

**EFFECTS OF AN EIGHT-WEEK AEROBICS PROGRAMME ON THE  
HEALTH-RELATED COMPONENTS OF FITNESS OF KENYAN FEMALE  
UNIVERSITY STUDENTS**

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**DECLARATION**

This thesis is my original work and has not been presented for the award of a degree or any other award in any other University.

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## **DEDICATION**

I dedicate this work to my family and fitness instructors for the continued support and encouragement during the entire studies. I also dedicate it to the ever-inspired people who train and encourage others to do so. You are blessings to me from GOD. Thank you all for the service you give to humanity trying to push them toward good health and well-being.

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**LIST OF ABBREVIATIONS AND ACRONYMS**

<b>AAHPERD</b>	: American Alliance for Health, Physical Education, Recreation and Dance
<b>ACSM</b>	: American College of Sports Medicine
<b>ACE</b>	: American Council on Exercise
<b>ADE</b>	: Aerobic Dance Exercise
<b>AHA</b>	: American Heart Association
<b>AME</b>	: Abdominal Muscular Endurance
<b>BPM</b>	: Beats per Minutes
<b>CBD</b>	: Central Business District
<b>CG</b>	: Control Group
<b>CRED</b>	: Cardiorespiratory Endurance
<b>CRF</b>	: Cardiorespiratory Fitness
<b>CVD</b>	: Cardiovascular Diseases
<b>DiD</b>	: Different in Different
<b>EG</b>	: Experimental Group
<b>HRPF</b>	: Health-Related Physical Fitness
<b>KUERC</b>	: Kenyatta University Ethics Review Committee
<b>LBF</b>	: Lower Back Flexibility
<b>MRW</b>	: Mile Run-Walk
<b>MVPA</b>	: Moderate to Vigorous Physical Activity
<b>NCD</b>	: Non-Communicable Disease

- ORPE** : Office of Research, Production and Extension
- P.A** : Physical Activity
- PACER** : Progressive Aerobic Cardiovascular Endurance Run
- PBFT** : Percentage Body Fat
- PCPF** : President’s Council of Physical Fitness
- P.E** : Physical Education
- SPSS** : Statistical Package for Social Sciences
- SUT** : Sit-Up Test
- UBSE** : Upper-Body Strength-Endurance
- UoN** : University of Nairobi
- WHO** : World Health Organization

## OPERATIONAL DEFINITIONS OF TERMS

**Abdominal Muscular Endurance:** The ability of the abdominal muscles to support the contents of the abdominal region, assist in the maintenance of the pelvic tilt, and assist the diaphragm during breathing.

**Aerobics:** Form of exercise that is done to music and purportedly develop all-round Health-Related Physical Fitness.

**Beats:** Are regular pulsations with even rhythm and continuous pattern in music.

**Body Composition:** This refers to all the tissues and fluids that make up the body.

**Cardiorespiratory Efficiency:** Ability of body systems to eliminate waste and provide enough oxygen to the working muscles during P.A.

**Health-Related Physical Fitness:** The capacity to engage in regular physical activities without excessive tiredness, while possessing attributes linked to a reduced likelihood of developing hypokinetic diseases.

**Low Back Flexibility:** Movement around the low back region through its range of motion (ROM) while performing daily activities.

**Non-Communicable Diseases:** Diseases that take a long time to develop and are not transmitted from one person to another.

**Overweight:** Weight that is considered above healthy or normal for a height.

**Percent Body Fat:** Alludes to the proportion of fat in relation to other tissues in the

body (especially muscle mass).

**Physical Activity:** This is contraction of the skeletal muscles, which results in movements of the body that need more energy than when at rest.

**Rhythm:** Continuous and regular patterns of sound or movement that can be detected and are caused by the occurrence of either strong or weak melodic or harmonic beats.

**Sedentary behaviors:** Refers to behavior associated with low energy expenditure (LEE) such as during prolonged sitting while studying, at home, screen watching such as TVs, videos, and on laptops, phone calls and sitting at a desk.

**Tempo:** Speed at which music is being played in beats per minute (BPM).

**Upper-Body Strength-Endurance:** This is the capacity of the muscles in the upper body to continuously exert force in order to sustain and assist with daily duties.

## ABSTRACT

It is globally recognized that Physical Activity (PA) plays a critical role in health, especially energy expenditure, energy balance and body composition. The absence of physical activity has been identified as a leading causative factor in Non-Communicable Diseases (NCDs) in the world, resulting in disability and death among young adults. Aerobics or Aerobic dance, which activates a variety of muscles, is gaining great popularity among young women because moving to music is enjoyable and sociable. The current research focused on effects of an eight-week aerobics programme on Health-Related Fitness components amongst Kenyan female university students. A quasi-experimental research design was used in this research that included a pre-test administered to all the participants (40) to assess status of the five selected components of physical fitness. Out of the 40, 38 (95%) of the sampled population participated to the end of the study period. This was followed by the administration of an eight-week aerobics treatment programme to the experimental group (20) only and culminated in a post-test administration to all the participants in both the experimental and the control groups. The assessments included the components of Cardiorespiratory Endurance, Low-Back Flexibility, Body Fat Percentage, Upper-Body Strength-Endurance, and Abdominal Muscular Endurance, all associated to health well-being. Data analysis was done using the Statistical Package for Social Sciences (SPSS Version 22). Authorization was sought from the Kenyatta University Graduate School to conduct research; an ethical review was obtained from the Ethical Review Committee of the Kenyatta University and a research permit was acquired from the National Council for Science, Technology and Innovation (NACOSTI), and the University of Nairobi's Research, Production and Extension office. The results for CRED, LBF, AME and UBSE variables showed that the experimental group's scores increased significantly, while the control group's scores did not differ significantly. For the PBFT variable, experimental group significantly decreased between the pre-test and post-test, while the control group's significantly increased. This showed that aerobics had a positive impact on the experimental group unlike control group. The positive post-tests revelations evidence recommended an introduction and implementation of Aerobics programmes in higher institutions of learning in support of Health-Related Fitness among female students. For further studies, quasi- experimental study is recommended to investigate overall physical fitness status of the Kenyan universities students so as to improve health status of students.

## CHAPTER ONE: INTRODUCTION

### 1.1 Background to the Study

From the moment humans came into being, lifestyle perspectives have evolved as scientific development has brought with it lesser need for physical activity (Akyol & Sogut, 2018). Technological advancement has brought newer tools and machines that are more efficient, which has not only simplified human workload but also human activity. As seen in the evidence from Akyol and Sogut (2018) studies, machines have reduced individual workload on body strength. The concept of fitness has transformed throughout the industrial revolution, shifting from simply the capability to carry out daily tasks without exhaustion to an assessment of the body's capacity to function effectively and healthily at work and during recreational pursuits, to prevent hypokinetic diseases, and to manage unexpected situations (Kumar, 2022). Kumar and Priyanka (2016) state that modern technology has simplified the mode of living and work by making life easier, more luxurious, more comfortable and inactive. Rather than walking, standing, or engaging in physical activity, the majority of the university students these days use motorized vehicles. All of which have resulted to less physically activity. Siquang (2018) supports the view that economic development and adoption of new lifestyles have led to a gradual increase in weight among the female students. Evidence has shown that inactive lifestyles along with consuming unhealthy food has resulted in excessive body weight amongst the young people living in developing countries (Spartali, Kostantinos, Ioannis & Thrasivoulos, 2014).

The American College of Sports Medicine (ACSM, 2013), identified the physical fitness constituents of body composition, cardiorespiratory fitness, muscular endurance, flexibility and muscular strength as critical to health and optimal functioning to daily living. Interestingly, the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) (1980) made an effort to relate physical activity (P.A) more closely with health. The HRF evaluation method separated low back/trunk flexibility, cardiac and thoracic endurance, abdominal muscle endurance, and percentage body fat as critical health factors in this endeavor (Esmail, 1983). Upper-body strength-endurance was included later. Though the ACSM (2013) definition gives the general impression that could apply to sports performance. The ACSM recommended assessment tests for health appear to be the same as those recommended by AAHPHERD for health-related physical fitness. Improving the elements of the Health-Related Physical Fitness (HRPF) by participating in the recommended daily MVPA has turned into a priority for improving well-being and reducing the risk of chronic diseases (Brusseau, Burns & Hannon, 2018). It has been shown that practicing aerobics for 30 minutes daily assists in maintaining HRPF components by enhancing energy expenditure and preventing sedentary behavior (Reddemma & Midhavi, 2015).

Exercise has been recognized as a valuable tool for health, but also for treatment and rehabilitation (Otinwa & Salami, 2019). A specific level of physical exercise is necessary to maintain strength and health, and it is a noteworthy modifiable risk factor for various non-communicable diseases (Sarpong, 2022). Apart from traditional forms of exercise, other more enticing types of exercise which have positive impact on the development of the fitness components have emerged (Stosic et al., 2016). The popularity of aerobics is

considered to have surpassed the popularity of other forms of physical exercise among different population (Zaletel, Gabrilo & Peric, 2013). Aerobic dance has become a popular mode of workout exercise in recent decades, particularly among women living in urban settings (Kouli, Rokka, Mavridis & Derri, 2009). The authors' reason that aerobics is interesting and 'fun' with musical background that leads to joyful dance-like movement.

Stosic *et al.*, (2016) add that regular participation in aerobic dance as a form of P.A. lowers the risk of developing cardiovascular diseases, osteoporosis, diabetes, hypertension, and ensures the normal functioning of all body organs. Ahmad and Rosli (2015) found that aerobic dance was useful in burning a lot of calories. Jaywant (2013) found that though aerobic dance was very effective in reducing fat among middle-aged women, it had no appreciable impact on cardiovascular function. Pantelic, Milanovic, Sporis and Tomic (2013) suggest that the rhythm, tempo and variety of music in Aerobic dance encourages activation of different muscle groups, energy systems and organs in the body. Exercise performance and adaptability is increased with prolonged training exercise (Hughes, Ellefsen & Baar, 2018). Lambert, Viljoen, Bosch, Pearce and Sayers (2009) studies focused on the general principles of training in which overload principle was explained to be affected by changes in the mode of Frequency, Intensity, Training and Time (FITT). This adaptation through prolonged exercise training allows athletes to perform well in their sporting event or maintain good physical condition throughout the life span (Hughes, Ellefsen & Baar, 2018). Based on these guidelines, this study decided on eight weeks because it was well above the minimum duration but at the same time less than the maximum that may have led to higher attrition among the participants. Research on how

aerobic exercise affects physical health seem to be sparsely conducted across the globe.

## **1.2 Problem Statement**

According to ACSM (2013) physical activity is defined as bodily movement produced by the contraction of the skeletal muscle that substantially increases energy expenditure. The definition includes exercise, that is planned, structured, and repetitive physical activity aimed at improving physical fitness. Until very recently, grandparents were more dynamic and occupied in energetic physical activities like angling, cultivating, chasing livestock, and walking from one place to another; all of which resulted in longer and healthier life compared to today (Akyol & Sogut, 2018). However, current urbanization and mechanization, reduced manual labor, less active transport and unhealthy eating habits have resulted in decreased physical fitness levels among many communities (Mwangi & Rintaugu, 2017). Sedentary lifestyle is counter-productive and is threatening the health of every individual in every moment of life (Arslan, 2011). Therefore, in female students, for instance lifestyle encourages or increases the risk of obesity, muscle weakness, postural deficiencies, diabetes, hypertension and coronary heart disease among other comorbidities.

The World Health Organization (WHO, 2010) pointed out that global health is affected by the four major trends of aging populations, unplanned rapid urbanization, globalization and congestion, all of which lead to unhealthy environs and behaviors. The WHO reports that 6% of deaths worldwide are due to lack of physical activity, with overweight and obesity accounting for 5% of global deaths. The fourth major risk factor for death in the globe has been found to be physical inactivity. According to research, between 70% and 90% of undergraduate students engage in sedentary behavior at any given time (Osipov,

Ratmanskaya, Zemba *et al.* 2021). This includes, extended periods of sitting at home, at class, in conference rooms, and when operating a vehicle are indicative of sedentary behavior (Inyang & Stella, 2015). However, Ajala, Adedokun, Adedeji and Ojo (2020) in World Heart Foundation believed that 60% and 80% of young women engaged in insufficient physical activity in order to achieve health benefit. In addition to this, leisure time behaviors have decreased human movement and muscular activities.

Yang *et al.* (2019) state that in order to avoid living a sedentary lifestyle, people should perform 150 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity aerobic exercise every week. Online shopping has taken technical innovation to a whole new level by eliminating the necessity for people to move while they purchase (Suman, 2016). Numerous women "who think they are healthy" struggle with being too big or not good enough hence aggravating the negative effects of obesity, overweight, and decreased levels of fitness (Nagy & Hanțiu, 2017). Additionally, aerobic exercise has been recommended by numerous doctors as a means of improving health (Ademola & Awopetu, 2018). For example, a vigorous aerobic exercise programme can be highly beneficial in lowering heart problems and, more crucially in this case, stress amongst the female university students. There is also a need to find alternative ways of encouraging students to be more active to avoid falling into the non-communicable diseases (NCDs) trap. It is anticipated by ACSM (2013) that aerobics provides an alternate means of attaining an ideal body fat percentage, strengthening upper-body strength-endurance, and boosting abdominal muscular endurance all of which are critical elements of health-related fitness. Therefore, the ACSM (2013) strongly advise that effective strategies must be developed and implemented for the evaluation and prevention of functional fitness loss

and lifestyle diseases amongst the university student. The current study utilized an eight weeks aerobics programme as an intervention approach among female university students

### **1.3 Purpose of the Study**

The intent of this research was to investigate the effects of an eight-week aerobics programme on the health-related fitness components of Kenyan female university students.

### **1.4 Objectives of the Study**

The research sought to explore the effects of an eight-week aerobics programme on the health-related fitness of Kenyan female university students.

The specific objectives of the research were to explore the following:

1. Effects of an eight-week aerobics programme on the cardiorespiratory endurance of the Kenyan female university students.
2. Effects of an eight-week aerobics programme on the percent body fat of the Kenyan female university students.
3. Effects of an eight-week aerobics programme on the low back flexibility of the Kenyan female university students.
4. Effects of an eight-week aerobics programme on the abdominal muscular endurance of Kenyan female university students.
5. Effects of an eight-week aerobics programme on the upper-body strength-endurance of Kenyan female university students.

## **1.5 Research Hypotheses**

The research null hypotheses included:

The general hypothesis of the research is that there are no significant effects in the Health-Related Fitness Components of the Kenyan Female University Students following an eight-week aerobics programme.

The specific hypotheses were:

**Ho1:** There is no significant effect in the cardiorespiratory endurance of the Kenyan female university students following an eight-week aerobics programme.

**Ho2:** There is no significant effect in the percentage body fat of the Kenyan female university students following an eight-week aerobics programme.

**Ho3:** There is no significant effect in the abdominal muscular endurance of the Kenyan female university students following an eight-week aerobics programme.

**Ho4:** There is no significant effect in the low-back flexibility of the Kenyan female university students following an eight-week aerobics programme.

**Ho5:** There is no significant effect in the upper-body strength- endurance of the Kenya female university students following an eight-week aerobics programme.

## **1.6 Significance to the Study**

This research could provide an insight into the current health status and Health-Related Fitness levels of female learners in Kenyan university. It was intended that the findings might be instrumental in designing specialized long-term non-sports specific exercise regimes for the female students. The findings of the study might inform the university curriculum developers about incorporating aerobics into curricula for enhancing fitness

levels of the students. The study results might lead to the implementation of the online workout programmes with the exercise prescription and offered work out programmes for the students. The study might provide the government (Ministry of Education) evidence for incorporating Aerobics as an alternative form of physical activities when implementing plans in support of health and fitness programmes among the female university students, hence minimize the cost of medical treatment resulting from NCDs/lifestyles diseases.

### **1.7 Limitations of the Study**

The study was limited to any registered female student in the University of Nairobi who was medically fit (Medical Form ‘Appendix B’) for participation in this study. The study was limited to the participants not involved in any other physical activity or sports apart from their normal daily living activities.

### **1.8 Assumptions of the Study**

The research was done on the assumption that Participant:

- i. Adhered to the requirements of attending every session during the eight-week aerobics programme;
- ii. Did not engaged in any other physical activity apart from that required in her normal daily living;
- iii. Continued with the normal diet; and
- iv. Was enthusiastic and positively active in all aspects of the programme.

## 1.9 Theoretical and Conceptual Framework

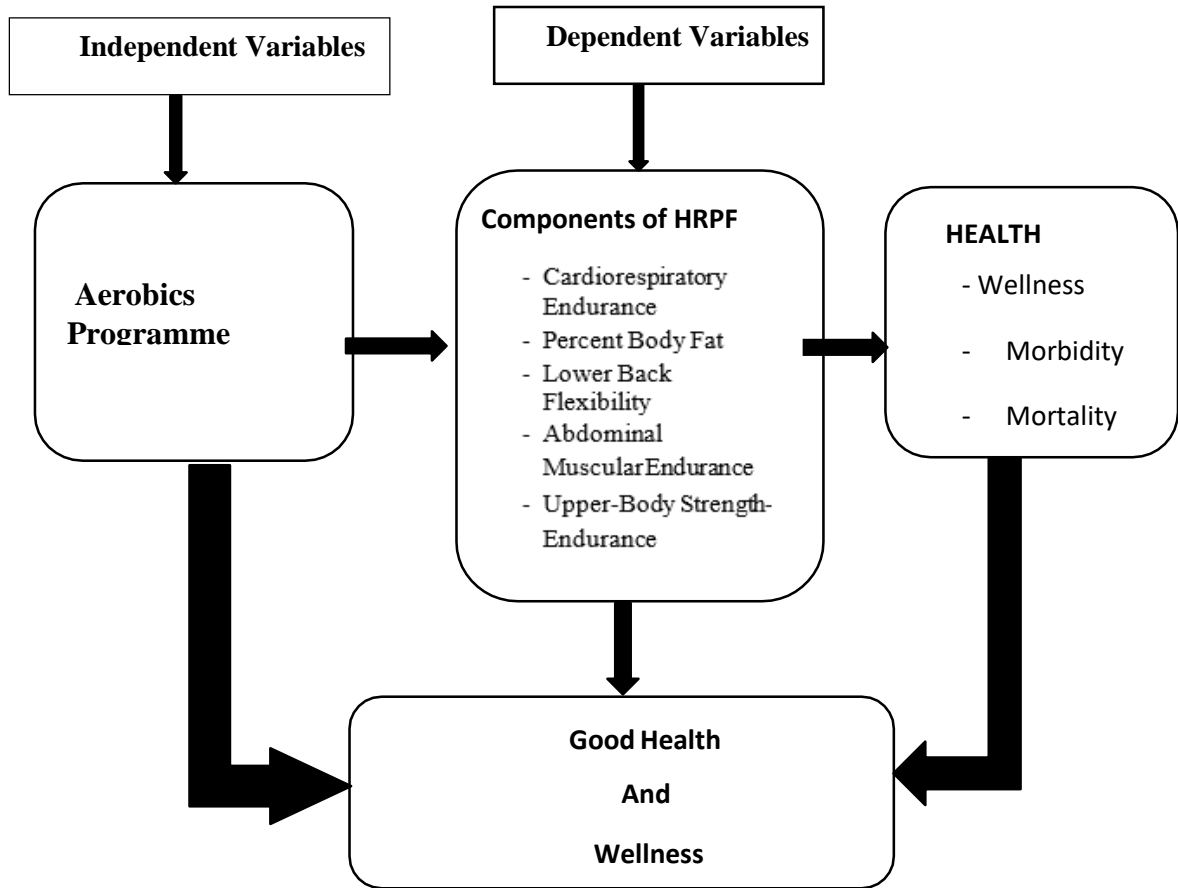
In an attempt to justify the effects of an eight-week Aerobics programme on the health-related components of fitness of Kenyan female university students, Affective-Reflective Theory of physical inactivity and exercise (Brand & Ekkekakis, 2018) was adapted. The theory asserts that stimuli such as a friendly reminder that you intended to go for a run, or remembering that you had planned to go for a run, triggers automatic associations resulting in automatic affective valuation of exercise. This is the result of modern technology which has affected the fitness and health of young people (Nawawi, 2014). It has consequently led to an inactive lifestyle with negative impacts on an individual's self-esteem, increased weariness, sleep disruptions, and trouble doing daily chores (Otinwa & Okeowo, 2017).

Physical fitness is the ability of the body to function properly during an emergency and prevent hypokinetic disorders (Sandeep, Chooda & Subraya, 2018). Physical fitness is now understood to be a gauge of the body's capacity to withstand hypokinetic illnesses, respond to emergencies, and operate healthily and efficiently both, at work and during leisure time (Medrano-Urena, Ortega-Ruiz & Benitez-Sillero, 2020). For this reason, physical exercises that result in physical fitness could be considered an effective active treatment for lowering NCDs and improving health in general (Lee, 2013).

Female students' activities have evolved over the past century, evidently moving toward more sedentary occupational tasks. This has led to tertiarization in studies that are more concerning (Thivel, Tremblay, Genin, *et al.*, 2018). Mirzaee, Jamshidi, Babaali and Nezhad (2015) assert that aerobic dance; a popular form of Moderate to Vigorous Physical Activity (MVPA) is very important to the health of young women and an essential factor in modern society. They found that aerobic dance has a positive effect on the health of women during

pregnancy, lactation, and old age. Improving the elements of the Health-Related Physical Fitness (HRPF) of female students by participating in the recommended daily MVPA has turned into a priority for improving well-being and reducing the risk of chronic diseases (Brusseau, Burns & Hannon, 2018). It has been shown that practicing aerobics for 30 minutes daily assists in maintaining physical fitness by enhancing energy expenditure and preventing sedentary behavior (Reddemma & Midhavi, 2015).

According to Suhaimi (2018), the President's Council of Physical Fitness (PCPF) explained HRF as a detailed constituent of physical fitness related to physical health. It has been mentioned that health-related physical fitness comprises of flexibility, body composition, muscular endurance, strength, and cardiorespiratory fitness (Kariyawasam *et al.*, 2019). This Health-Related Fitness can be maintained at higher healthier levels through P.A. by improving not only muscular strength, but also muscular endurance, cardiorespiratory endurance, flexibility and lowering overall body fat (Petroski, Lima, Silva & Pelegriani, 2012). The structure of a well-organized aerobics session includes training to improve cardiorespiratory function accompanied by reduction in percentage body fat and use of specific exercises to condition abdominal muscular endurance, upper body strength-endurance and low-back flexibility. In conclusion, lack of aerobics programme for Kenyan female university students might lead to poor maintenance of percent body fat, cardiorespiratory endurance, abdominal muscular endurance, low-back flexibility, and upper-body strength-endurance.



**Figure 1.1 Relationship of an intervention programme using Aerobics dance to access the impact on selected health-related physical fitness (Adapted from Schmidt, Tittlbach, Bos & Woll, 2017; Hisiso, Rani & Rekoninne, 2013; Brand & Ekkekakis, 2018).**

## CHAPTER TWO: LITERATURE REVIEW

The literature review chapter explored literature relating to the Independent variables of Cardiorespiratory Endurance, Percent Body Fat, Low Back Flexibility, Abdominal Muscular Endurance and Upper Body Strength Endurance; and the studies relating to this study's Dependent variable of Aerobics and the Summary.

### **2.1 Components of Health-Related Physical Fitness and their Assessment**

The quantity of exercise you get is an excellent indication of your general health and well-being. Gisele, Santos, Oliveira, Silva and Domingues (2023) defined Health-Related Physical Fitness (HRPF) as optimum physical condition in the components that enhance quality of life. Physical condition has a strong influence on people's quality of life. It develop one's capacity to perform better not only at work and in daily living routine tasks but also in sports. Cardiorespiratory endurance, muscle strength, flexibility, muscle endurance, and body composition are all components of the theoretical, multidimensional system known as health-related physical fitness (HPPF) (Britton, Belton, Issartel, 2019). These attributes, which are linked to health, can change in response to appropriate physical training programmes (Krishnamoorthi, Kodeeswaran, Kumaran & Halik, 2021).

Health-related physical fitness measures were utilized in Korea for the first time in the year 2009 to assess students (Lee, Roh & Kim, 2016). The FITNESSGRAM (Guide, 2013) was used to establish the standard procedures that are generally applicable to all population. The test battery measures Body Fat Percentage, Cardiorespiratory Endurance, Lower Back Flexibility, Abdominal Muscle Endurance, and Upper Body Strength Endurance through different tests (Plowman & Meredith, 2013). A comprehensive review of studies conducted

by Tabacchi, Lopez, Nese, *et al.* (2019) has identified body composition, muscular endurance, muscular strength, flexibility and cardiorespiratory endurance as the key factors influencing health. The authors content that these components play a crucial role in minimizing the likelihood of chronic diseases and promoting overall well-being.

Health-Related Physical Fitness components are assessed using either a field-based test battery or laboratory tests. However, in view of the high cost, time involvement, specialized equipment, qualified technicians and the limitation of evaluating few people at a time, Kolimechkov (2017) recommended use of field-based tests instead of laboratory tests. Ayan *et al.*, (2016) advocated the use of field tests to measure physical fitness, because they can handle a large group of participants with relative ease at lower costs, and they do not require special equipment. However, the reliability, validity, and feasibility of physical fitness (PF) evaluation techniques are crucial for precise and correct evaluations of PF (Marques, Henriques-Neto, Peralta *et al.*, 2021). This is particularly true when government and health organizations seek to screen a range of health signs in populations that are local, regional, national, or global in order to inform policy decisions.

### **2.1.1 Cardiorespiratory Endurance**

Cardiovascular fitness alludes to the capability of the respiratory and circulatory system to deliver oxygen and nourishment to the muscles over long periods of time during daily activities, exercise and physical activity. It also includes the critical function of removing waste (Hung, Liao, Chang, Wang & Wu, 2014). Prolonged and rhythmic use of large-muscles in dynamic exercises at moderate to high intensity leads to the development of the efficiency and effectiveness of the system (Singh, Laishram & Meetei, 2021). This gives cardiorespiratory endurance the general definition of the heart's and lungs' ability to

provide oxygen to the muscles through extended periods of high-intensity exercise, and is a crucial component of physical activity that promotes health (Lin, Zhang, Guo, 2015). Cardiorespiratory endurance influences performance of other Health-Related Fitness parameters. Decreased muscle strength, agility and neuromuscular functioning, extended reaction time and movement are detrimentally associated with low cardiorespiratory endurance hindering their optimum performance (Pavlovic & Radovanovic, 2014). Functional capabilities and frailty affect an individual's quality of life and longevity. This could have major physical implications and challenges, decrease independency and escalate to healthcare costs to higher levels (Kaminsky *et al.*, 2013). Cardiorespiratory fitness (CRF) has been recognized as a crucial element of health-related physical fitness by the American Heart Association (AHA) due to its remarkable capability in predicting cardiovascular disease (CVD) and all-cause mortality (Lan, Liu & Wang, 2021).

Young females who were less fit in terms of muscle strength and heart and lung health were more likely to experience high blood pressure, excess belly fat, and heart-related illnesses (Osipov *et al.*, 2020). Researchers have shown a strong correlation between students' and teenagers' cardiorespiratory fitness and activity-related healthy lifestyle choices. The 20m PACER is a highly recommended field test. It is a multistage fitness test with dynamic increments in pace while the participant runs constantly back and forth over a distance of 20-meters (Williams *et al.*, 2013). Burns, Hannon, Allen and Brusseau (2014) validated the 20m PACER model as having relative high accuracy ( $r > .80$ ,  $p < .001$ ) with the One mile run/walk model (1MRW) model. The authors suggest that the 20m pacer model showed strong ability for accurate classification of health-related fitness levels of youth.

### **2.1.2 Percent Body Fat**

According to Nagy & Hantiu (2017), Body Composition refers to everything that makes up the body (bone, muscle, organs, water, blood and fat). However, of critical concern to health is the ratio of fat free mass to fat. The ratio of free mass (bone, muscle, organs, water, and blood) to body weight, which includes fat. They found that extrinsic and essential body fat are both components of adipose tissue. For men and women, respectively, essential body fat accounts for around 3% and 12% of total body mass. In summary, American Council on Exercise (ACE) states that the overall body fat percentage for the health of young men is 18%–24% , while for young women, it is 25–31%, which is similar to the research conducted by Nagy et al. (2017).

Body composition alludes to all the tissues and fluids that make up the body. Can, Demirkan and Ercan (2019) demarcated body composition into two distinct components of fat and fat-free mass. Percent body fat is the proportion of fat to the remaining lean mass tissues in the body. Dogra, Bhattacharjee, and Shukla (2022) have elucidated that individuals, regardless of gender, are at risk of developing not only obesity but also various chronic conditions if their body fat percentage exceeds 25% for males and 30% for females. Ojo and Adetola (2017) have corroborated that females generally have a higher body fat percentage compared to males. Adequate fat levels in women is crucial for numerous essential functions such as menstrual regulation and the preservation of bone health. Body composition plays a pivotal role in determining an individual's overall fitness level by monitoring changes in both, fat and non-fat components of the body. Excessive fat accumulation poses a significant risk to the cardiovascular system, making it a primary contributor to obesity and chronic diseases (Loitongbam & Takhellambam,

2021).

Several studies have demonstrated the positive influence of aerobic dance on the overall health and well-being of individuals, particularly those who are overweight. This form of exercise helps in reducing excess body weight and lowering the risk factors associated with conditions such as hypertension and diabetes (Ademola & Awopetu, 2018). Sedentary lifestyle coupled with overeating leads to weight gain, primarily in the form of fat, which poses a threat to individual health by increasing the likelihood of hypertension, obesity, muscle weakness, and postural issues (Tangarani & Gajanana, 2018). Implementing preventive measures like engaging in physical activities during childhood and adolescence can help in reducing fat accumulation, thereby decreasing the obesity rate and promoting a healthier lipid profile (Dogra, Bhattacharjee & Shukla, 2022). Body composition plays a critical role in a person's health-related physical fitness levels, influencing maximal work capacity through its impact on training adaptations and various physiological parameters (Nar, Daglioglu & Kaya, 2013).

It would be helpful to assess body composition periodically among students so that they are aware of their current states of fitness. Researchers are opting for Skinfold Measurement Analysis more frequently due to its portability and reasonable cost. This measurement tool is ideal for analyzing a large population, as it is quick to use and does not demand advanced technical skills (Hashim, Elumalai & Rahman, 2018). On the other hand, the laboratory method requires a high level of technical expertise and expensive, specialized equipment that is not easily accessible. Skinfold measurement stands out as the most popular technique for estimating body fat percentage, thanks to its affordability, user-friendliness, and practicality. This method is accurate and everywhere in assessing Percent

Body Fat (Barreira, Renfrow, Tseh & Kang, 2013). However, Shim, Cross, Norman and Hauer (2014) studies found that skinfold measurement using a skinfold caliper is a quicker, modest and dependable strategy for estimating muscle versus fat ratios in female university competitors when performed by a skilled and knowledgeable skinfold assessor. Zin *et al.*, (2014) also revealed that skinfold caliper is utilized for determining the thickness of skin. Using Jackson and Pollock formula with Siri Formula, the sum of skinfold from various sites are converted to percentage body fat.

### **2.1.3 Low Back Flexibility**

Gadhiya, Arulsingh, Arunachalam, and Samuel (2014) define flexibility as the range of motion of a joint. The body's tissues have a quality called flexibility that controls how much a joint can move. The length and suppleness of the muscles and tendons in the joint, the curvature of the joint's bones, and the composition of the cartilage in the joint all affect how much movement a joint can accommodate. The muscles, limbs, and bones linked to the contracting muscles move when the muscle contracts. The body's innate ability to contract its muscles governs how much range of motion (ROM) the joints can have (Das, Sarkar & Goswami, 2018). The final phase of cool down purposely includes of a lot of stretching because the muscles, tendons and ligaments are warm and the joints well lubricated.

Wadhwa and Garg (2014) pointed out that flexibility could cause muscles to elongate and allow joints to move in a series of movements. Consequently, one should emphasize flexibility in athletic performance. A high level of flexibility will lower chances of injury (Arfanda, Wiriawan, Setijono, et al. 2022). Setyawan, Setijono and Kusnanik (2021) emphasized that; flexibility is a component that could affect a person's chance of getting

hurt. Optimal flexibility is an important fitness and health-related feature (Shah & Tiwari, 2016). Stretching allows the body muscles to elongate so to improve muscles elasticity. Das, Sarkar, and Goswami (2018) suggest that the breadth of movement and mobility within a joint, illustrates the range of motion capability of that body part or region. Overall flexibility can be improved through training

Low back pain (LBP) is becoming increasingly prevalent around the world. It is increasing as the world's population ages and becomes more sedentary (Shipton, 2018). Lack of flexibility is one of the significant factors in low back pain. Selvakumar and Yoga (2019) claim that good flexibility is significant for counteraction against injury. They content that stretching exercise could be utilized in restoration following injury and generally in the management of low back pain. Stretching exercises can be used in injury rehabilitation, recovery and relief of low back pain after sports. Flexibility is an integral part of Aerobic exercise making it essential for various reasons, including lowering health risks, keeping a healthy body weight, treating chronic illnesses, and improving mood (Barman & Sil, 2018).

Rinsa and Sultana (2017) uncovered that the Sit and Reach field test is acceptable for measuring lower back flexibility. Both the AAHPERD (1980) and FITNESSGRAM (Guide, 2013) test batteries recommend the sitting posture test as an effective and reliable field test to assess the flexibility of the lower back in the general population.

#### **2.1.4 Abdominal Muscular Endurance**

Javaid, Zahoor and Kalimuthu (2017) defined muscular endurance as the capability of the muscles to contract more than once over a significant stretch of time. However, abdominal

muscles continually contract to maintain the functional characteristics of the abdominal muscles. The abdominal muscles show a crucial role in maintaining internal abdominal pressure, supporting the organs, stabilizing the trunk, and facilitating movement. These core muscles, which include the deep abdominal and back muscles, are crucial for supporting the body and protecting the spine. Injuries to the abdominal muscles can occur due to factors such as overstretching, overuse, or performing trunk movements with excessive force and poor technique (Dorofeev, 2023).

Numerous neuromuscular mechanisms are believed to support the steadiness of the Lumbar Spine, with the role of the transverse abdominis and inner oblique muscles being particularly important (Page, Dubois & Descarreaux, 2011). The Strand, Hjelm, Shoepe, et al. (2014) study found that holding the plank exercise for long duration leads to maximum improvements in abdominal endurance. This is useful for improvement in sports performance, reducing back pain, and for withstanding abdominal impacts when subjected to certain conditions. Poor abdominal endurance results in back pain because of muscle imbalance between the abdominal and the low back muscles. Ishak, Zahari and Justine (2016) highlighted that the abdominal muscles together with low back muscles maintain spinal stability during body motion. They contend that strengthening the abdomen region is important in correcting a postural problem of lumbar lordosis and low-back injury prevention. Sil (2018) concluded that six-week aerobics dance training significantly improves muscular endurance in adolescent girls. For both injury prevention and proper posture, muscular endurance is crucial. It improves performance in both sports and the workplace and helps people manage the physical demands of daily life (Vineedkumar, 2022). For the majority of recreational and fitness activities, it is also

crucial.

Suhaimi (2018) used the 1-minute sit-up test (SUT) when comparing health-related fitness between male undergraduates involved in physical activity and sports science programme and those in other programmes. He endorsed the 1-minute sit-up test for abdominal endurance assessment within the test battery. Bianco *et al.*, (2015) determined that the SUT was cheaper, safer and the most acceptable test in assessing core muscular endurance for both males and females. For the aim of the existing research, 1-minute SUT was selected as a FITNESSGRAM test battery.

### **2.1.5 Upper-Body Strength-Endurance**

Wang *et al.* (2017) define muscular endurance as the capacity of a given muscle or a muscle group to contract repeatedly without becoming fatigued or to hold a single contraction for a lengthy amount of time. In contrast, muscular strength is measured by the power produced or the resistance encountered during a single, maximum voluntary effort (Javaid, Zahoor & Kalimuthu, 2017). The authors specifically contend that Upper-body strength-endurance is the capability of upper body muscles to exert force continuously during daily activities without undue fatigue. Also, an increase in strength could result in a moderate increase in endurance.

Upper-body strength-endurance is important in injury prevention. Birtukan and Sisay (2018) expound on this important significance by explaining that decreased muscle strength and endurance in the upper body and shoulders increases the chance of shoulder pain. The results obtained by Hosiso, Rani and Rekoninne (2013) show that after moderate aerobic exercise, muscle strength and other health-related fitness parameters are significantly improved. Participants in aerobics sessions can vary overload as necessary

and adequately for their personal needs. This is acceptable for general contribution. Exercises that target the upper body and improve endurance performance in healthy adults are frequently disregarded. Research indicates that performing upper body endurance exercises improves oxygen intake and function in the targeted muscles considerably (Marterer, Mugele, Schafer & Faulhaber, 2023).

An individual with strength and endurance can maintain physical activity for extended periods of time or continue it for longer (Devi & Kumari, 2014). Through its beneficial effects, primarily on the bodies cardiovascular and respiratory systems, aerobic exercise training can increase endurance capacity (Ghosh, Bera, & Khan, 2017). This is an essential component of total fitness and athletic performance, allowing athletes to compete and succeed in a variety of sports. Upper body strength helps to move the body forward and maintain balance, boosting total speed when running. It has been demonstrated to be a significant predictor of fighting ability.

The FITNESSGRAM test battery includes a valid and reliable 90<sup>0</sup> push-ups test suitable for assessing upper-body strength-endurance across all populations. Two reasons for recommending the 90<sup>0</sup> push- ups test is that it requires no equipment and it is easier than the flexed-arm hand (Hashim, Ariffin, Hashim & Yusof, 2018).

## **2.2 Aerobics**

Aerobics or Dance Aerobics (as previously known) is a form of modern exercise done to music, which has more interest and appeal, especially for women. The technique closely resembles disco dancing with slides, turns, jumps, hops and kicks providing variety for speed, coordination and strength that can be programmed for different abilities (Stosic *et*

*al.*, 2016). In the last decades of the 20<sup>th</sup> century, exercise has been very popular, mainly among women (Tangarini & Gajanana, 2018). Both sets of authors emphasized that aerobics has unique characteristics that enable exercisers perform movements rhythmically with constant tempo that activate different muscles group.

Aerobics dance is a combination of elegant dance steps with aerobics rhythm. It is a fun and enjoyable exercise that gives you energy to complete your daily tasks effectively and strengthens your body (Krishnamoorthi, Kodeeswaran, Kumaran & Halik, 2021). Aerobic dancing has gained popularity as a kind of exercise since it's fun, especially for women. Aerobic dancers can have fun and work out with the help of upbeat dance moves and great music background. Aerobic exercise has the ability to not only maintain but also improve cardiovascular fitness, as well as serve as an effective method for weight loss. As stated by Sil (2018), engaging in aerobic exercise can reduce health risks, help in managing weight, address chronic conditions, and boost one's mood. Aerobics Dance Exercise (ADE) improves the body and mind while also strengthening the heart, lungs, and muscle groups. One of the key goals of physical education programs has been the growth, enhancement, and maintenance of human physical functioning; aerobic dancing exercise is a crucial component of physical education (Ajala, Adedokun, Adedeji & Ojo, 2020). Engaging in consistent physical activity promotes optimal health and well-being by improving mobility and bodily performance.

Aerobics contributes positively to human health through strengthening the body, increased weight loss and building body muscles. Nayek and Chatterjee (2016) confirmed aerobics as a method of burning excess fat to meet the energy demands by the body during the activity. Interestingly, when accompanied by music, it is fun and enjoyable, encouraging

more movement resulting in higher fat/caloric burning among the participants (Derakhshan, Habib & Ghanbarzedeh, 2017). Gorkyurek, Sekmen and Usta (2016) state that exercising functionally enhances oxygen circulation, metabolic process, develops strength and endurance, decreases body fat and improves muscle joint movement. For effectiveness and safety, the American College of Sports Medicine (ACSM, 2013) recommends music tempo of 100bpm-120bpm for warm-up, 130bpm-160bpm for aerobics session and 100bpm to 120bpm for conditioning floor exercises; and less than 120 bpm for the cool down and final stretching.

### **2.3 Studies Related to the Effects of Aerobics on Health-Related Fitness Components**

Ahamad and Rosli (2015) revealed that aerobic dance could be used as an alternative to jogging, cycling and other exercises as a cardiovascular exercise. Sulistyoningrum and Candrawati (2017) found that a 12-week aerobic dance programme had a positive effect on reducing waist circumference and body mass index of 15 to 30 years' female participants. The study predicts that when levels of physical inactivity rise in many nations, the number of non-communicable diseases and global population health would increase. This therefore called for proper measure to increase participation in physical activity.

Godiyal Singh and Narayan (2016) found that just six weeks of exposure to dance aerobics led to reduction in physical parameters among 40 nursing students. Javaid, Zahoor, and Kalimuthu (2017) found that a 12-week aerobic training programme among 20 randomized dormitory-living college students improved the students' muscular endurance. Thus playing significant role in in improvement of Health-Related Physical Fitness among the individual.

Thirty college handball players took part in an aerobic dance-training program supervised by Vairavasundaram and Palanisamy (2014). The participants were divided into two groups - the control group and experimental group. Following the program, the experimental group demonstrated significant enhancements in abdominal muscle and strength endurance (evaluated through sit-ups), flexibility (evaluated by a sit-and-reach test), leg explosive power (evaluated by a standing broad jump), and agility (assessed through a shuttle run). Rahila and Shelvam (2015) investigated how aerobic dancing affected a group of collegiate athletes' endurance. According to their findings, the experimental group benefits from a considerable difference in resistance between the control and experimental groups. Thus, suggesting that Aerobic Dance was a viable option for endurance training among the university players.

In a recent research article by Krishnamoorthi *et al.* (2021), the impact of aerobic dancing training on the body composition and cardiopulmonary endurance of obese men was examined. The outcomes of the research validated the notion that overall physical fitness, which encompasses joint flexibility, skeletal muscle strength and endurance, and changes in body composition due to appropriate physical conditioning, is closely linked to health. Similarly, Raul, Maria, Cinthia, and Soraya (2023) further support the concept that physical abilities influencing one's quality of life are categorized as health-related physical fitness.

## **2.4 Summary of Literature Review**

As far as the current researcher can determine, there has been no other recorded research that focused specifically on the effect of Aerobics on the Health-Related elements of the physical fitness of Kenyan Female University learners. Muasya (2011) documented the effectiveness of low-impact aerobic dance in improving Health-Related Fitness among students at Kenyatta University, which distinguishes it from the current research. In which the study focused on both gender (Male and Female Students) exposed to low-impact aerobic dance. None of the studies reviewed considered the effects of aerobics/aerobic dance based on the overload principle factors of Frequency, Intensity, Time and Type (F.I.T.T), and use of Kenyan music on the health- related fitness elements. Some of the studies failed to address the issue of entry behavior of the selected participants, and some did not disclose whether the participants engaged in other sport or P.A during the study instruction. Whereas many studies indicated duration of the Aerobics programme, they did not reveal the intensity during sessions. As explained above, there were gaps observed in the studies carried out. However, the current study sheds the light on the positive impacts of Aerobics on the health-related fitness elements of percentage body fat, cardiorespiratory endurance, abdominal muscular endurance, low back flexibility, and upper-body strength-endurance among Kenyan female university students. This consequently, brings to light a viable alternative for improving health-related fitness.

## **CHAPTER THREE: MATERIALS AND METHODS**

### **3.1 Research Design**

This study adopted quasi-experimental research design. Participants were assigned to either the experimental or control groups, and all participants were tested before and after the intervention period. The study involved:

- (i) An experimental group that participated in the treatment of the eight-week Aerobics programme and a control group that did not take part in the Eight-Week Aerobics programme. Though no interference with normal routines of those in the control group.
- (ii) Administration of a pre-test to both, the experimental and the control groups, to establish initial base-line fitness levels of all participants on the dependent variables.
- (iii) Administration of the independent variable of an Eight-Week Aerobics programme to the experimental group.
- (iv) Subsequent to the Eight-Week Aerobics programme, a post-test was administered to both the experimental and the control groups to establish whether any changes had taken place in any of the health-related dependent variables.

### **3.2 Research Variables**

The Independent variable was the Eight-Week Aerobics programme. Cardiorespiratory Endurance, Percentage Body Fat, Low Back Flexibility, Abdominal Muscular Endurance

and Upper-Body Strength-Endurance constituted the dependent variables.

### **3.3 Study Location**

The study was conducted in the Fitness Room at the University of Nairobi (UoN) Main Campus. It is a public university with over 80,000 students within 6 colleges and 10 campuses offering different academic programmes (*according to UoN 2019 Registration Students File*). Main campus is located along University Way, in the Central Business District (CBD). The UoN main campus is centralized with more students, who are more cosmopolitan and are representative of a Kenyan university students involved in this study. The UoN has a fitness room at Chiromo Campus. The number of registered students as at *September 2020* were 86 students (60 Female and 26 Male students), (*Source from Students Registration files*) who were active participants.

### **3.4 Target Population**

The target population comprised the 60 quarterly registered female University students in the Fitness Room and who voluntarily participated in the Eight-Week Aerobics programme (*Sourced from 2020 records of registered students' members at the Fitness Room*). At the same time, the researcher recruited 60 female students in the same age category and who did not take part in any physical activities or sport to constitute the control group.

#### **3.4.1 Inclusion Criteria**

All females, deemed medically fit (Appendix B: Medical Form) for participation in the study who were registered as university students at the Chiromo Fitness Room, and who were not involved in any other physical or sports activity (including physical education) were included in the research.

### **3.4.2 Exclusion Criteria**

Any female student who was:

- (i) Involved in the physical education course,
- (ii) Involved any other physical activity programme,
- (iii) Deemed medically unfit (Appendix B. Medical Form)
- (iv) Involved in a sport, was excluded from the study.

### **3.5 Sampling Techniques**

The study used both, simple and stratified random sampling techniques. Simple random sampling allows conscious selection of participants based on the quality of the research requirements, and everyone from the population has the same chance of being selected. Researcher used randomly generated numbers to choose a sample. Stratified random sampling involved dividing the whole heterogeneous group (participants) into smaller groups or subpopulations such that the sampling units are homogeneous with respect to the characteristic under study within the subpopulation. This helps the researcher achieve the desired representations (Etikan, Musa & Alkassim, 2016).

### **3.6 Sample Size**

This alludes to the number of participants nominated from the students to provide the important information relevant to the study. Participants data derived from the selected sample is representative of the situation in the wider population (Chander, 2017). Using the Snedecor and Cochran formula (as explained by Dell *et al.*, 2002: Appendix E), the minimum sample size compulsory for this research was determined to be 40. The sample size for this study was set at 40 to provide for an equal distribution between the experimental group (20 students) and the control group (20 students).

### Sample Size Formula

$$n = \frac{s^2}{d^2} + 2 \left( \frac{z}{d} \right)^2$$

$$n = 2 + 2(11.51) \left( \frac{4}{3} \right)^2 = 2 + 21 \left( \frac{4}{3} \right)^2$$

$$n = 2 + 21(1.333)^2$$

$$n = 2 + 21(1.77768889)$$

$$n = 2 + 37.33$$

$$n = 2 + 38.33 = 40.33$$

**Sample Size for the Study is 40**

### 3.7 Research Instruments

The test battery used in the study was adopted from FITNESSGRAM (4<sup>th</sup> edition). Plowman and Meredith (2013) indicated that the significant test-retest coefficients found for the FITNESSGRAM makes it a reliable measure for a young population. The FITNESSGRAM Test battery is utilized worldwide to explore the Health-Related Fitness and health status of different groups of people, especially young people (Ramirez, Rodrigues, Correa, Izquierdo & Lobelo, 2015). The tests included the 20-meter PACER that assesses cardiorespiratory endurance, the skinfold measurement that assesses the percentage body fat, the sit-and-reach test that evaluates lower back flexibility, the 1-minute sit-up test that evaluates abdominal muscular endurance, and the 90<sup>0</sup> push-up test that assesses upper-body strength-endurance. The descriptions of the tests procedures, their intended purposes and scoring methods are described in Appendix B.

### **3.8 Pre-Testing of Research Instruments**

Pre-testing of the study tools was done among 10 purposely-selected female students from the University of Nairobi who were not selected for the sample in the research. Pre-testing allowed the researcher to (i) determine the amount of time that tests could take, (ii) polish the testing skills of the research assistants (iii) avoid bias in response (iv) inform the researcher about potential or expected challenges during data collection, and (v) ensure correct entry of the scores in the protocol sheets (Appendix C).

### **3.9 Validity and Reliability**

#### **3.9.1. Validity**

Validity alludes to the extent to which a research instruments accurately evaluates what is purported to measure (Bolarinwa, 2015). Selected fitness variables were validated through administration of tests to 10 female university students a week prior to training sessions. Fitness variables measure what they are supposed to measure, through checking the results prior and after training. Therefore, ensuring results correspond to the established theories and other measures of the study.

#### **3.9.2. Reliability**

Reliability is level to which research instruments used produce stable and consistent results (Heale & Twycross, 2015). Plowman and Meredith (2013) confirmed the reliability of tests in the test battery as 20 Meters PACER ( $r = 0.96$ ), Skinfold Measurements ( $r = 0.90$ ), Sit-and-Reach ( $r = 0.95$ ), 1-Minute Sit-Ups ( $r = 0.94$ ) and the 90<sup>0</sup> Push-Ups ( $r = 0.97$ ). Kolimechkov (2017) also determined that the FITNESSGRAM test battery is reliable and valid for assessing health-related physical fitness. The reliability of fitness variables was discovered using test-retest method and results correlated by administering the test twice

within an interval of four weeks.

### **3.10 Data Collection**

Potential participants were informed about all research requirements prior to participant recruitment. They were informed that all the selected participants in both, the experimental and the control groups would undergo a set of fitness tests before the start of the eight-week Aerobics programme and at the end of the eight-week Aerobics programme. Participants were assured that no test posed a risk. Additionally, they were informed that they could leave the research at any time without facing any concerns or repercussions and that participation in it was entirely optional. Each student who agreed to take part in the study signed a consent form (Appendix E) and fill Medical Form (Appendix B). The Pre-testing of the health-related fitness variables in the research was done during the week prior to the start of the research. This established the entry behavior of each participant. The post-test was administered during the week following completion of the eight-week programme. The post-test established whether the eight-week Aerobics programme had any effect on the health-related fitness components. Detailed procedures on data collection of the health-related fitness variables are shown in Appendix B. The Data protocol sheets, adopted from FITNESSGRAM, (2013), are provided in Appendix C. The procedure for testing was as follows:

- I. The 20M' Progressive Aerobic Cardiovascular Endurance Run (PACER) test was recorded. This constitute the number of completed laps by the participant's as an achievement for Cardiorespiratory Endurance.
- II. Three skinfold measurements sites was taken at the thigh, triceps and the suprailiac crest where three trials were allowed and the average recorded in millimeters for

percent body fat.

- III. Three trials were allowed for the sit- and-reach test and the average of the three tests was recorded in centimeters for low back flexibility.
- IV. The 1-Minute Sit-Up Test with knees flexed at 90 degrees was carried out for one minute and the score recorded in the number of successfully completed trials for abdominal muscular endurance.
- V. 90<sup>0</sup> Push-Ups Test was recorded with the number of successfully completed trials in 1 minute to measure upper-body strength-endurance. Elbow/Arm at 90<sup>0</sup>

### **3.11 Data Analysis and Presentation**

The gathered data underwent a process of cleaning, coding, and entry using excel. Subsequently, it was imported into the Statistical Package for Social Sciences (SPSS version 22) for analysis. Descriptive statistics like standard deviation, mean, and percentage were calculated. Furthermore, paired t-tests were utilized to determine any significant changes in health-related fitness variables after the eight-week Aerobics program. According to Manfei *et al.*, (2017), paired t-test is utilized in normally distributed data in the paired form. Tables and figures have been used to present results.

### **3.12 Logistical and Ethical Considerations**

Researcher obtained clearance for the study from Kenyatta University Graduate School and ethical approval from Kenyatta University Ethics Review Committee (KUERC) to conduct this research. Authorization for the study was acquired from the National Commission for Science, Technology and Innovation (NACOSTI) and the Office of Research, Production and Extension (ORPE) of the University of Nairobi before beginning data collecting. The consent and medical form was sought from all the participants

(Appendix B). Test procedures and possible contraindications were explained to the participants. Confidentiality and privacy were guaranteed to participants. To augment confidentiality, each participant was identified with a code e.g. EG (001....) and CG (01...). The participants were assured that the outcomes of the research would be utilized exclusively for study purposes.

## CHAPTER FOUR: RESULTS

### 4.1 Introduction

The research's experimental character necessitated the creation of an experimental (n=20) and control group (n=20). Both groups were given the FITNESSGRAM FITNESS test twice. One set of tests was performed prior to the start of the eight-week aerobics course to create a baseline, and the second set of post-tests was administered after the eight-week Aerobics programme. The study's general hypothesis was that there would be no significant difference in the health-related fitness of Kenyan female university students after an eight-week aerobics programme. The overall goal of the research was to explore the effect of an eight-week aerobics programme on the Health-Related Fitness components of Kenyan female university students. Each of the specific objectives, which included the variables Cardiorespiratory Endurance, Percentage Body Fat, Low Back Flexibility, Abdominal Muscular Endurance, and Upper-Body Strength-Endurance, were tested. This Chapter focuses on the display of pre- and post-test results. The data was analyzed using the Statistical Package for Social Sciences (SPSS Version 22), and a series of paired t-tests were performed to compare means before and after therapy. Each variable's means, percentages, frequencies, and standard deviations were examined using descriptive statistics. Every hypothesis was examined at the alpha level of 0.05.

#### 4.2. Cardiorespiratory endurance of the Kenyan female university students

There was a notable difference between experimental group and control in the Cardiorespiratory endurance after exposure to an eight-week aerobics programme. The findings indicate that although not evident at the initial test, there was a notable difference in the scores between the experimental and control groups after the test.

**Table 4.1: Pre-Test and Post-Test Raw Data for Cardiorespiratory Endurance (using 20 M PACER Test)**

Experimental Group (EG). Codes	Experimental Group (EG). Pre-Test	Experimental Group (EG). Post-Test	Change (EG).	Control Group (CG) Codes	Control Group (CG). Pre-Test	Control Group (CG). Post-Test	Change (CG).
EG 001	06	08	2	CG 01	04	04	0
EG 002	04	07	3	CG 02	08	08	0
EG 003	05	07	2	CG 03	06	04	-2
EG 004	09	10	1	CG 04	10	09	-1
EG 005	04	08	4	CG 05	07	08	1
EG 006	04	11	7	CG 06	04	03	-1
EG 007	06	09	3	CG 07	05	05	0
EG 008	04	08	4	CG 08	06	05	-1
EG 009	05	10	5	CG 09	05	04	-1
EG 0010	10	12	2	CG 010	09	10	1
EG 0011	06	08	2	CG 011	09	06	-3
EG 0012	07	08	2	CG 012	09	09	0
EG 0013	07	10	3	CG 013	07	06	-1
EG 0014	04	10	6	CG 014	04	04	0
EG 0015	03	07	4	CG 015	05	06	0
EG 0016	05	08	3	CG 016	04	05	1
EG 0017	06	08	2	CG 017	06	05	-1
EG 0018	08	10	2	CG 018	08	09	1
EG 0019	04	08	4	CG 019	06	06	0
EG 0020	10	12	2	CG 020	08	07	-1

**N=40 (20: Experimental Group and 20: Control Group).**

Table 4.2 shows that the average scores for cardiorespiratory endurance (CRED) before the test were  $5.85 \pm 0.47$  and  $6.50 \pm 0.43$  for the experimental and control groups respectively. The experimental group achieved an average score of  $8.95 \pm 0.35$  in the post-test, while the control group's average score was  $6.15 \pm 0.46$ . Through the use of an independent t-test, the CRED scores of the two groups were analyzed both before and after the test. The findings in Table 4.2 indicate that although not evident at the initial test ( $p=0.313$ ), there was a notable difference in CRED scores between the experimental and control groups after the test [ $t(38) = 4.83$ ;  $p < 0.001$ ].

**Table 4.2: Differences in the Cardio-Respiratory Endurance Scores Between Experimental and Control Groups at Pre-Test and Post-Test.**

	CRED scores by study group (mean+SE)		Statistic
	Experimental, N=20	Control, N=20	p-value
Pretest	$5.85 \pm 0.47$	$6.50 \pm 0.43$	0.313
Posttest	$8.95 \pm 0.35$	$6.15 \pm 0.46$	<0.001

***[t (38) = 4.83; p < 0.001]***

Cardiorespiratory endurance scores for the experimental group had increased significantly between the pre-test and post-test, but the score for the control group did not change significantly (Table 4.3 below) [0.47 and 0.43 at pre-test and 0.35 and 0.46 respectively]. According to the paired t-test analysis conducted to examine the change in scores, experimental group improve significantly in comparison with the control group.

**Table 4.3: Differences Between Pre-Test and Post-Test Cardiorespiratory Endurance Scores for Study Groups and Paired T-Test.**

Study group	CRED scores (mean±SE)		Difference (MoC)	Statistic p-value
	Pretest	Posttest		
Experimental, N=20	5.85±0.47	8.95±0.35	3.1±0.35	<0.001
Control, N=20	6.50±0.43	6.15±0.46	-0.35±0.24	0.167

Paired t-test analysis performed to investigate the change in scores in each of the two groups between pre-test and post-test (table 4.4 below) showed that while CRED scores for the experimental group had increased significantly between pre-test and post-test [ $t(19) = 8.74$ ;  $p < 0.001$ ], the score for the control group did not change significantly [ $t(19) = -1.44$ ;  $p = 0.167$ ]. This indicates that the experimental group improved statistically as a result of their involvement in aerobics programme. Therefore, the hypothesis stating that there would be no significant difference in cardiorespiratory endurance between pre and post-test results was rejected at 0.05.

**Table 4.4: Comparison of the Magnitude of Change in Cardiorespiratory Endurance Scores Between Experimental and Control Groups at Post-Test (DiD)**

Experimental, N=20	Control, N=20	DiD	df	t-value	p-value
4.83±0.28	1.44±0.24	-3.25±0.37	38	8.74	<0.001
<i>[t (19) =8.74; p&lt;0.001] [t (19) =-1.44; p=0.167]</i>					

### 4.3. Percent body fat of the Kenyan female university students

The experimental group's post-test scores significantly decreased, indicating that aerobics had a positive impact on percent body fat reduction. The findings showed that percent body fat scores for the experimental group decreased significantly between pre-test and post-test while those of the control group increased significantly during the same duration.

**Table 4.5: Pre-Test and Post-Test Raw Data for Body Fat Percentage (Using Skinfold Measurement Test)**

Experimental Group (EG). Codes	Experimental Group (EG). Pre-Test	Experimental Group (EG). Post-Test	Change (EG).	Control Group (CG) Codes	Control Group (CG). Pre-Test	Control Group (CG). Post-Test	Change (CG).
EG 001	16	13	3	CG 01	13	12	1
EG 002	14	13	2	CG 02	14	14	0
EG 003	11	09	2	CG 03	10	11	-1
EG 004	18	16	2	CG 04	20	22	-2
EG 005	11	09	2	CG 05	21	20	1
EG 006	13	09	4	CG 06	27	28	-1
EG 007	18	16	2	CG 07	19	20	-1
EG 008	17	11	6	CG 08	16	18	-2
EG 009	19	17	2	CG 09	20	20	0
EG 0010	15	13	2	CG 010	23	24	-1
EG 0011	20	19	1	CG 011	12	11	1
EG 0012	21	19	2	CG 012	17	18	-1
EG 0013	24	22	2	CG 013	15	16	-1
EG 0014	23	20	3	CG 014	19	20	-1
EG 0015	19	14	5	CG 015	21	20	1

EG 0016	20	18	2	CG 016	15	16	-1
EG 0017	13	10	3	CG 017	14	14	0
EG 0018	17	14	3	CG 018	11	14	-3
EG 0019	14	12	2	CG 019	23	23	0
EG 0020	19	15	4	CG 020	18	19	-1

**N=40 (20: Experimental Group and 20: Control Group).**

The average percentage body fat (PBFT) before and after the test scores for the experimental and control groups are displayed (Table 4.6 below). The pre-test averages are  $17.10 \pm 0.83$  and  $17.40 \pm 1.00$ , while the post-test averages are  $14.45 \pm 0.87$  and  $18.00 \pm 1.01$ , respectively. An independent t-test was performed to compare the PBFT scores of the two study groups at both pre-test and post-test. The results showed that the pre-test PBFT scores between the experimental and control study groups were not statistically significantly different [ $t(38) = -0.23$ ;  $p = 0.819$ ]. However, at post-test, the PBFT scores between the two groups showed statistically significant differences [ $t(38) = -2.66$ ;  $p = 0.011$ ]. Indicating improvement in experimental group than control group.

**Table 4.6: Differences in the Percent Body Fat Scores Between Experimental and Control Groups at Pre-Test and Post-Test**

	PBFT scores by study group (mean+SE)		Statistic
	Experimental, N=20	Control, N=20	p-value
Pretest	$17.10 \pm 0.83$	$17.40 \pm 1.00$	0.819
Posttest	$14.45 \pm 0.87$	$18.00 \pm 1.01$	0.011
<i>[t(38) = -0.23; p = 0.819]</i>			<i>[t(38) = -2.66; p = 0.011]</i>

A paired t-test conducted to investigate the change in scores after the intervention showed that percentage body fat scores for the experimental group decreased significantly between pre-test and post-test [ $t(19) = 9.35$ ;  $p < 0.001$ ] [ $\pm 0.83$  and  $0.87$  for experimental groups] while those of the control group increased significantly [ $t(19) = -2.45$ ;  $p = 0.024$ ] during the same duration (Table 4.7 below). This showed that there was no discernible difference between the experimental and control groups' from the pre-test and post-test scores.

**Table 4.7: Differences Between Pre-Test and Post-Test Percent Body Fat Scores Between Study Groups and Paired T-Test.**

Study group	PBFT scores (mean+SE) at		Difference (MoC)	Statistic p-value
	Pretest	Posttest		
Experimental, N=20	17.10±0.83	14.45±0.87	2.65±0.28	<0.001
Control, N=20	17.40±1.00	18.00±1.01	-0.60±0.24	0.024

***[t(19) = 9.35; p < 0.001] [t(19) = -2.45; p = 0.024]***

Nevertheless, statistically significant variations were observed in the PBFT scores between the two groups at the post-test (Table 4.8 below). The experimental group's PBFT scores significantly decreased between the pre-test and post-test [ $t(19) = 2.65 \pm 0.28$ ;  $p < 0.001$ ], while the control group's significantly increased [ $t(19) = -0.60 \pm 0.24$ ;  $p = 0.024$ ] over the same duration. This is in accordance with a paired t-test utilize to assess the change in scores following the intervention. An additional analysis was carried out using the Difference-in-Difference (DiD) method to assess and contrast the extent of change in PBFT test scores between the two study groups before and after the test. The PBFT score changes between the study groups where the pre- and post-tests were found to be statistically

significantly different [ $t(38) = 8.67; p < 0.001$ ] as shown in Table 4.8. The experimental group's post-test scores significantly decreased, indicating that aerobics had a positive impact on PBFT reduction. The hypothesis stating that there would be no significant difference in the percent body fat after eight weeks of aerobics programme and related exercises was rejected at 0.05 alpha level.

**Table 4.8: Comparison of the Magnitude of Change in PBFT Scores Between Experimental and Control Groups at Post-Test (Difference in Difference)**

Experimental, N=20	Control, N=20	DiD	df	t-value	p-value
2.65±0.28	-0.60±0.24	-3.25±0.37	38	8.67	<0.001
[ $t(38) = 8.67; p < 0.001$ ]					

#### 4.4 Low Back Flexibility of the Kenyan Female University Students

Findings showed that the experimental group's scores increased significantly while the control group's scores did not differ significantly. Thus, the experimental group's changes in low back flexibility demonstrated the benefits of an eight-week Aerobics programme.

**Table 4.9: Pre-Test and Post-Test Raw Data for Low Back Flexibility (Using Sit-and Reach Test)**

Experimental Group (EG). Codes	Experimental Group (EG). Pre-Test	Experimental Group (EG). Post-Test	Change (EG).	Control Group (CG). Codes	Control Group (CG). Pre-Test	Control Group (CG). Post-Test	Change (CG).
EG 001	21.8	22.5	<b>0.7</b>	CG 01	12.1	12.2	<b>0.1</b>
EG 002	17.0	18.9	<b>1.9</b>	CG 02	13.0	13.0	<b>0.0</b>
EG 003	18.3	20.0	<b>1.7</b>	CG 03	15.5	15.3	<b>-0.2</b>
EG 004	11.5	13.0	<b>1.5</b>	CG 04	14.0	13.9	<b>-0.1</b>
EG 005	16.9	19.0	<b>2.1</b>	CG 05	18.5	18.2	<b>-0.3</b>

EG 006	16.0	18.4	<b>2.4</b>	CG 06	16.0	16.2	<b>0.2</b>
EG 007	19.0	21.7	<b>2.7</b>	CG 07	14.5	14.6	<b>0.1</b>
EG 008	18.7	20.0	<b>1.3</b>	CG 08	17.3	17.5	<b>0.2</b>
EG 009	21.0	22.0	<b>1.0</b>	CG 09	17.8	17.6	<b>-0.2</b>
EG 0010	17.4	19.5	<b>2.1</b>	CG 010	19.2	19.5	<b>0.3</b>
EG 0011	18.0	20.0	<b>2.0</b>	CG 011	15.3	15.2	<b>-0.1</b>
EG 0012	14.7	16.3	<b>1.6</b>	CG 012	19.5	19.6	<b>0.1</b>
EG 0013	19.3	21.1	<b>1.8</b>	CG 013	20.1	20.0	<b>-0.1</b>
EG 0014	15.4	16.8	<b>1.4</b>	CG 014	21.5	21.5	<b>0.0</b>
EG 0015	20.9	22.0	<b>1.1</b>	CG 015	12.7	12.9	<b>0.2</b>
EG 0016	19.8	21.0	<b>1.2</b>	CG 016	18.6	18.4	<b>-0.2</b>
EG 0017	20.4	21.9	<b>1.5</b>	CG 017	20.0	19.8	<b>-0.2</b>
EG 0018	17.6	18.6	<b>1.0</b>	CG 018	14.6	13.6	<b>-1.0</b>
EG 0019	13.8	14.7	<b>0.9</b>	CG 019	18.0	18.3	<b>0.3</b>
EG 0020	15.7	17.0	<b>1.3</b>	CG 020	20.0	19.5	<b>-0.5</b>

**N=40 (20: Experimental Group and 20: Control Group).**

Table 4.10 shows that at both, the pre- and post-test, individuals in the experimental group had low back flexibility (LBF) scores of  $17.66 \pm 0.59$  and  $19.22 \pm 0.58$ , respectively, while those in the control group had LBF values of  $16.91 \pm 0.63$  and  $16.84 \pm 0.63$ , respectively. There were no discernible variations in LBF scores between the experimental and control study groups in the pre-test, according to an independent t-test [ $t(0.38) = 0.87$ ;  $p = 0.390$ ].

**Table 4.10: Differences in the Low Back Flexibility Scores Between Experimental and Control Groups at Pre-Test and Post-Test**

	LBF scores per study group (mean $\pm$ SE)		Statistic
	Experimental, N=20	Control, N=20	p-value
Pretest	$17.66 \pm 0.59$	$16.91 \pm 0.63$	0.390
Posttest	$19.22 \pm 0.58$	$16.84 \pm 0.63$	0.008

**$[t(0.38) = 0.87; p = 0.390]$**

In the post-test, however, there were statistically significant differences in the low back flexibility scores between the two groups ( $t(38) = 2.78$ ;  $p = 0.008$ ) as indicated by Table

4.11. A paired t-test was used to compare the LBF scores from the pre-test and post-test which shades the light on the positive impact of an eight-week aerobics programme.

**Table 4.11: Differences between Pre-Test and Post-Test Low Back Flexibility Scores Between the Study Groups**

	LBF scores (mean+SE)		Difference (MoC)	Statistic p-value
	Pretest	Posttest		
Experimental, N=20	17.66±0.59	19.22±0.58	-1.56±0.12	<0.001
Control, N=20	16.91±0.63	16.84±0.63	0.07±0.30	0.317

***(t (38) = 2.78; p = 0.008)***

The results showed that the experimental group's scores increased significantly while the control group's scores did not differ significantly (see Table 4.12). Thus, the experimental group's changes in low back flexibility demonstrated the benefits of an eight-week Aerobics programme. Consequently, the hypothesis stating that there would be no significant effects in low back flexibility before and after eight weeks' exposure to aerobics programme was rejected at 0.05 alpha level.

**Table 4.12: Comparison of the Magnitude of Change in Low Back Flexibility Scores Between Experimental and Control Groups at Post-Test (DiD)**

Experimental, N=20	Control, N=20	DiD	df	t-value	p-value
2.65±0.28	-0.60±0.24	-3.25±0.37	38	8.67	<0.001

#### 4.5. Abdominal muscular endurance of Kenyan female university students

Significant increase in experimental group score showed that the Eight-week Aerobics positively affects Abdominal Muscular Endurance. These findings warranted that the hypothesis stating that there would be no significant difference in abdominal endurance before and after eight weeks' exposure to aerobics programme and related exercises be rejected at 0.05 alpha level.

**Table 4.13: Pre-Test and Post-Test Raw Data for Abdominal Muscular Endurance (Using 1-minute Sit-Up Test)**

Experimental Group (EG). Codes	Experimental Group (EG). Pre-Test	Experimental Group (EG). Post-Test	Change (EG)	Control Group (CG). Codes	Control Group (CG). Pre-Test	Control Group (CG). Post-Test	Change (CG)
EG 001	17	21	4	CG 01	16	15	-1
EG 002	15	17	2	CG 02	17	18	1
EG 003	11	17	6	CG 03	13	13	0
EG 004	10	12	2	CG 04	18	19	1
EG 005	09	13	4	CG 05	09	08	-1
EG 006	18	23	5	CG 06	11	10	-1
EG 007	14	17	3	CG 07	19	17	-2
EG 008	15	20	5	CG 08	20	17	-3
EG 009	12	19	7	CG 09	21	19	-2
EG 0010	26	28	2	CG 010	14	14	0
EG 0011	18	21	3	CG 011	19	20	1
EG 0012	13	15	2	CG 012	14	13	-1
EG 0013	14	17	3	CG 013	16	16	0
EG 0014	17	23	6	CG 014	11	09	-2
EG 0015	20	22	2	CG 015	14	13	-1
EG 0016	10	13	3	CG 016	08	08	0
EG 0017	14	19	5	CG 017	14	10	-3
EG 0018	17	24	7	CG 018	12	10	-2
EG 0019	19	23	4	CG 019	08	07	-1
EG 0020	15	17	2	CG 020	10	10	0

**N=40 (20: Experimental Group and 20: Control Group).**

As can be seen in Table 4.14, the Abdominal Muscular Endurance (AME) scores for the experimental and control study groups were  $15.20 \pm 0.90$  and  $14.20 \pm 0.89$  at pre-test, while at the post-test they were  $19.05 \pm 0.93$  and  $13.30 \pm 0.93$  respectively. Independent t-test revealed that the two groups were not significantly different in their AME scores at pre-test [ $t(38) = 0.788$ ;  $p = 0.788$ ]. However, significant statistical differences in the AME scores were evident between the two groups at post-test [ $t(38) = 4.37$ ;  $p < 0.001$ ].

**Table 4.14: Differences in the Abdominal Muscular Endurance Scores Between the Experimental and Control Groups at Pre-Test and Post-Test**

	AME scores by study group (mean+SE)		Statistic
	Experimental, N=20	Control, N=20	p-value
Pretest	$15.20 \pm 0.90$	$14.20 \pm 0.89$	0.436
Posttest	$19.05 \pm 0.93$	$13.30 \pm 0.93$	<0.001

***[t(38) = 0.788; p = 0.788]***

Using the paired t-test to compare the differences between the initial and final test scores, it was observed that there was a significant statistical fluctuation in the AME scores for each group from the first to the final test, or after the eight-week aerobics program. Scores for the experimental group increased significantly [ $t(19) = -9.98$ ;  $p < 0.001$ ] while those of the control group decreased significantly [ $t(19) = 3.02$ ;  $p = 0.007$ ] (Table 4.15).

**Table 4.15: Differences Between Pre-Test and Post-Test Abdominal Muscular Endurance Scores Between the Study Groups and Reflection of Paired T-Test Results.**

Study group	AME scores (mean+SE) at		Difference (MoC)	Statistic
	Pretest	Posttest		p-value
Experimental, N=20	$15.20 \pm 0.90$	$19.05 \pm 0.93$	$-3.85 \pm 0.39$	<0.001

Control, N=20	14.20±0.89	13.30±0.93	0.90±0.30	0.007
<b><i>[t (19) = -9.98; p &lt; 0 .001] [t (19) = 3.02; p = 0.007]</i></b>				

Therefore, a further difference in difference (DiD) analysis was done to ascertain the impact of the Eight-Week Aerobics intervention programme on the AME scores by comparing the magnitude of change in the AME scores between pre-test and post-test across the two groups. The outcomes uncovered that the change recorded in the experimental group score was significantly higher than that recorded among the control study group [t-(38) = -9.74; p=<0.001] (Table 4.16). Therefore, the significant increase in experimental group score showed that the Eight-week Aerobics positively affects Abdominal Muscular Endurance. These findings warranted that the hypothesis stating that there would be no significant difference in abdominal endurance before and after eight weeks' exposure to aerobics programme and related exercises be rejected at 0.05 alpha level.

**Table 4.16: Comparison of the Magnitude of Change in AME Scores Between Experimental and Control Groups at Post-Test (Difference in Difference)**

Experimental, N=20	Control, N=20	DiD	df	t-value	p-value
-3.85±0.39	0.90±0.30	4.75±0.49	38	-9.74	<0.001
<b><i>[t-(38) = -9.74; p=&lt;0.001]</i></b>					

#### 4.6. Upper-body strength-endurance of Kenyan female university students.

Based on the results, the average improvement in upper-body strength-endurance (UBSE) scores for the experimental group was significantly greater than that of the control group. Findings revealed the improvement in the experimental group Upper-Body Strength-Endurance than control group hence signifying the effectiveness of Aerobics programme.

**Table 4.17: Pre-Test and Post-Test Raw Data for Upper-Body Strength-Endurance (Using 90<sup>0</sup> Push-Ups Test)**

Experimental Group (EG). Codes	Experimental Group (EG). Pre-Test	Experimental Group (EG). Post-Test	Change (EG).	Control Group (CG) Codes	Control Group (CG). Pre-Test	Control Group (CG). Post-Test	Change (CG)
EG 001	08	10	2	CG 01	09	09	0
EG 002	10	14	4	CG 02	11	10	-1
EG 003	11	16	5	CG 03	13	11	-2
EG 004	13	14	1	CG 04	16	15	-1
EG 005	11	13	2	CG 05	08	09	1
EG 006	09	11	2	CG 06	07	06	-1
EG 007	07	10	3	CG 07	11	12	1
EG 008	14	16	2	CG 08	08	08	0
EG 009	15	18	3	CG 09	07	07	0
EG 0010	10	12	2	CG 010	14	14	0
EG 0011	04	10	6	CG 011	12	10	-2
EG 0012	07	09	2	CG 012	10	07	-3
EG 0013	10	11	1	CG 013	08	06	-2
EG 0014	11	15	4	CG 014	09	11	2
EG 0015	09	12	3	CG 015	11	10	-1
EG 0016	05	08	3	CG 016	12	13	1
EG 0017	09	11	2	CG 017	10	09	-1
EG 0018	11	13	2	CG 018	16	14	-2
EG 0019	06	08	2	CG 019	14	13	-1
EG 0020	10	14	4	CG 020	11	10	-1

**N=40 (20: Experimental Group and 20: Control Group).**

As can be seen in Table 4.18, the experimental and control study groups had mean upper-body strength-endurance (UBSE) scores of  $9.50 \pm 0.63$  and  $10.85 \pm 0.61$  at pre-test while at post-test they recorded scores of  $12.25 \pm 0.62$  and  $10.20 \pm 0.60$  respectively. The Independent t-test showed that the pre-test UBSE scores were not significantly different [ $t(38) = -1.54$ ;  $p = 0.133$ ] between the two study groups while at post-test, the difference was significant [ $t(38) = 2.38$ ;  $p = 0.023$ ].

**Table 4.18: Differences in the Upper Body Strength Endurance Scores Between the Experimental and Control Groups at the Pre-Test and the Post-Test Levels**

	UBSE score by study group (mean+SE)		Statistic
	Experimental, N=20	Control, N=20	p-value
Pretest	$9.50 \pm 0.63$	$10.85 \pm 0.61$	0.133
Posttest	$12.25 \pm 0.62$	$10.20 \pm 0.60$	0.023
<b><i>[t(38) = -1.54; p = 0.133] [t(38) = 2.38; p = 0.023]</i></b>			

The effects of the eight-week aerobics programme on the study subjects' scores were investigated using a paired t-test. The findings revealed that the experimental group's UBSE scores significantly increased [ $t(19) = -9.51$ ;  $p < 0.001$ ], but the control group's scores significantly decreased [ $t(19) = 2.29$ ;  $p = 0.033$ ] as seen in Table 4.19.

**Table 4.19: Differences Between the Pre-Test and the Post-Test in the Upper-Body Strength-Endurance Scores of the Study Groups and Reflection of Paired T-Test Results**

Study group	UBSE scores (mean+SE)		Difference (MoC)	Statistic p-value
	Pretest	Posttest		
Experimental, N=20	9.50±0.63	12.25±0.62	-2.75±0.30	<0.001
Control, N=20	10.85±0.61	10.20±0.60	0.65±0.28	0.033

***[t (19) = -9.51; p = <0.001] [t (19) = 2.29; p = 0.033]***

Difference in difference (DiD) analysis was conducted to ascertain the impact of the eight-week Aerobics intervention by comparing the magnitude of change in the UBSE scores of the two study groups. Based on the results, the average improvement in UBSE scores for the experimental group was significantly greater than that of the control group ( $t(38) = -8.40$ ;  $p < 0.001$ ) (Table 4.20 below). The improvement in the experimental group participants Upper-Body Strength-Endurance shows effectiveness in Aerobics in building Upper-Body Strength-Endurance. Further analysis using paired t-test for the separate groups showed that the mean change for the two groups using the separate parameters was significant at 0.05 alpha level. The hypothesis stating that there would be no significant difference in upper body strength endurance after an eight weeks' aerobics programme was rejected at 0.05 alpha level.

**Table 4.20: Comparison of the Magnitude of Change in UBSE scores between experimental and Control Groups at Post-Test (Difference in Difference)**

Experimental	Control	DiD	df	t-value	p-value
-2.75±0.29	0.65±0.28	3.40±0.40	38	-8.40	<0.001

## **CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

### **5.1 Introduction**

This chapter presents a discussion of the above findings based on the objectives of the study as well as comparisons and contrasts with the available literature. This includes: Cardiorespiratory Endurance of the Kenyan Female University Students, Percent Body Fat of the Kenyan Female University Students, Low Back Flexibility of the Kenyan Female University Students, Abdominal Muscular Endurance of Kenyan Female University Students and as well as Upper-Body Strength-Endurance of Kenyan Female University Students. The research aimed to assess how an eight-week aerobics programme affected health-related fitness among female university students in Kenya. Participants were separated into two groups: a control group, which received no training, and an experimental group, which received training for eight weeks. The study's objectives were to ascertain the effects of an eight-week aerobics programme on:

- The Cardiorespiratory endurance of the Kenyan female university students.
- The Percent body fat of the Kenyan female university students.
- The Low back flexibility of the Kenyan female university students.
- The Abdominal muscular endurance of Kenyan female university students.
- The Upper-body strength-endurance of Kenyan female university students.

The findings revealed that the mean scores for cardiorespiratory endurance (CRED) among the control and experimental groups at the pre-test were  $6.50 \pm 0.43$  and  $5.85 \pm 0.47$

respectively while at the post-test the scores were  $8.95\pm 0.35$  and  $6.15\pm 0.46$  for experimental and control groups respectively. The experimental group's CRED scores improved significantly after the test compared to before. In contrast, the control group's scores stayed constant across the two data collection points. However, at post-test, the PBFT scores between the two groups were statistically significantly different. The higher mean meant that the Experimental group experience changes during an Eight-Week Aerobics programme. Participants in the experimental group participants recorded low back flexibility (LBF) scores of  $17.66\pm 0.59$  and  $19.22\pm 0.58$  at pre-test and post-test respectively; while the control group recorded LBF scores of  $16.91\pm 0.63$  and  $16.84\pm 0.63$  at pre-test and post-test respectively. This revealed that while there were no statistically significant variations in the scores of the control group, the experimental group's LBF scores dramatically improved at the post-test. The Abdominal Muscular Endurance (ABE) scores for the experimental and control study groups were  $15.20\pm 0.90$  and  $14.20\pm 0.89$  respectively at pre-test, while at the post-test they were  $19.05\pm 0.93$ , and  $13.30\pm 0.93$  respectively. The paired t-test analysis showed that after the Eight-Week Aerobics programme, there was a significant difference in the AME scores for both groups between the pre- and post-tests. The experimental group's score improvement was clearly greater than the control groups, according to the results. In the Upper-Body Strength-Endurance (UBSE), the mean scores for experimental and control groups were  $9.50\pm 0.63$  and  $10.85\pm 0.61$  respectively at the pre-test while at the post-test they recorded scores of  $12.25\pm 0.62$  and  $10.20\pm 0.60$  respectively. Nonetheless, the findings of a paired t-test, which examined the impact of the Eight-Week Aerobics Program on the participants' UBSE scores, revealed that the experimental group's scores increased significantly, while the

control group's scores decreased dramatically. Therefore, Eight-week aerobics programme had a positive and significant effect on all the health-related fitness components of the Kenyan Female University students who were selected for the study. Therefore, the hypotheses stating that there would be no significant change on the health-related fitness components of subjects after eight weeks of exposure to aerobics programme and related exercises were rejected at 0.05 alpha level. The implication here is that aerobics is able to maintain and develop all the health-related fitness components.

## **5.2 Discussions**

This section discusses the findings from the study variables of the selected health-related physical fitness components. Findings revealed that there were notable changes at the end of an eight-week aerobics programme for the experimental group than the control group.

### **5.2.1 Cardiorespiratory Endurance of the Kenyan Female University Students**

The study revealed changes between Experimental and Control groups during the pre-test and the post-test of an Eight-Week Aerobics Programme. The significance of cardiorespiratory endurance is highlighted, whereby the heart, lungs, and blood vessels can operate at their best while carrying out their functions. This makes it possible for the body to take in oxygen and transport it throughout, especially to active tissue, where metabolic activities may use it (Arfanda, Wiriawan, Setijono, *et al.*, 2022). This is among the most significant elements of physical fitness that have to do with health. According to Subramani and Suba (2019), the lungs are where oxygen is taken in and transferred to the heart, which in turn transfers the oxygenated blood and energy to the working muscles such that prolonged activity is possible. Thus enhancing endurance in sports or daily activities at

maximum level.

Therefore, the significant change in the mean scores for cardiorespiratory endurance among the experimental group as compared to the control group is an indication of the impact of an Eight-Week Aerobics Programme. Interestingly, Annadurai and Gandhimaheswaran (2021) had found similar positive improvement in cardiorespiratory endurance performance following an aerobics programme. The current study found noteworthy distinction in the experimental group's cardiorespiratory endurance between the pre- and post-tests. Thus, the current study also supports the findings of Naveena and Glory (2019) who had demonstrated that cardiorespiratory endurance for the participants in their experimental groups significantly improved after exposure to aerobic dancing training.

At the pre-test, there was no significant difference in the CRED scores between the experimental and control groups; however, there was a significant difference at the post-test. The changes imply the need to live healthy life by improving cardiorespiratory endurance through exercise. Singh, Laishram and Meetei (2021) affirm that healthy cardiorespiratory endurance is essential to high level of fitness and wellness. Regarding that, there was no discernible change in the control group's cardiorespiratory endurance between the pre- and post-test. The goal is to perform aerobic exercise since it strengthens the heart, enhances the circulatory system, and increases the body's capacity to supply oxygen to the muscles. This is because CRED is the most crucial and significant aspect of physical fitness relating to health, other from flexibility, muscular endurance and strength, and body composition (Anuar, 2020). Therefore, an increase in CRED fitness indicates an improvement in the heart's capacity to supply oxygen to all of the working muscles.

A strong cardiorespiratory base is necessary for success in endurance sports, and aerobic metabolism powers endurance exercise (Arfanda, Wiriawan, Setijono, et al 2022). They fortify our heart and lungs and teach our circulatory system to better control and distribute oxygen throughout our body in the course of daily activities and athletic endeavors. Large muscle groups with a rhythmic character that can be sustained for at least 10 minutes are used during the procedure (Mathai & Balasubramanian, 2022). Maintaining enough cardiorespiratory fitness is necessary to enable the completion of these full-body exercises without experiencing abrupt and intense tiredness. Furthermore, knowledge of the heart, lungs, and blood vessels (as well as the blood they carry) is necessary to improve cardiorespiratory fitness (Ajisafe, 2019).

Aerobic exercise generates beneficial changes in the body and mind and activates the heart, lungs, and all functioning groups of muscles (Alemayehu, Bayile & Mossa 2021). They cause positive changes in the body, particularly in the heart, lungs, and blood circulation. According to Annadurai and Gandhimaheswaran (2021), this kind of exercise strengthens the heart, enhances the circulatory system, and increases the body's capacity to supply oxygen to the muscles. The changes exhibited in the experimental group during the post-test ascertained the need of exercising at least 3 days per week for the improvement of cardiorespiratory endurance.

### 5.2.2 Percent Body Fat of the Kenyan Female University Students

According to Nagy and Hantiu (2017), body composition is the distribution of fat and fat-free mass within the overall weight of the body. It includes a variety of elements such as blood, water, muscles, organs, and bones. There are two forms of fat in the body: necessary body fat, which is located in the bone marrow, nervous system, and organs, and non-essential or store fat, which is subcutaneous adipose tissue surrounding the liver, heart, and kidneys. The two primary components of body composition that are studied are fat mass and fat-free mass. According to Can *et al.* (2019), fat mass is made up of subcutaneous, storage, and essential fats, whereas fat-free mass is made up of muscle, bone, veins, water, nerves, and organic structures. An individual's overall health state can be inferred from their body fat percentage evaluation.

Comparing to the control group, the experimental group's percentage of body fat decreased dramatically. In a study by Ajala, Adedokun, Adedeji & Ojo, (2020), those who participated in the experimental side, scored significantly higher on average after the test, showing they focused a lot on the advantages of a two-month cardio exercise programme. Stosic *et al* (2016) demonstrated that visceral fat is lowered more than subcutaneous fat. They emphasized that regular exercise is more successful in reducing visceral fat without significantly lowering body weight. Exercise during childhood and adolescence is one preventive strategy that can help reduce fat deposition, which lowers the obesity risk and promotes a healthy lipid profile (Dogra, Bhattacharjee & Shukla, 2022). In view of supporting evidence, results of the current study suggest that aerobics training improved overall fitness, prevented obesity, helped participants lose weight by reducing body fat.

The pre-test scores did not indicate any variation between the experimental and control

groups. However, the independent t-test revealed an increase in post-test values. This implies that regular physical activity, along with proper nutrition, tend to decrease the complications of some risk factors such as the block at the coronary arteries of heart and complication of atherosclerosis (Yazdani, Ramazani, Moomnikh & Nasiri, 2018). They contend that in terms of reducing visceral fat, it outperforms a weight loss-focused diet. In the current study, the mean scores of the experimental group during the post-test considerably surpassed those of the control group, leading to a direct beneficial effect on lifestyles diseases.

To assess and compare the degree of change in PBFT test scores between the two study groups at the pre- and post-test, more analysis was done. Between the study groups, there was a statistically significant difference in the mean PBFT scores between the pre- and post-test. Akyol and Imamoglu (2019) showed that engaging in moderate to strenuous physical exercise three to five times per week increases total high-density lipoprotein cholesterol levels while decreasing low-density lipoprotein cholesterol and triglycerides. Body composition significantly changed when the eight-week aerobics programme was implemented. It should be mentioned that prior to the start of the treatment, all participants were informed not to adjust their nutrition and diet. It is assumed that this remained unchanged throughout the study. By decreasing body fat percentage, real body fat, and increasing fat-free mass, the aerobics programme improved body composition.

Excessive body fat poses a significant risk to the heart and its supporting systems, leading to obesity and chronic illnesses (Loitongbam & Takhellambam, 2021). Exercises ranging from moderate to high intensity can increase aerobic capacity, aid in fat loss, help maintain an appropriate body weight, and increase muscle mass. The principles of training must be

taken into account while creating a training programme in order to determine the appropriate level of difficulty for each activity, whether it be low or moderate. According to Osman (2019), lack of optimal health condition and having overweight is the other reason for having cardiovascular disease, which occur because of increasing the amount of fat deposit. This enables the hearts, lungs and muscle groups performed inefficiently.

One of the fundamental objectives of physical fitness programmes, of which aerobic exercise is a crucial component, has been the growth, enhancement, and maintenance of human physical functioning. Exercise can help change body composition and lower the risk of cardiovascular disease. It is also a low-cost, non-pharmacological activity (Widiastari, Taufik & Mukhtar, 2020). One important component in determining a person's degree of fitness was their body composition. It monitors alterations in both, our body's fat and non-fat constituents. Accordingly, body fat is the quantity of fat that corresponds to a person's body weight and may be associated with a number of illnesses liking diabetes, high blood pressure, heart disease, and cancer (Asep, Sofyan & James, 2021). According to Aktas Ozdil, Bağış, and Guven's (2016) study, inactive ladies' body composition and weight loss were positively impacted by aerobic exercise application. Accordingly, the study discovered that inactive ladies who participated in a two-month aerobic exercise programme saw a 9.06% reduction in body weight.

### **5.2.3 Low Back Flexibility of the Kenyan Female University Students**

Essentially, flexibility refers to the extent to which a body part can move in or around the joints. It encompasses the range of motion and mobility within a joint (Das, Sarkar & Goswami, 2018). Flexibility is a highly adaptable component of physical well-being. It increases with regular exercise and decreases with a lack of physical activity. Moreover,

flexibility is joint-specific, meaning that a joint's flexibility does not necessarily indicate flexibility in another joint. However, the means scores reflected in the study showed that, experimental group recorded high low back flexibility (LBF) scores at post-test; while the control group recorded low LBF scores at post-test. Hence, demonstrating the effects of aerobics programme on flexibility.

It can be more challenging for individuals who are overweight to effectively carry out tasks and achieve their desired level of flexibility (Multani, Sutar, Nikhade & Ghodey, 2019).

This makes it more difficult for a person to move most joints in the body through their full ranges of motion without putting undue strain on their articulations and muscle attachments. The improvement in the flexibility among the experimental group is an indication that individuals were able to display some movement of joint through unrestricted and pain free ROM with ease. There were no discernible differences in the LBF scores between the experimental and control study groups at the pre-test, according to the statistical analysis. The post-test findings of an eight-week aerobics programme showed statistically significant differences in the LBF scores between the two groups. The pre-test and post-test results did not show any statistically significant increases in the control group. However, a statistically significant increase in the LBF was noted in the experimental group.

Exercise has a noteworthy effect on the development and enhancement of low back flexibility. Flexibility plays a crucial role in certain elite sports disciplines, including gymnastics, diving, and skating (Selvakumar & Yoga, 2019). Sports performance is significantly influenced by flexibility, since being flexible might actually lower the chance of injury. It is effective to move the same joint or group of joints through a Range of Motion

(ROM) so that to reduce injury cases (Mathai & Balasubramanian, 2022). According to Nuzzo (2020), flexibility is an inherent characteristic of bodily tissues that controls range of motion (ROM) without posing a risk of harm. Lack of flexibility is a key factor influencing the likelihood of harm (Setyawan, Setijono, & Kusnanik, 2021). Aerobics ability in enhancing flexibility, makes it an important factor for encouraging the young generation' to participate in Aerobics as a form of modern exercise.

There are as many different types of aerobic dance programmes as there are performers' interests and preferences thanks to the variety, style, and musical accompaniment of the movements (Jayakumar, 2021). The condition of our flexibility is influenced by both our age and the level of physical activity we engage in. As we age, our muscles tend to decrease in size, strength and stretch ability, leading to reduced flexibility and increased stiffness. This may have an impact on the range of motion in our joints, resulting in muscle and joint stiffness (Mathai & Balasubramanian, 2022). Individuals who live sedentary lifestyles are more prone to experiencing a decline in flexibility, as they grow older.

Stretching exercises have multiple benefits, including aiding in injury recovery, preparing the body for sports activities, and facilitating post-physical activity recovery. The primary determinants of flexibility are the tightness of ligaments, tendons, and muscles that are linked to the joint. Therefore, maintaining joint health and avoiding injuries require good flexibility. Sit and reach tests were utilized in this research to examine static flexibility of the low back. In order for the research assistant to record scores, participants had to sit on the floor and reach toward their toes three times.

#### **5.2.4 Abdominal Muscular Endurance of Kenyan Female University Students**

Toppo and Sultana (2014) offered a succinct description of muscle endurance. They described it as a muscle's capacity to apply a submaximal force at a single location for a predetermined amount of time. The impact experienced by the participants during an Eight-Week Aerobic Programme concur with the researcher. This proves that having sufficient muscle endurance allows one to maintain a certain degree of muscle tension, which can be achieved by holding a muscle contraction for an extended amount of time as in static stretching or by contracting the same muscle repeatedly as in dynamic stretching.

Muscular endurance is crucial for both, injury prevention and proper posture. It improves performance in both work, sports, and helps people deal with the physical demands of daily life. Additionally, it is crucial primarily when engaging in recreational and physical activities (Vineedkumar, 2022). For those who participate in sports, muscular endurance is crucial. This is because it provides stability and endurance to the muscles surrounding the abdomen. Kumar, Kumar, Nezamuddin, and Sharma (2015) provided support for the aforementioned perspectives. They highlighted that the quadratus lumborum, internal oblique and medial fibers of the external oblique serve as secondary stabilizers with significant stabilizing capabilities. The study's findings indicated a disparity in the post-test abdominal muscular endurance ratings between the experimental and control groups, while not much difference was observed during the pre-test phase. This meant that an eight-week aerobics programme positively affect AME of the experimental group by affecting the mentioned muscles.

At the end of the eight-week aerobics programme, there was a notable increase and drop in the experimental groups and the control groups mean scores, respectively, indicating the

fundamental effects of aerobic exercise. The body's core, which resembles a box, is made up of different muscle groups. The rectus abdominis supports the front, and the diaphragm and pelvic floor are positioned at the top. The sides of the body house the internal and external obliques, while the back is home to the erector spinae, lumbar multifidus, and quadratus lumborum. Finally, the iliac psoas muscle reinforces the bottom (Oliva-Lozano & Muyor, 2020). The center is more crucial, particularly for stabilization. These study results demonstrated the fundamental effects of an aerobics-training programme. However, according to the paired t-test comparison of the pre- and post-test scores statistically significant differences in the AME scores were seen in both groups between the pre- and post-tests following the eight-week aerobics programme.

Endurance is necessary for daily tasks; if one has strong endurance, one will not feel excessive exhaustion from these activities. It has a close connection to the heart, lungs, and circulatory system (Puspodari, Setijono, Wiriawan, *et al.* 2022). The outcomes from the research uncovered that the two groups were not significantly different in their AME scores at pre-test. The significant statistical differences in the AME scores were evident between the two groups at post-test. The impact felt by the experimental group at the end of eight-week aerobics programme gives better support for positive effects of exercise on abdominal muscular endurance. There is sufficient data to demonstrate that muscular endurance determines one's capacity for physical exercise, which in turn benefits the muscles. Consequently, it is believed that abdominal muscle endurance is one of the utmost significant aspects of fitness, which is linked to health and can improve general health.

The transversus abdominis and internal oblique muscles play a crucial role in stabilizing the lumbar spine through various neuromuscular pathways. (Page, Dubois & Descarreaux,

2011). In a similar vein, the study suggested that a risk factor for the onset of low back pain (LBP) could be insufficient trunk muscle endurance. The fact that not many individuals understand the value of muscle endurance and other training techniques that can help to develop it is another issue. Aerobic dance can be a highly successful method for developing skeletal muscles and abdominal endurance when it is customized for each participant (Vineedkumar, 2022). Furthermore, the same study shows that during the last decade, various writers have claimed that the abdominal muscles play an important role in spinal stability. This is because they can maintain consistent, low-intensity isometric contractions, which help to support the trunk in diverse situations.

### **5.2.5 Upper-Body Strength-Endurance of Kenyan Female University Students**

According to Thomas *et al.* (2017), strength endurance is a specific type of strength demonstrated in tasks that require a sustained time of muscle contraction with minimum decline in efficacy. The study revealed that experimental and control study groups had different mean scores in the Upper-Body Strength-Endurance (UBSE) at the pre-test and the post-test, supporting aerobics impact. As explained by Marterer, Mugele, Schafer, and Faulhaber (2023), upper-body endurance training is a highly underappreciated exercise regimen that can improve endurance performance in healthy individuals. It also improves oxygen uptake and performance in the trained muscles. This provides some clarification on the notion of strength endurance, which is the muscle's capacity to continuously apply force over a lengthy period of time.

According to Osipov *et al.*, (2020), the foundation of training female students should consist of aerobics along with strength training and stretching. The UBSE scores of the two study groups did not significantly differ during the pre-test, according to statistical

analysis, but the post-test findings clearly demonstrated a difference. According to Patel and Patel (2018), research on a variety of training techniques and relevant literature has demonstrated the value of physical exercise in preserving general fitness. For long-term success in any sport, strength and endurance are necessary. This is affirmed by the analysis conducted to ascertain the impact of the eight-week Aerobics intervention by comparing the magnitude of change in the UBSE scores of the two study groups. The purpose of this workout was to increase upper body strength, which may also be used as a measure of assessment. The data clearly show this, with the experimental group's mean score being considerably higher than the control study group.

The Hosiso, Rani, and Rekoninne (2013) findings demonstrate a significant improvement in muscle strength and other health-related fitness indicators following moderate aerobic activity. Hence, strength endurance serves as a proxy for functional capacity, which varies depending on the muscle. This is consistent with the findings, which indicated that the experimental group's UBSE scores significantly increased while those of the control group significantly decreased. Muscular endurance and strength are necessary for all daily physical activity, such as cycling, swimming, walking, and running. This promotes long-term energy sustainability and aids in injury prevention (Toppo & Sultana, 2014). Birtukan and Sisay (2018) expound on this important significance by explaining that decreased muscle strength and endurance in the upper body and shoulders increases the chance of shoulder pain.

The 90° push-up test assesses the shoulder and arm girdles' strength and longevity. According to this research, male students' upper body muscular strength and endurance may be measured using 90° push-ups, which has a greater validity value than that of female

students (Hashim, Ariffin, Hashim & Yusof, 2018). For girls' 90° push-up test scores, interclass reliability coefficients ranging from  $r = .64$  to  $.96$  were reported in the FITNESSGRAM®. Participants in aerobics sessions can vary overload as necessary and adequately for their personal needs. This is acceptable for general contribution.

### 5.3 Conclusions

The study concluded that:

1. Participants in the experimental group adhered to the requirements of attending every session during the Eight-Week Aerobics programme. Every participant in the experimental group cooperated with the instructors during training by following set rules. Experimental group was exposed to actual training (Eight-Week Aerobics Programme) while Control group remained unexposed to the training programme. Adherence to the requirements of the study by the experimental group led to their improvement in these components.
2. The study participants attended the scheduled sessions in the gym at the UoN Chiromo Campus. They attended the sessions for the period of Eight-Week Aerobics programmed (100% attendance '*according to the provided signing attendance forms*'). This enabled the instructors to achieved desirable and commendable results according to the study objectives. It also provided the instructors appropriate time, and sufficient sample size.
3. As required by the study, the experimental group participants did not engage in any other physical activity apart from that required in her normal daily living. Most of the respondent honored the requirements by not engaging in any physical

activity apart from the normal daily. They embrace normal routine of walking from the training room (Gym) to their hostels.

4. Participants were enthusiastic and positively active in all aspects of this programme. They cultivated the spirit of positivity before, during and after training. Students were positively engaged in participating in the study. This was evident from the time of participant recruitment when more students in the target population.
5. There was no significant difference between the Experimental group and Control group in the pre-test. However, after an Eight-Week Aerobics Programme, the Experimental group experienced significant changes in its mean scores compared to the means of the Control group. This meant that Experimental group had an increase in mean scores compared with Control group. There were significant changes in the Selected Health-Related Physical Fitness Components among the experimental group in comparison of Control group.

#### **5.4 Recommendations for Policy and Practice**

Several policy and practice recommendations are provided in light of the study's findings:

1. Understanding own Health-Related Physical Fitness status, is key to motivating consistency and adherence to Aerobics among female Kenyan University Students.
2. Fitness instructors in Kenyan universities should be aware of each student's unique demands in order to reduce dropout rates and improve exercise adherence. Instructors should set up their programmes facilities, and activities with an emphasis on creating a welcoming, adaptable, and accommodating workout

environment for their students.

3. Fitness instructors in Kenyan universities can have a structured competition that would last for several months that would greatly enhance exercise effectiveness, motivation, and increase the number of students using the training rooms (gyms).
4. It will be prudent for institutional facility providers and instructors at Kenyan universities' gym facilities and programmes to recognize any weaknesses and solve them within a minimum time to better support the execution of programmes and their integrity.
5. Fitness instructors in the Kenyan Universities can incorporate innovative and unique fitness routine that enhance fun, enjoyable and encourages great adherence for participation among the students. The popular, innovative and unique fitness exercises and routines encourage consumers to stick with their programmes or renew their subscriptions while also ensuring that they enjoy the exercise.
6. Provision of forms (for comments, recommendations, complaints, compliment or suggestions, then sign) and follow up of students can also be valuable.
7. Facility owners could collaborate with local community and county officials in planning physical activity projects that promote overall health while innervating sense of unity.
8. Fitness instructors can encourage their students to switch between indoor and outdoor workouts on a regular basis. This will encourage clients to alternate between indoor and outdoor workouts on a regular basis and would go a long towards alleviating boredom and monotony.

## **5.5 Recommendations for Further Research**

The existing research findings lead to the following research recommendations for further research:

1. This existing research used quasi-experimental research design. True-experimental research design can be used as alternative in the studies on impacts of an Eight-Week Aerobics Programme on the Health-Related Components of fitness of Kenyan Female Universities Students. In addition, the future researcher could use different research instruments to test and validate the health-related components scores.
2. An experimental study using objective tools to determine the amount, levels and types of training between two programmes could be undertaken to reveal more objective information concerning the frequency, intensity, time and type (FITT) among types of physical activity programmes.
3. Further research ought to be conducted to evaluate how Aerobics dance impacts physical fitness related to health in male students at Kenyan universities.
4. This research focused on the effects of an eight-week programme. It would be informative to examine effects of Aerobics on the Health-Related components over varied duration apart from the eight weeks.

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**APPENDICES****APPENDIX A: PARTICIPANT INFORMATION LETTER AND CONSENT  
FORM.****Information Letter**

**Dear Student,**

I would like to encourage you to join in a research that I believe will be very beneficial to women's health in the future. The study is entitled **“Effects of an Eight-Week Aerobics Programme on Health-Related Components of Fitness of Kenyan Female University Students”**. The study will involve pre-testing selected health-related fitness components variables, participation in Aerobics threetimes a week for a period of eight weeks and then post-testing the selected health-related fitness variables at the end of the programme. All information collected will be dealt with in the strictest confidential manner. To enhance confidentiality, the respondent's will be noted by a code and not hername. The data gathered will be utilized strictly for the educational reason and publications required forfulfilment of the course.

**Consent Form**

....., confirm that the researcher, Abraham Kipchirchir Too, has explained the study, its intent and its risks verbally and in writing.

Based on the information, I understand what I am expected to do as a participant.

I therefore, consent to take part in the study.

Participant Code .....

Date .....

Phone Number .....

Signature .....

**APPENDIX B: MEDICAL FORM**

(Do be filled by the medical certified medic Only)

**A. PERSONAL INFORMATION**

- I.** Full Name :
- II.** Date of Birth :
- III.** Gender :
- IV.** Phone number :
- V.** Email Address :
- VI.** Alternative phone number :

**B. MEDICAL HISTORY/CONDITION**

- I.** Have You Ever Had or Do You suffer the following condition;

<b>S/No</b>	<b>Condition</b>	<b>Yes</b>	<b>No</b>
1	High/Low Blood Pressure		
2	Hearth Related Diseases		
3	Blood Related Diseases		
4	Diabetes		
5	Tuberculosis		
6	Epilepsy		
8	Mental Illness		
9	Eating Disorders		

II. Any other condition not mentioned .....

**C. DECLARATION**

I hereby certify that the above information is correct and that I agree to undergo medical checkup if required to do so. I also declare that I will be responsible for the consequences of my eligibility to the applied course for giving false medical information.

**Signature of the Participant..... Dates:**

**Signature of the Guardian or Legal Parent..... Dates:**

**Research Assistance Signature..... Dates:**

## **APPENDIX C: PROCEDURES FOR DATA COLLECTION.**

### **I. Cardiorespiratory Endurance Test**

**Test:** '20M' Progressive Aerobic Cardiovascular Endurance Run (PACER).

**Description:** Starting at a low pace and gradually getting faster, the Pacer 20m test will involve running as long as possible, back and forth between two markers placed 20 metres apart. Participants run between the two markers until they get tired or are not able to continue running at a faster speed.

**Equipment and Materials:** Tape Measure, Marking Cones, Pacer CD, CD player and Sheets.

**Procedure:** The participants will run a 20-meter course at a progressively faster speed from the start line to the finish line. As the beeps get gradually faster, the participant will need to run faster to keep up with them. By the time beeps sound, both feet of the participants' must have crossed or touched the line. Participant stop when she fails to arrive at the line at a subsequent beat.

**Scoring:** A lap will constitute to and fro from the start marker. The number of completed laps will be recorded as the participant's achievement.

### **II. Percentage Body Fat**

**Test:** The Skinfold measurement.

**Description:** A skinfold caliper (Accu-Measure and Slim Guide Calipers) will be used to assess the skinfold thickness of participants to estimate the percentage of body fat. Skinfolds will be measured at three sites: thigh, triceps and the suprailiac crest. Each site will be measured three times.

**Equipment and materials:** skinfold calipers, marker pen, tape measure, and recording sheets. **Procedure:** The Researcher will pinch the participant's skin firmly between thumb and index finger at the appropriate site for the purpose of raising a double layer of skin and the underlying adipose tissue. A skinfold caliper will be placed at a straight angle and one centimeter below the pinch. The researcher will release the pressure between the fingers, but remain to hold the skinfold. Then release the handle of the calipers. The reading will be taken in 'mm' to the nearest 0.1 mm during each of the three trials.

**Scoring:** The average of the three trials in millimetres (mm) at each site will be recorded as the participant's score for that site. **Jackson and Pollock Formula** plus **Siri Formula** to be used to calculate body density then converted to percent body fat.

### **III. Lower Back Flexibility**

**Description:** Since discomfort in the lower back is linked to stress in this area, the elasticity of the muscles in the lower back is essential. The test measures the range of motion in the low back region.

**Equipment and materials:** Mats, Sit-and-reach box and recording sheets.

**Procedure:** Participant will sit in bare feet. Participants should place the bottoms of their feet on the box. The knees must be fully extended and pressed firmly against the ground. Participants place their palms down on top of one another or next to each other. The participant moves as slowly as possible along the measurement line. After several practice attempts, participants must walk as far forward as possible and maintain this position for three seconds while recording the distance. Participant will repeat the test three times and the average of the three tests will be recorded as the participants' performance in the sit-and-reach test.

**Score:** Score will be recorded to the nearest centimetres of the distance reached by the tip of the fingers.

#### **IV. Abdominal Muscular Endurance**

**Test:** 1-Minute Sit-Up Test.

**Equipment and materials:** A CD player with curl-up cadence track, mats, stop watch and a recording sheets.

**Description:** Fitness test requires a participant to do each sit up correctly so as to quantity the strength and endurance of the abdominal muscles.

**Procedure:** The participant will begin by lying on mats in supine position, knees should be bent with flat feet on the mat and legs slightly apart. Arms bent at the elbow pointing out to the sides and hands will be placed either side of head. Feet should be in contact with the mat. Participants will raise the upper body slowly, by contracting the core muscles lifting the chest upwards towards the knees. Participant will then return the upper body down until her head touches the mat. Throughout the sit up the movement should be smooth.

**Score:** The total number of correctly performed Sit-Ups per minute will be recorded as the participant's score.

## **V. Upper-Body Strength-Endurance**

**Test:** 90° Push-Ups Test.

### **Equipment and materials:**

Mats, stop watch, metronome and recording sheet.

**Procedure:** Participants began in a prone position (face down), with their hands and feet touching the ground, while their back and legs were in a straight line. Spread your feet slightly, spread your hands shoulder-width apart, and extend your arms at right angles to your body. When lowering the body until the elbows are at a 90-degree angle and the upper arms are parallel to the floor, the participant should maintain a straight back and knees. The arm should be at a 90° angle so that the participant only descends before the chest touches the object. Then the participant straightens the arms to return to the starting position.

**Scoring:** The number of successfully completed push-ups in 1 minute will be recorded as the participants score.

*Adapted from FITNESSGRAM Manual (Guide, 2013).*

**APPENDIX D: HEALTH-RELATED FITNESS COMPONENTS VARIABLES  
EVALUATION PROTOCOL SHEET**

**A.** Student Code:

**B.** Date of Birth:

**C.** Age:

**D.** Year of Study:

**E.** Date of test:

**1. Progressive Aerobic Cardiovascular Endurance Run (PACER).**

The research assistance to cross the lap completed. Then tally the crossed numbers. Laps completed: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, =

.....

Student codes	Completed Laps

**2. Skinfold Measurement (Measurement in Millimetres).**

Triceps			Thigh			Suprailiac		

**Note: Jackson and Pollock Formula;**  $1.099421 - (0.0009929 \times \text{the sum of the triceps, thigh and suprailiac measurements}) + (0.0000023 \times \text{the square of the sum of the three sites measurements}) - (0.0001392 \times \text{age}) = \text{Body Density}$ . Then use **Siri Formula** to get Percent Body Fat.  $[(4.95/\text{Body Density}) - 4.5] \times 100 = \text{Percent Body Fat}$ .

**3. Sit and Reach (Measurements in Centimetres).**

Three times of trials.			Average
1 <sup>st</sup> Trial	2 <sup>nd</sup> Trial	3 <sup>rd</sup> Trial	

**4. 1-Minute Sit-Ups.**

The Research assistance will circle each successfully completed sit-ups; and the number circled will constitute the participants' achievement.

Completed sit-ups:

1, 2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20, 21,22,23,24,25,25,26,27,28,29,30

The total number of correctly performed Sit-Ups per minute: -----

**a. 90<sup>0</sup> Push-Ups.**

The research assistance will circle each successfully completed 90<sup>0</sup> push-ups; and the last number circled will constitute the participants' achievement.

Completed push-ups

1, 2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20, 21,22,23,24,25,25,26,27,28,29,30

Number of successfully completed 90<sup>0</sup> Push Ups achieved per minute: -----

## APPENDIX E: SAMPLE SIZE DETERMINATION.

(Snedecor and Cochran, 2002)

$$n = 1 + \frac{s^2}{d^2} C^2$$

**n**: sample size to be determined, **s**: is the standard deviation, **d**: is the difference to be detected, and **C** is a constant dependent on the value of  $\alpha$  and  $\beta$  selected. **C** gives values for two levels of  $\alpha$  and  $\beta$ . Note that for  $\alpha = 0.05$  and  $1 - \beta = 0.9$ , **C** is 10.51. If **s** is 4, **d** is 3,  $\alpha = 0.05$ , and  $1 - \beta = 0.9$ , then;

$$n = 1 + 2(10.51) \left(\frac{4}{3}\right)^2$$

$$n = 1 + 21(1.333)^2$$

$$n = 1 + 21(1.77768889)$$

$$n = 1 + 37.33$$

$$n = 38.33 + 2$$

**Sample Size for the Study is 40**

**APPENDIX F: AEROBICS TRAINING PROGRAMME.**

<b>Phase</b>	<b>Activities</b>	<b>Time (Minutes)</b>	<b>Tempo (Bpm)</b>
Warm-Up	Warm-up exercises with a light stretch to prepare the body for the aerobics session.	5	120
Aerobics training  (Focuses on cardiovascular endurance and improvement of % body fat).	Movements that target mostly the large muscles of the legs, with arms. Activities of moderate to high intensity to raise the heart rate. (Match in, match out, step touch, two side steps with grapevine, hamstring curl, Tip toe, arm rises, side rises, knee up, forward, back and sides kicks, and punching).	20	130 – 160
Standing cool-down.	Reduce speed and size of movements. Stretch large muscles.	5	Less than 100



**Age range of participants: 19 years to 24 years.**

**Note: Exercises will vary from session to session over the eight weeks.**

**Recommendations adapted from American College of Sports Medicine (2013)**

**APPENDIX G: APPROVAL LETTER FROM GRADUATE SCHOOL.**

**KENYATTA UNIVERSITY  
GRADUATE SCHOOL**

E-mail: [dean-graduate@ku.ac.ke](mailto:dean-graduate@ku.ac.ke)

Website: [www.ku.ac.ke](http://www.ku.ac.ke)

P.O. Box 43844, 00100  
NAIROBI, KENYA  
Tel. 020-8704150

**Internal Memo**

**FROM:** Dean, Graduate School

**DATE:** 13<sup>th</sup> October, 2021

**TO:** Mr. Too Abraham Kipchirchir  
C/o Department of Physical Education  
Exercise & Sports Science

**REF:** H108/37473/2017

**SUBJECT: APPROVAL OF RESEARCH PROPOSAL**

=====

This is to inform you that Graduate School Board, at its meeting on **29<sup>th</sup> September, 2021**, approved your Research Proposal for the M.Sc. Degree entitled, **"Effects of an Eight-Week Aerobics Programme on the Health-Related Components of Fitness of Kenyan Female University Students."**

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The Forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

  
**REUBEN MURIUKI**  
**FOR: DEAN, GRADUATE SCHOOL**

CC. Chairman, Physical Education, Exercise and Sports Science Department

**Supervisors:**

1. Dr. Yasmin Goodwin  
C/o Department of Physical Education, Exercise and Sports Science  
**Kenyatta University**
2. Dr. Festus Kiplamai  
C/o Department of Physical Education, Exercise and Sports Science  
**Kenyatta University**

**APPENDIX H: ETHICAL CLEARANCE LETTER.**

**KENYATTA UNIVERSITY  
ETHICS REVIEW COMMITTEE**

Fax: 8711242/8711575  
Email: [kuerc.chairman@ku.ac.ke](mailto:kuerc.chairman@ku.ac.ke)

P. O. Box 43844,  
Nairobi, 00100  
Tel: 8710901/12

Website: [www.ku.ac.ke](http://www.ku.ac.ke)

Our Ref: **KU/ERC/ COND. APPROVAL/VOL.1**

Date: 21<sup>st</sup> /02/ 2022

Too Abraham Kipchirchir  
P.O BOX 43844-00100  
Nairobi.

**APPLICATION NUMBER: PKU/2442/I1574- Effects of Eight week Aerobics Program on the Health related components of the fitness of Kenyan Female University Students**

**1. IDENTIFICATION OF PROTOCOL**

The application before the committee is with a research topic “**Effects of Eight week Aerobics Program on the Health related components of the fitness of Kenyan Female University Students**”. Received on January, 2022 and discussed on February, 2022.

**2. APPLICANT**

**Too Abraham Kipchirchir**

**3. SITE**

Kenyan Female University Students

**4. DECISION**

The committee has considered the research protocol in accordance with the Kenya University Research Policy (section 7.2.1.3) and the Kenya University Ethics Review Committee Guidelines and **APPROVED that the research may proceed ON CONDITION that you incorporate its advice as below**

**5. ADVICE/CONDITIONS**

- Explain how the care and protection of research participants will be ensured
- Provide details of sampling techniques
- State recruitment criteria and how participants will be derived at
- Explain your exclusion criteria
- State Community considerations

**The above specific conditions must be fulfilled in writing before an approval can be granted.**

**The manner of fulfilling these conditions should be outlined and submitted to Kenyatta University Ethical Review Committee.**

**When replying, kindly quote the application number above.**

**If you accept the decision reached and advice and conditions given please sign in the space provided below and return to KU-ERC a copy of the letter.**



**Prof. Judith Kimiywe**  
**CHAIRPERSON - ETHICS REVIEW COMMITTEE**



I .....accept the advice given and will fulfill the conditions therein.

Signature..... Dated this day of..... 2022.

cc. DVC – Research Innovation and Outreach

**APPENDIX I: RESEARCH LICENSE LETTER FROM NACOSTI.**

 <p>REPUBLIC OF KENYA</p>		
Ref No: 312497	Issue: 29/March/2022	Date of
<b>RESEARCH LICENSE</b>		
		
<p><b>This is to Certify that Mr. ABRAHAM KIPCHIRCHIR TOO of Kenyatta University, has been licensed to conduct research in Nairobi on the topic: EFFECTS OF AN EIGHT-WEEK AEROBICS PROGRAMME ON THE HEALTH-RELATED COMPONENTS OF FITNESS OF KENYAN FEMALE UNIVERSITY STUDENTS for the period ending: 29/March/2023.</b></p>		
License No: NACOSTI/P/22/16633		
312497	Applicant Identification Number	 Director General NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
<p>NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.</p>		Verification QR C
		

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is Guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014

1. The License is valid for the proposed research, location and specified period
2. The License any rights thereunder are non-transferable
3. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research
4. Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies
5. The License does not give authority to transfer research materials
6. NACOSTI may monitor and evaluate the licensed research project
7. The Licensee shall submit one hard copy and upload a soft copy of their final report (thesis) within one year of completion of the research
8. NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice

National Commission for Science,  
Technology and Innovation  
off Waiyaki Way, Upper  
Kabete,

P. O. Box 30623, 00100 Nairobi, KENYA

Land line: 020 4007000, 020 2241349, 020 3310571, 020 8001077

Mobile: 0713 788 787 / 0735 404 245

E-mail: [dg@nacosti.go.ke](mailto:dg@nacosti.go.ke) /  
[registry@nacosti.go.ke](mailto:registry@nacosti.go.ke)

Website: [www.nacosti.go.ke](http://www.nacosti.go.ke)

**APPENDIX J: RESEARCH AUTHORIZATION**



**UNIVERSITY OF NAIROBI**  
**OFFICE OF ASSOCIATE VICE-CHANCELLOR**  
(Research, Innovation and Enterprise)

P.O. Box 30197-00100  
Nairobi, Kenya  
Website: [uonresearch.uonbi.ac.ke](http://uonresearch.uonbi.ac.ke)

Tel: +254-2-4913164  
Email: [averic@uonbi.ac.ke](mailto:averic@uonbi.ac.ke)

UON/RIE/3/5/Vol.XX

April 4, 2022

Abraham Kipchichir Too  
P. O. Box 43844-00100  
Nairobi  
Email: [abrahamchirchirso@gmail.com](mailto:abrahamchirchirso@gmail.com)  
Tel: 0701543997

Dear Mr Too

**PERMISSION TO COLLECT DATA**

I refer to your request to conduct research at the University of Nairobi, for your project entitled *“Effects of an eight-week aerobics programme on the health-related components of fitness of Kenyan female university students.”*

I write to inform you that your request has been approved.

You are however required to share the findings of your study with the University of Nairobi by depositing a copy of your findings with the Director Library & Information Services on completion of your study.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'M. Hutchinson', with a long horizontal line extending to the right.

**PROF. M. JESANG HUTCHINSON**  
**ASSOCIATE VICE-CHANCELLOR (AG.)**  
**(RESEARCH, INNOVATION AND ENTERPRISE)**  
**AND**  
**PROFESSOR OF HORTICULTURE**

Copy to: Director, Library and Information Services  
Dean of Students