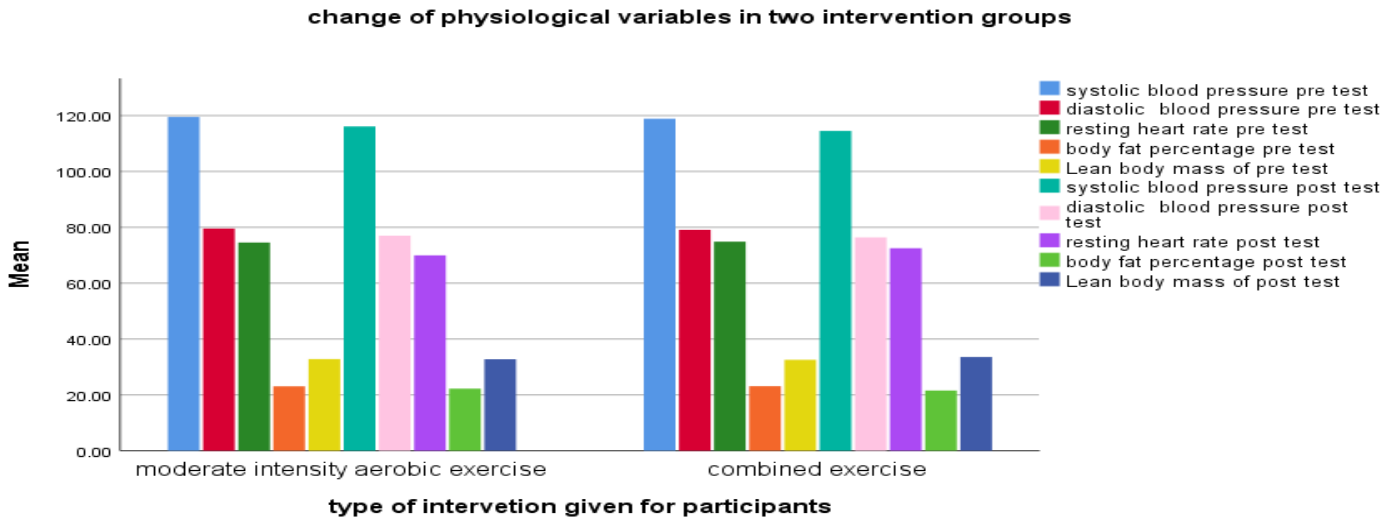


Figure 6: Graphical comparison of pre-post test results of the two groups

The above table and figure show the descriptive statistics results of the pre and post-test for experimental group 1 and experimental group 2 in the following measures: systolic blood pressure, diastolic blood pressure, resting heart rate, body fat percentage, and lean body mass. For the experimental group 1, the pre-test results were: systolic blood pressure 119.5000 ± 4.06612 mmHg, diastolic blood pressure 79.5625 ± 2.63233 mmHg, resting heart rate 74.5625 ± 2.30850 bpm, body fat percentage 23.0500 ± 1.88644%, and lean body mass 42.8000 ± 1.08074 kg.

After the 8-week moderate-intensity aerobic training intervention, the post-test results for experimental group 1 improved, showing decreases in systolic blood pressure (116.1250 ± 4.48516 mmHg), diastolic blood pressure (77.0000 ± 2.52982 mmHg), resting heart rate (69.9375 ± 3.08693 bpm), and body fat percentage (22.2438 ± 1.70801%). However, there was no great clear change in lean body mass (42.7375 ± 1.02168 kg) from the baseline measurements.

Based on the above descriptive statistical results shown in the above table in CEX group, mean and standard deviation of pre-post-test results of Systolic blood pressure, Diastolic blood pressure, resting heart rate, Body fat percentage, and Lean body mass before the intervention for

experimental group 2 found to be 118.8750±3.32415, 79.0625±2.63233,74.8750±2.12525, 23.0875±2.00794 and 42.5750±1.03891respectively. However, after the intervention regular combined (aerobic with resistance exercise) the result of Systolic blood pressure, Diastolic blood pressure, resting heart rate, Body fat percentage, and Lean body mass of the students were 114.5000±3.70585,76.3750±2.47319,72.5000±2.73252,21.5188±1.83565,and43.5625±1.11647r espectively.

The findings describe that decreases in systolic and diastolic blood pressure, resting heart rate, and body fat percentage, as well as the increase in lean body mass, demonstrating the effectiveness of the exercise program (CEX) and its changes after 8 weeks of interventions.

Table 4.5: paired sample t-test of mean differences pre-post-test of physiological variables

Paired Samples Test of Pre -post mean difference for MAIE and CEX intervention groups

		Moderate-intensity aerobic group							
					95% CI of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	T	F	Sig. (2-tailed)
Pair 1	SBPB – SBPA	-3.37500	2.70493	.67623	-4.81636	1.9364	-4.991	15	.000
Pair 2	DBPB – DBPA	-2.56250	2.70724	.67681	-4.00509	1.11991	-3.786	15	.002
Pair 3	RHRB – RHRA	-4.62500	1.82117	.45529	-5.59543	-3.65457	-10.158	15	.000
Pair 4	BF%B – BF%A	-.80625	.61261	.15315	-1.13269	.47981	-5.264	15	.000
Pair 5	LBMB – LBMA	-.06250	.70699	.17675	-.43923	.31423	-.354	15	.729
		Combined intervention groups							
Pair 1	SBPB – SBPA	-4.37500	2.21736	.55434	-5.55655	-3.19345	-7.892	15	.000
Pair 2	DBPB – DBPA	-2.68750	2.82179	.70545	-4.19113	-1.18387	-3.810	15	.002
Pair 3	RHRB – RHRA	-2.37500	2.09364	.52341	-3.49062	-1.25938	-4.538	15	.000
Pair 4	BF%B – BF%A	-1.56875	1.08549	.27137	-2.14717	-.99033	-5.781	15	.000
Pair 5	LBMB – LBMA	.98750	.30083	.07521	.82720	1.14780	13.130	15	.000

Note: **MIAE**-moderate intensity aerobic exercise, **CEX**-combined exercise-test statistic, **SBPB**-systolic blood pressure posttest in mmHg, **BBPB**-diastolic blood pressure post-test in mmHg, **RHRB** –resting heart rate post-test in bpm, **body fat %B**-body fat percentages post-test based on skin fold caliper result and **LBMB**-lean body mass post-test. **SBPA**-systolic blood pressure post-test, **BBPA**-diastolic blood pressure pre-test, **RHRA** –resting heart rate pre-test in bpm, **body fat %A**-body fat percentages pre-test based on skin fold caliper result, and **LBMA**-lean body mass pre-test.

The data from Table 4.5 provided the paired sample t-test that is more suitable for analyzing within-a group differences, as it directly compare the means of the same group under different conditions or at different time points.

The paired sample t-test is an appropriate statistical method used to analyze within-group changes from pre-intervention to post-intervention for the MIAE and CEX groups.

Specifically, the MIAE group experienced a statistically significant decrease in systolic blood pressure, with a mean reduction of 3.375 units ($t = -4.991$, $p<0.05$). Similarly, diastolic blood pressure also decreased significantly within the MIAE group, with a mean reduction of 2.563 units ($t = -3.786$, $p = 0.002$).

Furthermore, the MIAE group demonstrated a notable decrease in resting heart rate, with a mean reduction of 4.625 units ($t = -10.158$, $p<0.05$) additionally, the MIAE group showed a statistically significant decrease in body fat percentage, with a mean reduction of 0.806 units ($t = -5.264$, $p=0.000$). However, the change in lean body mass on MIAE group was not statistically significant, with a mean decrease of 0.063 units ($t = -0.354$, $p = 0.729$).

Turning to the Combined Exercise (CEX) group, the paired sample t-test results also reveal substantial improvements in several physiological parameters. The CEX group experienced a statistically significant decrease in systolic blood pressure, with a mean reduction of 4.375 units ($t = -7.892$, $p<0.05$Similarly, diastolic blood pressure decreased significantly within the CEX group, with a mean reduction of 2.688 units ($t = -3.810$, $p =0.002$). The CEX group also demonstrated a notable decrease in resting heart rate, with a mean reduction of 2.375 units ($t = -4.538$, $p<0.05$). Moreover, the CEX group showed a statistically significant decrease in body fat

percentage, with a mean reduction of 1.569 units (t = -5.781, p<0.05). Interestingly, the CEX group also exhibited a statistically significant increase in lean body mass, with a mean increase of 0.988 units (t = 13.130, p<0.05).

Table 4.6 Multivariate effect of training group on the combined set of physiological parameters

Effect		Value	F	Hypothesis df	Error df	Sig.	η^2
Intercept	Pillai's Trace	1.000	30987.63[b]	10.000	21.000	.000	1.000
	Wilks' Lambda	.000	30987.63[b]	10.000	21.000	.000	1.000
	Hotelling's Trace	14756.017	30987.63[b]	10.000	21.000	.000	1.000
	Roy's Largest Root	14756.017	30987.63[b]	10.000	21.000	.000	1.000
Intervention	Pillai's Trace	.589	3.003[b]	10.000	21.000	.016	.589
	Wilks' Lambda	.411	3.003[b]	10.000	21.000	.016	.589
	Hotelling's Trace	1.430	3.003[b]	10.000	21.000	.016	.589
	Roy's Largest Root	1.430	3.003[b]	10.000	21.000	.016	.589

a. Design: Intercept + intervention

b. Exact statistic,

Key: F- F-ratio, **Hypothesis df**- Hypothesis Degrees of Freedom, **Error df**- Error degrees of Freedom, **b** -superscript- Exact Statistic and **η^2**- Eta-squared

In Table 4.6 focusing on the Wilks' Lambda statistic the intervention effect on combined physiological variables are F(10, 21) = 3.003; p = 0.016; (λ) = 0.411, η^2 = 0.589 results were obtained. The associated F-statistic of 3.003 with 10 and 21 degrees of freedom is statistically significant at the p = 0.016 level. The statistical analysis indicates that the exercise intervention itself was the primary driver behind the observed differences in the combined set of physiological outcomes.

The Wilks' Lambda statistic reported in the table is 0.411, which indicates the proportion of the total variance in the combined physiological parameters that not explained by the training

intervention. A Wilks' Lambda values of 0.411 means that 41.1% of the total variance in the combined physiological parameters not explained by the training intervention.

The partial η^2 value of 0.589 further reinforces the practical significance of the intervention effect. This large effect size suggests that the type of exercise intervention had a strong influence on the participants' physiological responses, accounting for 58.9% of the total variance in the combined set of outcome physiological parameters.

Taken together, the Wilks' Lambda (λ) value, the statistically significant F-test, and the large effect size (partial η^2) provide compelling evidence that the moderate-intensity exercise and combined exercise interventions had markedly different effects on certain participants' physiological parameters. This indicates that the choice of exercise intervention is an important factor in determining the specific physiological adaptations and outcomes observed in the study.

In order to explore further the differential effects of the exercise interventions, the investigators performed Univariate tests, on each of the physiological outcome measures separately. This would allow us to determine which specific variables showed statistically significant differences between the moderate-intensity and combined exercise groups. To examine the specific significance difference between the two groups upon which differences are evident, it needs to look at the tests of between-subjects effects.

Table 4.7 Univariate results of each physiological variable between MIAE and CEX group

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	η^2
Intervention	SBPB	21.125	1	21.125	1.248	.273	.040
	DBPB	3.125	1	3.125	.499	.485	.016
	RHRB	52.531	1	52.531	6.182	.019	.171
	BF%B	4.205	1	4.205	1.338	.257	.043
	LBMB	5.445	1	5.445	4.755	.037	.137

Error	SBPB	507.750	30	16.925
	DDBP	187.750	30	6.258
	RHRB	254.938	30	8.498
	BF%B	94.304	30	3.143
	LBMB	34.355	30	1.145

R Squared = .040 (Adjusted R Squared = .008)

R Squared = .016 (Adjusted R Squared = -.016)

R Squared = .171 (Adjusted R Squared = .143)

R Squared = .043 (Adjusted R Squared = .011)

R Squared = .137 (Adjusted R Squared = .108)

Key: **df** - degrees of freedom, **F**- F-test, **η²-** Eta-squared

As shown in the Table tests of between-subjects, effects revealed some interesting findings. For systolic blood pressure (SBP), diastolic blood pressure (DBP), and body fat percentage, the results were not statistically significant. Specifically, the contrast effect for SBP was F (1, 30) = 1.248; p = 0.273; partial η^2 = 0.040. Systolic blood pressure explain by the intervention in 4% but not significant p>0.05.Therefor, the intervention had no statistically significant effect difference on SBP between MIAE and CEX groups.

The contrast effect for DBP between two exercise groups: The statistical results showed an F-statistic of 0.499 with 1 and 30 degrees of freedom, and a p-value of 0.485. The partial eta-squared (partial η^2) value was 0.016, indicating that the contrast accounted for only 1.6% of the total variance in DBP. These findings suggest that the intervention, did not have a statistically significant impact on DBP (p = 0.485). The small effect size, as represented by the partial η^2 of 0.016, the contrast accounted for 1.6% of the total variance.

The analysis of the contrast effect on body fat percentage revealed an F-statistic of 1.338 with 1 and 30 degrees of freedom, and a corresponding p-value of 0.257. The partial eta-squared (partial

η^2) value was calculated to be 0.043, indicating that the contrast accounted for 4.3% of the total variance in body fat percentage. These statistical findings suggest that the intervention, which compared the effects of the aerobic exercise group and the combined exercise group, did not have a statistically significant impact on participants' body fat percentage ($p = 0.257$)

However, the contrast effect was a significant for resting heart rate RHR (Resting Heart Rate): $F (1, 30) = 6.182$; $p = .019$; partial $\eta^2 = .171$). The p-value for the contrast effect on RHRB was $p = .019$ which is less than the commonly used significance threshold of $p < .05$. Which means the contrast effect on resting heart rate is statistically significant. The medium-to-large effect size (partial $\eta^2 = .171$) suggests that a meaningful proportion of the variance in resting heart rate can be explained by the contrast, Out of the total variability in resting heart rate, 17.1% of it can be attributed to the contrast effect.

The contrast effect for LBMB was also statistically significant, $F (1, 30) = 4.755$; $p = .037$; partial $\eta^2 = .137$). With $p = .037$, Similar to RHRB, the p-value is also less than .05 which is a significant contrast effect on lean body mass. This tells us that there was a significant difference in lean body mass between MIAE and CEX. This indicates that the two groups differed significantly in their lean body mass after the intervention or manipulation. The contrast accounted for 13.7% of the total variance in lean body mass explained by the contrast effect. Whereas the remaining other physiological variables did not show significant effect differences across the group.

Table 4.8: Pair-wise comparison between two intervention groups on physiological variable

Dependent Variable	(I) intervention	(I) intervention	Mean Difference (I-J)	Std. Error	Sig.[b]	95% CI for Difference	
						Lower Bound	Upper Bound
SBPB	MIAE	CEX	1.625	1.455	.273	-1.346	4.596
	CEX	MIAE	-1.625	1.455	.273	-4.596	1.346
DBPB	MIAE	CEX	.625	.884	.485	-1.181	2.431
	CEX	MIAE	-.625	.884	.485	-2.431	1.181
RHRB	MIAE	CEX	-2.562	1.031	.019	-4.667	-.458
	CEX	MIAE	2.563	1.031	.019	.458	4.667
BF%B	MIAE	CEX	.725	.627	.257	-.555	2.005
	CEX	MIAE	-.725	.627	.257	-2.005	.555
LBMB	MIAE	CEX	-.825*	.378	.037	-1.598	-.052
	CEX	MIAE	.825*	.378	.037	.052	1.598

Based on estimated marginal means

The mean difference significant in the 0.05 levels

B. Adjustment for multiple comparisons: Bonfferoni

Note: **MIAE**-moderate intensity aerobic exercise, **CEX**-combined exercise, **SBP**-systolic blood pressure, **BBP**-diastolic blood pressure, **RHR** –resting heart rate in bpm, **body fat %**-body fat percentages **LBM**-lean body mass and CI confidence interval for difference.

Table 4.8 presents the result of a pairwise comparison between the two intervention groups on physiological dependent variables. For systolic blood pressure, the mean difference between the moderate-intensity aerobic exercise group and the combined exercise group is 1.625. A positive mean difference (1.625) means that CEX group showed higher SBP reduction compared to the MIAE group. However, this difference is not statistically significant at ($p = 0.273$) between MIAE and CEX.

Likewise, the results show that for DBP, the combined exercise (CEX) group experienced a greater reduction compared to the moderate-intensity aerobic exercise (MIAE) group, with a 0.625 mmHg mean decrease. This suggests the CEX intervention was more effective for lowering diastolic blood pressure. However, the difference between groups was not statistically significant (p=0.485), the p-value of 0.485 exceeds the typical threshold of 0.05.

In RHR, the results showed (MIAE) group experienced a significantly greater reduction in RHR compared to (CEX) group. With the mean RHR decrease by 2.562 bpm, the negative mean difference shows the MIAE group saw a greater drop in resting heart rate from baseline (p=0.019). The p-value of 0.019 is less than the typical threshold of 0.05, meaning it can be confident the observed 2.562 bpm difference did not occur by chance. These findings provide reliable evidence that the MIAE program led to superior improvements in this key cardiovascular health marker.

For body fat percentage, the combined exercise (CEX) group saw a greater reduction compared to the moderate-intensity aerobic exercise (MIAE) group. The mean change in BF% was 0.725% higher in the CEX group than the MIAE group, suggesting the CEX intervention was more effective. However, this difference was not statistically significant (p=0.257).

Finally, results indicated on lean body mass CEX group experienced a significantly greater increase in lean body mass (LBMB) compared to the MIAE group. The mean difference in LBMB changes between the two groups was 0.825 kg, and this difference was statistically significant (p=0.037). This indicates that the increase in lean body mass was 0.825 times higher in the CEX group relative to the MIAE group. In other words, the CEX intervention was more effective than the MIAE intervention in promoting gains in lean body mass.

These findings have important implications for understanding the comparative efficacy of the exercise two interventions on SBP, DBP, RHR BF%, and LBM. There was a statistically significant difference only in resting heart rate and lean body mass with their mean changes 2.562 bpm, and 0.825kg, and with a p-value of 0.019, and 0.037 respectively. Whereas, the other three variables have not found a significant effect between the two intervention groups.

CHAPTER FIVE

DISCUSSION AND IMPLICATION

5.1. Discussion

The goal of the present study was to investigate the comparison effect of 8 weeks of aerobics and a combination of aerobic with resistance exercise on selected physiological variables among university students. The present study has focused on examining the comparable effects of the two different exercise interventions on a set of physiological outcome variables within each group and between the groups. The key physiological variables examined after the 8 weeks of training intervention programs included blood pressure (both systolic and diastolic), heart rate, body fat percentage, and lean body mass.

The variables that showed statistically significant effect changes in the MIAE group are systolic blood pressure, diastolic blood pressure, and resting heart rate. These three variables demonstrated statistically significant decreases, with p-values less than 0.05. On the other hand, the change in lean body mass within the MIAE group was not statistically significant, with a p-value of 0.729.

The Combined Exercise (CEX) group results also indicate a positive impact on multiple physiological measures in posttest results. Statistically significant decreases in systolic blood pressure, diastolic blood pressure, and resting heart rate (all $p < 0.05$).In addition, the CEX group also showed a statistically significant decrease in body fat percentage ($p < 0.05$) and a statistically significant increase in lean body mass ($p < 0.05$).

5.1 Blood pressure (systolic and diastolic BP)

Both the MIAE and CEX interventions were effective in reducing blood pressure among the participants. The MIAE group experienced a statistically significant decrease in systolic blood pressure, with a mean reduction of 3.375 units ($p < 0.05$). Their diastolic blood pressure also decreased significantly, with a mean reduction of 2.563 units ($p < 0.05$). The CEX group demonstrated even larger improvements, with a statistically significant decrease in systolic blood

pressure, with a mean reduction of 4.375 units ($p < 0.05$). The CEX group's diastolic blood pressure decreased significantly as well, with a mean reduction of 2.688 units ($p < 0.05$). These robust statistical findings, indicated by the p-values well below the 0.05 significance threshold, show that both the MIAE and CEX interventions were highly effective at lowering both systolic and diastolic blood pressure among the study participants.

The result of the finding is in line with the study of Schroeder et al.(2019**)** combined training provided significant reductions in peripheral (-4 mmHg) and an increase in lean body mass (0.8 kg). The combination of aerobic and resistance exercise could have an additive effect and further decrease the risk of CVD risk factors.

The result was also supported by the study Mustedanagić et al. (2016) changes were noted in female students aged from 22 to 25. The exercise model realized three times a week, for 8 weeks has also a significant effect on cardiorespiratory fitness, precisely systolic arterial blood pressure, and heart rate. In addition, in the study of Zhang and Min (2022) also combining aerobic and RT can lower blood pressure more than either type of exercise alone. This aligns with and strengthens the key insights I have gathered through my investigations in this area.

IMPLICATION: Depending on the result of this study, both aerobic exercise and combined aerobic with resistance exercise are valuable interventions for managing and reducing blood pressure. This provides health practitioners with effective exercise-based options to recommend to trainees. The combined exercise approach, which integrates both aerobic and resistance training, may be the most optimal exercise strategy for maximizing blood pressure-lowering benefits. The additive effects of the two exercise modalities appear to produce greater reductions in both systolic and diastolic blood pressure. Therefore, fitness trainers should prioritize prescribing combined aerobic and resistance exercise programs for managing and improving blood pressure in their trainees/clients.

5.2 Resting Heart Rate (RHR)

The MIAE group showed a larger mean reduction of 4.125 units in resting heart rate, compared to the 2.375 unit reduction in the CEX group. Both changes were statistically significant, but the

MIAE group had a stronger effect on decreasing resting heart rate, as indicated by the larger t-value and smaller p-value from the result of Table tables 4.5 with a mean reduction of 4.625 units ($t = -10.158$, $p < 0.05$).

The findings of this study aligned with the recent comparative research by (Jat, 2023) which examined the effects of aerobic, resistance, and concurrent training on resting heart rate (RHR) in college students. Consistent with my results, Jat reported that all three-exercise interventions produced statistically significant reductions in RHR.

The results indicated significant reductions in RHR both groups, with the aerobic training group showing the most pronounced decrease, followed by the concurrent and resistance training groups. This pattern is consistent with the current findings, where MIAE training intervention, shows a significant result than CEX.

The findings from the study conducted by Mustedanagić et al.(2016) study on moderate-intensity aerobic exercise in female college cardiorespiratory fitness and body composition of female college students. Results align with investigator findings and report significant improvements in notably, statistically significant improvements in measures of cardiorespiratory fitness, specifically a reduction in heart rate in MIAE.

IMPLICATION: Based on the result of this study, Moderate-intensity aerobic exercise (MIAE) appears to be the most effective exercise modality for lowering resting heart rate compared to combined exercise (CEX) training. Combined exercise programs that blend aerobic and resistance training can also produce meaningful reductions in resting heart rate. However, the magnitude of the effect may not be as large as that achieved through aerobic exercise alone. From a practical standpoint, fitness professionals and healthcare providers should consider prescribing aerobic-focused exercise programs as the preferred exercise intervention for clients/trainees specifically aiming to lower their resting heart rate as part of a cardiovascular health improvement plan.

5.3 Body Fat Percentage (BF %)

The results demonstrate that both the MIAE group and the CEX group experienced statistically significant decreases in body fat percentage. However, the CEX group exhibited a larger mean reduction of 1.569 units ($p < 0.05$) compared to the 0.806 unit decrease in the MIAE group ($p < 0.05$). This suggests that the combined exercise program, which included both aerobic and resistance training, was more effective at reducing body fat than the moderate-intensity aerobic exercise alone.

The findings of the current study align with previous research that demonstrates the benefits of combined or concurrent exercise training for improving body composition. As Talebi (2021) reported that a concurrent training program, involving both endurance and resistance exercises, was more effective have a significant effect than endurance training or resistance training alone for enhancing aerobic fitness and body composition parameters. This finding is in somewhat inconsistent with the conclusions of the (Pacholek et al., 2021) study, which reported that the combined and separate training programs yielded nearly identical benefits on physiological measures.

Consistent with the findings of Topsakal et al.(2019) investigated that the intervention applies for 8 weeks, 3 days per week, and 1 hour per day. The findings show that the current investigation found that the combined training program led to significantly greater reductions in body fat percentage compared to the aerobic-only intervention. As stated by Mendonça et al.(2022) CEX (aerobic plus resistance exercise) produces a significant reduction in body fat percentage and gain fitness when compared to any exercise modality done alone. In addition, MICT training should give in conjunction with the RT training technique applied in the recommendation of workouts for youth.

IMPLICATION: The main implication of these findings is that a combined exercise program, incorporating both aerobic and resistance training, is more effective for reducing body fat percentage compared to a moderate-intensity aerobic exercise program alone. The results demonstrate that the combined exercise group experienced a significantly larger reduction in body fat percentage compared to the aerobic-only group. The combination of aerobic and

resistance training appears to have a synergistic effect, leading to greater improvements in body fat percentage

5.4 Lean Body Mass (Fat-Free Mass)

The current result shows that the MIAE group did not see a statistically significant change in lean body mass from the two interventions on lean body mass, with a mean drop of 0.063 units ($t = -0.354$, $p = 0.729$). On the other hand, the mean increase in lean body mass for the CEX group was 0.988 units ($t = 13.130$, $p < 0.05$), which was statistically significant. This result suggests that the combination exercise intervention which included strength and aerobic training was successful in raising the participant's lean body mass.

In line with the existing research, this finding suggest that combination training (CEX), which incorporates resistance and aerobic exercise, leads to the most significant improvements in lean body mass compared to any single exercise modality.

Similar significant findings in the study by Mendonça et al.(2022) were conducted on adolescents who undergo combination training (CEX), which combines resistance and aerobic exercise in a single session. Findings have indicated that as compared to any exercise modality used alone, CEX (aerobic plus resistance training) produced the biggest gains in fat-free mass and overall fitness. Similarly, in the study of Alves et al.(2021) even though there were no significant differences in fat-free mass, a small increase in the CEX+MIAE group was found after the 8-week intervention period. Moreover, the outcomes from the MIAE group only presented a significant decrease in the fat-free mass, with a large effect size.

Furthermore, Skrypnik et al.(2015) conducted on comparative study on the effects of endurance training with endurance-strength training on, body composition, physical capacity, and circulatory parameters in females. Consistent significant comparative findings result in decreases in body mass, total body fat, and body fat mass observed after both types of intervention. Marked increases in total body lean and total body fat-free mass were documented in group B. Likewise Tan et al.(2023) study on an intervention training program lasted for eight weeks and consisted

of a 3-day per week. Concurrent strength and aerobic training were a crucial component of physical training intended to increase total lean mass and they indicated a significant effect.

IMPLICATION: The main finding of these results is that, in comparison to aerobic exercise alone, a combined exercise program that includes both aerobic and resistance training is more successful at increasing lean body mass. The combination of aerobic and resistance training (CEX) resulted in the largest increases in fat-free mass and total fitness levels, according to studies on both adults and adolescents. Training programs that only focused on aerobic training frequently caused a reduction in lean body mass or only a slight increase in it. It follows that a complete exercise program including both aerobic and resistance-training elements is more beneficial for people who want to gain more lean body mass than aerobic exercise alone.

5.5 Comparative Effectiveness of Two Intervention Groups

The multivariate test results describes that there is a significant intervention effect, with Wilks' Lambda = 0.411, $F(10, 21) = 3.003$, and $p = 0.016$. The partial eta-squared (η^2) value of 0.589 indicates a large effect size. Since the overall multivariate test was significant, the Univariate tests on the individual dependent variables applied to determine which ones contributed to the significant group difference.

Between-subjects effect results revealed that resting heart rate (RHR) and lean body mass (LBM) both showed statistically significant differences between the two intervention groups. Specifically, the contrast effect for RHR was significant, with $F(1, 30) = 6.182$ and $p = 0.019$. This indicates a medium-to-large effect size, as evidenced by the partial η^2 of 0.171. Similarly, the contrast effect for LBM was also statistically significant, with $F(1, 30) = 4.755$ and $p = 0.037$. The partial η^2 of 0.137 suggests a medium effect size for the difference in lean body mass between the groups.

Eta-squared (η^2) values, the treatments were responsible for explaining 13.7% of the variance in lean body mass (LBM) and 17.1% of the variance in resting heart rate (RHR). These medium-to-large effect sizes imply that the groups' outcomes differed significantly because of the interventions.

The investigator evaluated the hypotheses designed in this study on multivariate analyses of MANOVA and assessed them as follows. For the first and third hypotheses, the investigator was able to conclude that there was no significant difference between the MIAE and CEX interventions on (BP) and (BF %) of the students. Therefore, the investigator was obliged to reject the alternative hypotheses one: there is a significant difference in the effects of 8 weeks of aerobic vs. combined exercise on resting blood pressure. In addition, hypotheses three: there is a significant difference in the effects of 8 weeks of aerobic vs. combined exercise on body fat percentage.

Therefore, investigator concludes that there was no significant difference between e aerobic and combined intervention groups on blood pressure and body fat percentage. For hypothesis one and three $p>0.05$ which insignificant difference between the two intervention groups on the multivariate analyses test of between the subjects. Investigator reject these two hypothesis instead of accept it on multivariate analyses.

However, for the second and fourth hypotheses, the investigator was unable to conclude that there was no significant difference between MIAE and CEX resting heart rate and lean body mass. The result implies that there is a significant difference between the two methods on the resting heart rate (RHR) and lean body mass (LBM) of the students. The multivariate analysis of between the subject effect (between MIAE &CEX on LBM&BF %) results implies that there is significant effect difference between the two groups $p<0.05$.Consequently, the investigator failed to reject (accept it) alternative hypotheses two and four, and concluding that there was a significant difference between MIAE and CEX on these two physiological variables.

Finally, the last hypothesis: there is a statistically significant effect difference on 8 weeks of two-intervention exercise on multivariate effect of combined physiological variables. The multivariate effect of combined physiological variables $F(10, 21) = 3.003$;$p = 0.016$; Wilks' Lambda (λ)=0.411;partial eta squared(η^2)=0.589. The result indicated that there is significant effect on the multivariate analyses at $p=0.016$ which was significant. Therefor investigator accept this alternative hypothesis ($p<0.05$).

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 Summary

The primary purpose of this study was to investigate the comparison effect of 8 weeks of aerobics and a combination of aerobic with resistance exercise on selected physiological variables among Bahir Dar University's female students. For this purpose, the investigator reviewed related available kinds of literature to establish a theoretical and empirical foundation. The following specific research objectives formulated, to attain the general objective of the study.

The specific objectives of this study are to:

- Examine the effects of 8 weeks of aerobic versus combined exercise on resting blood pressure among university students
- Determine the effects of 8 weeks of aerobic versus combined exercise on resting heart rate among university students.
- Evaluate the effects of 8 weeks of aerobic versus combined on body fat percentage among university students.
- Assess the effects of 8 weeks of aerobic versus combined on lean body mass among university students.
- Compare 8 weeks of aerobic versus combined exercise on multivariate effect of combined physiological variables.

To address the above fundamental goals, this study focused on female students age (22.188 ± 0.8342) for MIAE and CEX (22.13 ± 0.719) years students that pass the investigator's criteria. Only a few physiological measurements from cardiovascular (resting heart rate), body composition (body fat percentages and lean body mass), and blood pressure were examined in this study.

The study examined key physiological variables as part of the analysis. Specifically, the investigator measured systolic blood pressure (SBP), diastolic blood pressure (DBP), resting heart rate (RHR), body fat percentage, and lean body mass (LBM). To compare the mean scores

on these variables between the Moderate-Intensity Aerobic Exercise (MIAE) group and the Combined Exercise (CEX) group, the investigator used paired sample t-test, and one-way MANOVA. This statistical technique allowed them to assess whether there were any significant differences in these physiological measures between and within the two exercise intervention groups. Statistical tests of significance at 95% confidence interval used to identify significant effects between two groups and the data were analyzed using SPSS version 26.0.

The study's final findings revealed that MIAE group found significant improvements in decreases in blood pressure and resting heart rate, as well as a reduction in body fat percentage. However, there was no significant change in lean body mass for this group.

In contrast, (CEX) group demonstrated benefits like reductions in blood pressure and heart rate. Importantly, the CEX group also experienced a significant increase in lean body mass along with a decrease in body fat percentage. In general, conclude that within-group findings underscore the importance of CEX training components to drive positive physiological adaptations, including enhanced cardiovascular health, reduced body fat, and increased lean muscle mass.

Between the two intervention groups, result revealed that there were no significant differences between MAIE group and the CEX group on key physiological variables, including systolic blood pressure (SBP), diastolic blood pressure (DBP), and body fat percentage(BF%).

Whereas, there was a significant difference between the two interventions groups on lean body mass (LBM),) and resting heart rate (RHR).

The following are key findings of the result of the study.

1. The result indicated that both MIAE and CEX interventions were effective at lowering both SBP&DBP among the participants. However, CEX group demonstrated larger improvements, with a statistically significant decrease in SBP&DBP.

2. The findings of this study revealed that both MIAE and CEX group changes were statistically significant on RHR, but the MIAE group had a stronger effect on decreasing resting heart rate than CEX group participants.

3. The results demonstrate that both the MIAE group and the CEX group experienced statistically significant decreases in body fat percentage. However, the combined exercise program, which included both aerobic and resistance training, was more effective at reducing body fat than the moderate-intensity aerobic exercise alone.

4. The current result indicates that from two interventions MIAE group did not see a significant change in lean body mass. However, the combined exercise intervention, which included both aerobic and resistance training, was significant and effective in increasing lean body mass.

5. Finally, MIAE shows a greater significant effect in decreasing RHR than CEX. While CEX were more significantly effective in increasing LBM, and decreasing SBP, DBP, and BF%. There was a statistically significant difference only in resting heart rate and lean body mass between two intervention groups.

6.2 Conclusion

Based on the findings of this study, these points stated as a conclusion.

- Both MIAE and CEX effectively lowered systolic and diastolic blood pressure, with the CEX group demonstrating larger improvements of SBP 4.375 mmHg and, DBP of 2.688 mmHg ($p < 0.05$).
- The MIAE group had a stronger effect, resulting in greater decreases in resting heart rate compared to the CEX group. MIAE group found a larger mean reduction of 4.125 bpm units in resting heart rate, compared to the 2.375 bpm unit reduction in the CEX group
- MIAE and CEX groups saw significant reductions in body fat percentage, but the combined exercise program (CEX) was more effective at lowering body fat. CEX group exhibited a larger mean reduction of 1.569% units compared to the 0.806% unit decrease in the MIAE group ($p < 0.05$).
- While MIAE group did not see a notable change lean body mass with a mean drop of 0.063 kg units, combined exercise intervention (CEX) led to a significant increase in lean body mass was 0.988 kg units $p < 0.05$), which was statistically significant.

- While CEX exhibited greater significant improvements in lean body mass, blood pressure, and body fat percentage, MIAE showed a more significant reduction in resting heart rate. There was a statistically significant difference between the two intervention groups on RHR and LBM. On resting heart rate with $F(1, 30) = 6.182$, $\eta^2=0.171$, $p <0.05$ contrast effect was significant. Lean body mass also significant at, $F(1, 30) = 4.755$, $\eta^2=13.7\%$; $p <0.05$ between the two intervention groups.

6.3 Limitation of the Study

In the present study, the following points were the limitations of the study. Firstly, the relative inexperience of the investigator, particularly with advanced analysis methods on MANOVA, has an impact on the study's data analysis and interpretation.

Secondly, there was a lack of sufficient prior research directly comparing the effects of aerobic exercise versus combined aerobic with resistance exercise on the specific physiological variables of interest in the target population of female college students. This limited the ability to generate strong a priori hypotheses, refine the methodological approach, and contextualize the current findings within the broader scientific consensus.

Thirdly, with a limited number of participants in each group, the statistical power to detect meaningful multivariate differences between the interventions limited by the small sample size of female students.

Finally, lack of previous research literature or related materials on the area of comparing the effect of two interventions was one challenging issue. In additions, stress, level of sleep pattern, long fasting of Easter (during intervention) was affected the feeding mechanism of the participants it was beyond the control of the investigator.

6.4 Direction for Future Investigations

Based on the limitations identified in the present study, several directions for future investigations are emerging:

1. Since the scope of the present study is potentially limited to a few physiological variables, future studies could aim to examine a wider range of physiological parameters, such as cardiorespiratory fitness, lactate levels, and VO2 max, to provide a more comprehensive understanding of the effects of exercise interventions. This would require securing additional resources, such as specialized equipment and expertise, as well as overcoming the time and financial constraints mentioned in the current study.

2. Investigator recommended that by increasing the Sample Size and diversifying the Population: recruiting a larger and more diverse sample of participants. Beyond just female students, it would help improve the generalizability of the findings. Considering participants from different age groups, activity levels, and backgrounds could provide valuable insights into the broader applicability of the exercise interventions. Recruiting a larger number of participants would increase the statistical power to reliably detect meaningful multivariate differences between the exercise intervention groups for the general population is clearly required.

3. Thirdly, Investigator will recommend increasing the duration of the interventions from 8 weeks to 12 weeks and adding long-term follow-up evaluations would enable investigators to examine the durability of the noted alterations in physiological variables. This may facilitate the assessment of the long-term effects of exercise regimens and long-lasting treatments that support long-term physiological gains in the creation of greater-effective interventions.

4. This study only includes female non-athlete college students; however, investigator advised to include both male and adult students to allow for a more comprehensive assessment of exercise interventions. This would enable researchers to identify any potential gender-specific differences in the physiological responses to MIAE and CEX. This would provide insights into whether the superior benefits of the CEX intervention are consistent across both genders or if there are any gender-specific variations.

5. Finally, the findings of this study demonstrate the superior benefits of the Combined Exercise (CEX) intervention in most physiological parameters compared to the Moderate-Intensity Aerobic Exercise (MIAE) intervention. Based on the observed outcomes, future research and practical applications should prioritize the further development and optimization of the CEX approach. Because it contributes to the advancement of exercise science and the delivery of more, effective and evidence-based exercise strategies for improving health and well-being.

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BAHIR DAR UNIVERSITY
SPORT ACADEMY

POSTGRADUATE PROGRAM

APPENDIX A: Physical Health and Fitness Readiness Question

For Participants: This questionnaire is prepared to obtain information on the health status and physical activity readiness of Subjects participating in the study. Please read the questions carefully and answer each one honestly by encircling it on the choice letter given and describing your condition in the space provided. Thank you.

1. Do you have a recent physical injury such as bone, muscle, or joint which will be serious by physical exercise? A. Yes B. No If yes indicate the type of injury that you had_____

2. Do you suffer with heart condition? A. Yes B. No

3. Do you have any of the following risk 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. Are you taking any prescription medicines recently? A. Yes B. No 53 If yes, name them below: - Name of drug Dosage_____ _____ _____ _____

9. Do you currently smoke? A. Yes B. No

10. Do you know your current level of s physical fitness? A. Yes B. No

11. Have you taken any health-related physical fitness skill tests before? A. Yes B. No

12. Do you know any other reason why you should not participate in a program of physical Activity? A. Yes B. No If yes explains your Reason

here_____ I have read and understand the form and have given accurate information regarding to my current health status. Signed (participant player) _____date_____

Signed (examiner) _____date_____

Source: htt://www.Barnes fitness.co.uk

ባህር ዳር ዩኒቨርሲቲ

የስፖርት አካዳሚ

የድህረ ምረቃ ፕሮግራም

ሀ፡ የአካላዊ ጤና እና የአካል ብቃት ዝግጁነት ጥያቄ

ለተሳታፊዎች፡ ይህ መጠይቅ የተዘጋጀው

ስለ ጤና ሁኔታ እና የአካል ብቃት እንቅስቃሴ ዝግጁነት መረጃ ለማግኘት ነው ለጥናቱ የሚሳተፉት። እባክዎን ጥያቄዎቹን በጥንቃቄ ያንብቡ እና በተመረጠው ደብዳቤ ላይ በመክበብ እና በተሰጠው ቦታ ላይ ያለዎትን ሁኔታ በመግለጽ እያንዳንዱን በሐቀኝነት ይመልሱ። አመሰግናለሁ.

1. በቅርብ ጊዜ በአካል ብቃት እንቅስቃሴ ከባድ የሆነ እንደ አጥንት፣ ጡንቻ እና መገጣጠሚያ ያለ የአካል ጉዳት አሎት? ሀ. አዎ ለ. አይ አዎ ከሆነ ያጋጠመዎትን ጉዳት ያመልክቱ

2. በልብ ሕመም ተሰቃይተዋል? A. አዎ ለ. አይደለም

3. ከሚከተሉት ውስጥ ለልብ ሕመም የመጋለጥ እድሎች አሎት፡ ለምሳሌ ለደም ግፊት፣ በደም ውስጥ ያለው ኮሌስትሮል እና ማንኛውም የቅርብ ዘመድ (አባት፣ እናት፣ ወንድም ወዘተ.) ሀ. አዎ ለ. አይ.

4. አካላዊ እንቅስቃሴ ስታደርግ በደረትህ ላይ ህመም ተሰምቶህ ያውቃል? ሀ. አዎ ለ. አይደለም

5. በእረፍት ጊዜ ወይም ቀላል የአካል ብቃት እንቅስቃሴ በማድረግ የትንፋሽ ማጠር አጋጥሞህ ያውቃል? ሀ አዎ ለ. አይደለም

6. በቤተሰብዎ ውስጥ የኮሮናሪ የልብ ህመም ታሪክ አለ? ሀ አዎ ለ. አይደለም

7. መቼም ድካም ይሰማዎታል; የማዞር ስሜት አለህ ወይስ ራስህ ስቶ ታውቃለህ? ሀ. አዎ ለ. አይደለም

8. በቅርብ ጊዜ በሐኪም የታዘዙ መድኃኒቶችን እየወሰዱ ነው? ሀ. አዎ ለ. አይደለም 53 አዎ ከሆነ፣ ከዚህ በታች ስጧቸው፡ - የመድኃኒት መጠን ስም _____ _____ _____ _____

9. በአሁኑ ጊዜ ታጨሳለህ? A. አዎ ለ. አይደለም

10. አሁን ያለዎትን የአካል ብቃት ደረጃ ያውቃሉ? ሀ አዎ ለ. አይደለም

11. ከዚህ በፊት ከጤና ጋር የተያያዙ የአካል ብቃት ችሎታ ፈተናዎችን ወስደዋል? ሀ. አዎ ለ. አይደለም

12. በአካላዊ እንቅስቃሴ ፕሮግራም ውስጥ የማይሳተፉበት ሌላ ምክንያት ታውቃለህ? ሀ. አዎ B. አዎ ከሆነ ምክንያትዎን እዚህ ያብራሩል _____

ቅጹን አንብቤ ተረድቻለሁ እናም አሁን ስላለኝ የጤና ሁኔታ ትክክለኛ መረጃ ሰጥቻለሁ። የተፈረመ (ተሳታፊ ተጫዋች) _____ ቀን----------

የተፈረመ (ፈታኝ) _____ ቀን----------

APPENDIX-B:

Eight Week Training Schedule

The main objective of this study's training schedule plan is to investigate the comparison effect of 8 weeks of aerobics exercise alone and a combination of aerobic with resistance exercise on specific physiological variables. The whole exercise in the study included warming up, the main part, and cooling down by applying the FITT training principle; F-Frequency, - Intensity, T-Time, and T-Type of Exercise and take place from March 20- May 20.

Frequency: describes how often the given exercise is performed. The frequency of exercises relates to the goal of the exercise program in consideration of the overall program (Ahmad & Amravati, 2016).Intensity: Intensity is the level of exertion experienced during the activity. The intensity of Exercise is grouped into three groups of intensity levels. These levels include (40-60%MHR) and (60-70%MHR) increase gradually. Time (duration of training) :time or duration refers to the number of minutes that an activity is performed and it should be recorded daily.

According to Adling and Bangar (2017), Tan et al. (2023), and (Linda S. Pescatello, 2015) Moderate intensity exercise three times per week is commonly adopted and most consistently effective approach across the studies reviewed and the book written by many researchers.so investigators designed the training programs based on considering the above training protocols.

Table 6.1 Eight Weeks Exercise Training Plan for MIAE Group

Weeks	Types of workouts	Intensity	Repetitions	Day	Seasons	Volume in minute
Week 1	Warming up, walking, jogging, running, general conditioning, fun movement and Stretching &cooling down	40-60% max HR	_____	Monday, Wednesday Friday	Morning 12.00-1.00 am	45
Week 2	Warming up, dynamic Stretching Synchronize fast walk Jogging movements of hands, legs, arms &cooling down	40-60% max HR	8-10 x	Monday, Wednesday Friday	Morning 12.00-1.00 am	50
Week 3	Warming up, dynamic Stretching, fast Jumping rope ,walking Jogging light running, sprawls &cooling down	60-70% max HR	7-8 x	Monday, Wednesday Friday	Morning 12.00-1.00 am	50-60
Week 4	Warming up, dynamic Stretching Jogging, running on the spot and running in place High knee &cooling	60-70% HR	6-7X	Monday, Wednesday Friday	Morning 12.00-1.00 am	60

	down					
Week 5	Warming up, dynamic Stretching Punch, Jumping rope, steps up jack &cooling down	60 -70% max	6-7X	Monday, Wednesday Friday	Morning 12.00-1.00 am	60
Week 6	Warming up, dynamic stretching ,side bend, spot jump &cooling down	60 -70% max HR Moderate	5-6 X	Monday, Wednesday Friday	Morning 12.00-1.00 am	60
Week 7	Warming up, dynamic Stretching, jump, brisk walk, running in place, leg kick &cooling down	60 -70% max HR	4-5 x	Monday, Wednesday Friday	Morning 12.00-1.00 am	60
Week 8	Warming up, dynamic Stretching, stair climbing, leg kick, brisk walk running in place &cooling down	60 -70% max HR	4-5 x	Monday, Wednesday Friday	Morning 12.00-1.00 am	60

Table 6.2 Eight Weeks Exercise Training Plan for Group Two

Weeks	Types of workouts	Day	NO of day /week	Volume in minutes	set	Repetition
Week 1	Warming up Dynamic Stretching, general conditioning, Fun movement, stretching &Cooling down	Tuesday Thursday Saturday	3days /week	45	2-3 x	_____
Week 2	Warming up Dynamic Stretching Jumping rope, running in place side to side reach &jumping jack &cooling down	Tuesday Thursday Saturday	3 days/week	45-50	2-3 x	8-10x
Week 3	Warming up Dynamic Stretching Running in place lunges, AB plank &squat &cooling down	Tuesday Thursday Saturday	3 days/week	50-60	3 x	6-8 x
Week 4	Warming up Dynamic Stretching High knee &lunges, glute bridge &cooling down	Tuesday Thursday Saturday	3days/week	60	3-4 x	6 -7x
Week 5	Warming up Dynamic Stretching Knee rise, set up& push up &cooling down	Tuesday Thursday Saturday	3 days/week	60	4x	6x

Week 6	Warming up Dynamic Stretching Punch, plank, I-Y-T, walkout jump, burpees, sit-ups and cooling down	Tuesday Thursday Saturday	3 days/week	60	4-5x	4-5 x
Week 7	Warming up Dynamic Stretching Mountain climbs set up, side bend, Alt. reverse jump toe touch &cooling down	Tuesday Thursday Saturday	3 days/week	60	5 x	3-4 x
Week 8	Warming up Dynamic Stretching Spot jumps ,squat side bend, super woman extensions, cooling down	Tuesday Thursday Saturday	3 days/week	60	5 x	3-4 x

BAHIR DAR UNIVERSITY

SPORT ACADEMY

DEPARTMENT OF SPORT SCIENCE

APPENDIX -C Consent to participate voluntarily in this research study

Researcher Name: Zemenu Desalegn Wube

Supervisor Name: Tesfaye Desalegn (PhD)

Proposal Title: Comparative study on the effect of eight weeks aerobic and combination of aerobic with resistance exercise on selected physiological variables among active female university students.

You are being asked to participate in this study as described below. All this like research studies carried out are governed by the regulations for research on human beings. These regulations require that the researcher obtain a signed agreement (consent) from you to participate in this research project. The researcher explains to you in detail the purpose of the study, the procedure to be used, the potential benefits, and the possible risks of participation in this study.

You can ask the researcher any questions that you may have about the study. The basic explanation of the study is summarized below. After discussion, if you agree to participate in the study, please sign this form in the presence of the researcher. You may discontinue at any time from the study if choose to do so.

1. Purpose and procedure

The purpose of this study is to investigate the comparative effect of change in eight weeks of aerobic and combination of aerobic with resistance exercise on selected physiological variables among active female university students of BDU between the ages of 21-24 years. The subject involved in this study is 32 in number and participation in this study will be required to answer the physical readiness questionnaires before starting physical activity and the test.

Risk and the safeguards

The risk of this study will be small, while administering the tests and during the test, you may experience localized muscle fatigue in your thigh, and you might feel some muscle soreness and fatigue during the tests. However, we do not expect any unusual risks as a direct result of the study, if any unexpected physical injury occurs, appropriate first aid psychological treatments will be provided, but no financial compensations were found.

Confidentiality

The information obtained about you will keep you in confidence, although you are free to release it to your trainer. The information will used only for scientific purposes without identifying you as an individual.

Contact Address:

Zemenu Desalegn _____0943572570/.

Email address ----------zemenudesalegn01@gmail.com

I certify I have read and fully understand the above study. I willingly consent to participate

Name of subject: _____

Signature of subject: _____

Address: _____

Date: _____

I certify that I have explained fully to the above subject the nature, the purpose, the potential benefits, and the possible risks involved in this research study.

Date: _____

Signature of the investigator: _____

ባህር ዳር ዩኒቨርሲቲ

ስፖርት አካዳሚ፣

ጥናት ውስጥ በፈቃደኝነት ለመሳተፍ ፈቃድ

ተመራማሪ ስም፡ ዘመኑ ደሳለኝ ውቤ

የሱፐርቫይዘር ስም፡ ተስፋዬ ደሳለኝ (ዶክተር)

የፕሮፖዛል ርዕስ፡ በስምንት ሳምንታት የኤሮቢክ ለውጥ እና ኤሮቢክ ከኤሮቢክ የአካል ብቃት እንቅስቃሴ ጋር በማጣመር በነቃ ሴት የዩኒቨርሲቲ ተማሪዎች መካከል በተመረጡ የፊዚዮሎጂ ለውጦች ላይ የንፅፅር ጥናት

ከዚህ በታች እንደተገለጸው በዚህ ጥናት ላይ እንድትሳተፉ እየተጠየቁ ነው። ይህ ሁሉ እንደ የምርምር ጥናት የሚካሄደው በሰው ልጆች ላይ በሚደረገው ምርምር ደንብ ነው. እነዚህ ደንቦች ተመራማሪው በዚህ የምርምር ፕሮጀክት ውስጥ ለመሳተፍ ከእርስዎ የተፈረመ ስምምነት (ስምምነት) ማግኘት አለባቸው። አጥኚው የጥናቱ ዓላማ፣ ጥቅም ላይ የሚውለውን ሂደት፣ ሊኖሩ ስለሚችሉት ጥቅሞች እና በዚህ ጥናት ውስጥ የመሳተፍ አደጋን በዝርዝር ያብራሩልዎታል።

ስለ ጥናቱ ሊኖርዎት የሚችለውን ማንኛውንም ጥያቄ ለተመራማሪው መጠየቅ ይችላሉ። የጥናቱ መሰረታዊ ማብራሪያ ከዚህ በታች ተዘርዝሯል። ከውይይት በኋላ፣ በጥናቱ ለመሳተፍ ከተስማሙ፣ እባክዎን ይህን ቅጽ በተመራማሪው ፊት ይፈርሙ። ይህንን ለማድረግ ከመረጡ በማንኛውም ጊዜ ከጥናቱ ማቋረጥ ይችላሉ።

1. ዓላማ እና አሰራር

የዚህ ጥናት ዓላማ በስምንት ሳምንታት ውስጥ የሚደረጉ ለውጦችን ንፅፅር ውጤት ኤሮቢክ እና ኤሮቢክን ከመቋቋም ጋር በማጣመር በ 21-24 አመት እድሜ ውስጥ ባሉ የ BDU ሴት የዩኒቨርሲቲ ተማሪዎች መካከል በተመረጡ ፊዚዮሎጂያዊ ተለዋዋጭነቶች ላይ መመርመር ነው። ትምህርቱ በዚህ ጥናት ውስጥ በቁጥር 32 መሆንን ያካትታል እና በዚህ ጥናት ላይ መሳተፍ የአካል ብቃት እንቅስቃሴን እና ፈተናውን ከማየት በፊት የአካል ዝግጁነት መጠይቆችን ይጠይቃል።

2. አደጋ እና መከላከያዎቹ

የዚህ ጥናት አደጋ ትንሽ ይሆናል፣ ፈተናዎችን በሚሰጥበት ጊዜ እና በፈተና ወቅት በጭኑ ላይ የጡንቻ ድካም ሊሰማዎት ይችላል፣ በፈተናዎቹ ወቅት የተወሰነ የጡንቻ ህመም እና ድካም ሊሰማዎት ይችላል። ነገር ግን፣ በጥናቱ ቀጥተኛ ውጤት ምክንያት ምንም አይነት ያልተለመዱ አደጋዎችን አንጠብቅም፣ ያልተጠበቀ የአካል ጉዳት ቢከሰት ተገቢ የመጀመሪያ እርዳታ ተደርጎለታል፣ ነገር ግን ምንም አይነት የገንዘብ ማካካሻ ገንዘብ አይደረግም።

3. ምስጢራዊነት

ምንም እንኳን ለእራስዎ አሰልጣኝ ለመልቀቅ ነፃ ቢሆኑም ስለእርስዎ የተገኘው መረጃ በራስ መተማመን ይኖረዋል። መረጃው እርስዎን እንደ ግለሰብ ሳይለይ ለሳይንሳዊ ዓላማ ብቻ ጥቅም ላይ ይውላል።

4. አድራሻ፡- ዘመኑ ደሳለኝ _____0943572570/0931111527።

ኢሜልአ ድራሻ ----------zemenudesalegn01@gmail.com

ከላይ ያለውን ጥናት እንዳነበብኩ እና ሙሉ በሙሉ እንደተረዳሁ አረጋግጣለሁ። ለመሳተፍ ፈቃደኛ ነኝ የርዕሰ ጉዳይ ስም፡- _____

የርዕሰ ጉዳይ ፊርማ፡- _____

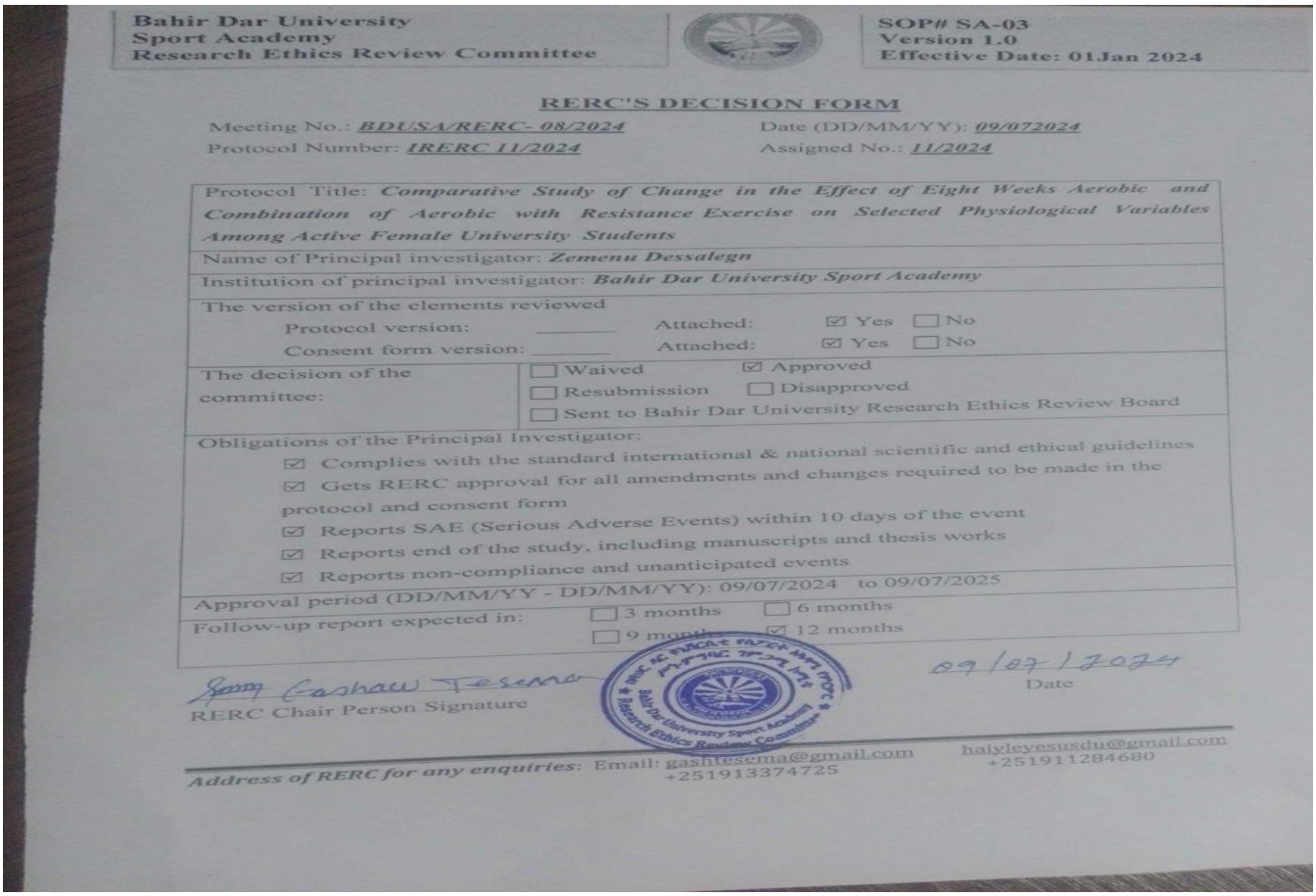
አድራሻ፡- _____

ቀን፡- _____

በዚህ የምርምር ጥናት ውስጥ ያለውን ተፈጥሮ፣ ዓላማ፣ ሊኖሩ የሚችሉ ጥቅሞችን እና ሊኖሩ ስለሚችሉ አደጋዎች ከላይ ለተጠቀሰው ርዕሰ ጉዳይ ሙሉ በሙሉ እንደገለጽኩ አረጋግጣለሁ።

ቀን፡-_____ የመርማሪው ፊርማ፡- _____

APPENDEX D ETHICAL CLERIANCE



Bahir Dar University
Sport Academy
Research Ethics Review Committee

SOP# SA-03
Version 1.0
Effective Date: 01Jan 2024

RERC'S DECISION FORM

Meeting No.: *BDUSA/RERC- 08/2024* Date (DD/MM/YY): *09/072024*

Protocol Number: *IRERC 11/2024* Assigned No.: *11/2024*

Protocol Title: ***Comparative Study of Change in the Effect of Eight Weeks Aerobic and Combination of Aerobic with Resistance Exercise on Selected Physiological Variables Among Active Female University Students***

Name of Principal investigator: ***Zemenu Dessalegn***

Institution of principal investigator: ***Bahir Dar University Sport Academy***

The version of the elements reviewed

Protocol version: _____ Attached: ☑ Yes ☐ No

Consent form version: _____ Attached: ☑ Yes ☐ No

The decision of the committee:

☐ Waived ☑ Approved

☐ Resubmission ☐ Disapproved

☐ Sent to Bahir Dar University Research Ethics Review Board

Obligations of the Principal Investigator:

☑ Complies with the standard international & national scientific and ethical guidelines

☑ Gets RERC approval for all amendments and changes required to be made in the protocol and consent form

☑ Reports SAE (Serious Adverse Events) within 10 days of the event

☑ Reports end of the study, including manuscripts and thesis works

☑ Reports non-compliance and unanticipated events

Approval period (DD/MM/YY - DD/MM/YY): 09/07/2024 to 09/07/2025

Follow-up report expected in: ☐ 3 months ☐ 6 months ☐ 9 months ☑ 12 months

Gashaw Tesema
RERC Chair Person Signature

09/07/2024
Date

Address of RERC for any enquiries: Email: gashtesema@gmail.com +251913374725 haiyleyesusdu@gmail.com +251911284680