IMPLICATIONS OF AEROBIC EXERCISE ON CLINICAL OUTCOMES OF HIV POSITIVE CLIENTS IN UGANDA: A CASE OF GENERAL MILITARY HOSPITAL-BOMBO

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OCTOBER, 2024

DECLARATION

I, Mwebaze Nicholas, hereby declare that this thesis is my original work and has not been submitted, in part or in whole, for any academic purpose other than the one specified herein.

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APPROVAL

This is to certify that this thesis has been presented by Mwebaze Nicholas. It has not been previously submitted and or published for any award in any Institution/University. It is hereby submitted with approval of the supervisors whose signatures are appended hereunder.

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DEDICATION

This work is dedicated to my parents, Mr. Musenene Rusaniya (RIP), my mother Aida Musesene and to my other family members and their children whose love for me knows no boundaries. They taught me the value of hard work, and have always shown great joy to my success. Thank you so much; I will forever remember you and I will always remind your children/grandchildren the value of hard work as you did to me.

Next, my children; Andre, Mark, Becky, Tracy, Hugo and Jose Aden who have endured with my absence and little attention during the time of my academic endeavours.

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LIST OF ABBREVIATIONS AND ACRONYMS

AE	Aerobic Exercise
AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Therapy
ARV	Anti-Retroviral
CAD	Cardiac Risk Factors
CARE	Combination of Aerobic and progressive Resistive Exercise
CD4	Clusters of Differentiation 4
CVD	Cardio vascular Disease
DASI	Duke Activity Status Index
DHIS	District Health Information System
FWC	Functional Work Capacity
GMH	General Military Hospital
HAART	Highly Active Antiretroviral Therapy
HIV	Human Immunodeficiency Virus
MET	Metabolic Equivalent
MoH	Ministry of Health
MST	Multi-Shuttle-Run-Test
NCD	Non-Communicable Disease
OIS	Opportunistic Infections
PAR-Q	Physical Activity Readiness Questionnaire
PI	Protease Inhibitor
PLHIV	People Living With HIV
POC	Point of Care
RPE	Rate of Perceived Exertion
UNAIDS	United Nations Programme on HIV/AIDS

UNCST	Uganda National Council of Science and Technology
UPHIA	Uganda Population-based HIV Impact Assessment
VO_2	Volume of Oxygen
WHO	World Health Organisation

ABSTRACT

Aerobic exercise may be a helpful treatment for a variety of ART side effects and symptoms, according to studies from both healthy individuals and those with various chronic illnesses. The use of aerobic exercise to address the symptoms, and undesirable side effects that lower the quality of life for people with chronic HIV infection is currently being investigated. This study's primary goal was to determine how aerobic exercise affected the clinical outcomes of HIV-positive patients receiving antiretroviral therapy in Uganda. It further aimed at evaluating the effect of a 12 weeks aerobic exercise on immunological measures, functional work capacity and psychological markers of HIV positive clients on ART in Uganda. The study, conducted at the General Military Hospital in Uganda, employed a quasi-experimental design. Quantitative data was collected using questionnaires and a sample of 135 people living with HIV on antiretroviral therapy engaged in the study. Quantitative data was analyzed using t-tests, revealing significant reductions in depression and anxiety symptoms among participants. The participants were divided into two groups at random: Group 1, which received a moderately intense aerobic exercise program for twelve weeks, and Group 2, which received no treatment. Physical Activity Readiness Questionnaire (PAR-Q) was used to screen both groups. Clinical outcomes, like: immunological measurements, were then evaluated using Clusters of Differentiation 4 (CD4), Functional work capacity using Rate of Perceived Extortion (RPE)/ Duke Activity Status Index (DASI) and psychological markers using a questionnaire. The aerobic exercise intervention was administered to the experimental group for twelve weeks. Members of the control group were called weekly to make a follow up on them during the 12 weeks and ensure that they did not feel left out of the survey. Following the completion of the 12-week post-test, the results showed that: (i) aerobic exercises significantly increased the CD4 count in experimental group with an average mean of 29.7% and a p=0.001; (ii) It had a statistically significant effect the functional work capacity of HIV positive clients on ART with p<0.001 which was less than initial p= 0.05, a decreased heart rate, significantly improved VO_2 max from 25.13 ml/kg/min to 34.19 ml/kg/min and (iii) it also had significant effect on psychological markers indicating a decrease in paranoid ideation, depression, neuroticism, anxiety, and phobia in HIV positive clients on ART with *p-value*<0.001. Therefore, well-structured supervised 12 weeks moderate intensity aerobic exercises at a tempo of 120-150 beats per minute improved CD4 cell in the body of HIV positive clients on ART. It also improved the clinical outcomes of people living with HIV on antiretroviral therapy. It is recommended that aerobic exercise be used as an additional therapy in the care and treatment of HIV positive clients on ART in Uganda by adding it in the HIV care and treatment guidelines. There is also need to investigate the effect of aerobic exercise on other clinical outcome like viral load, body composition and adherence to drugs.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

There have been significant changes in the quality of human life since Acquired Immune Deficiency Syndrome (AIDS) was first declared in humans in 1981 in Uganda (Okoroiwu et al., 2022). Bailes et al. (2011), states that the Human Immunodeficiency Virus (HIV), a retrovirus belonging to the Lentivirus genus, is the cause of the sickness. The virus slowly affects a human body and deprives it of its immunity by seeking to destroy Clusters of Differentiation 4 (CD4) cells gradually - a type of T-lymphocytes (T-cells) that is critical to the immune system. According to O'Brien et al. (2016), there is a higher chance of opportunistic infections, which can reduce one’s functional work capacity and have other psychological impacts, when the immune system is significantly compromised.

In 2020, the United Nations Programme on HIV & AIDS [UNAIDS] released a report stating that HIV is one of the most serious public health issues facing the world today (UNAIDS, 2020). Of the approximately 37.9 million people living with HIV/AIDS worldwide in 2019, 95.5% were adults and 4.5% were children under the age of 15 years. An estimate of 1.7 million individuals worldwide became newly infected with the virus in 2018 and 94% of these were aged 15 years and above. Africa was the most affected with 25.7 million people living with HIV hence making Africa to account for about two thirds of the global total of new infections in 2018 with about 1.1 million infected (Velavan et al., 2021). In 2021, there were about 1.5 million new infections in the world with the highest infections recorded from Africa (UNAIDS, 2021). According to a UNAIDS (2022) report, over 2.5 million people have died due to AIDS and more than 1.5 million people live with HIV infection in Uganda.

People living with HIV (PLHIV) in Uganda frequently suffer from mental illnesses, yet these conditions are frequently ignored and neglected (Ministry of Health (MoH), 2018). This situation was worsened by COVID-19 pandemic that disrupted the already imperfect mental health services, (Hong et al., 2023). People living with HIV often suffer from psychological disorders, injury from infection, treatment toxicity, and associated comorbidities (Althoff et al., 2016).

The quality of life and life expectancy of those afflicted with AIDS have been greatly enhanced by scientific advances in therapy and attempts to expand these medicines. For example, Anti-retroviral Therapy (ART) such as the Highly Active Antiretroviral Therapy (HAART) have reduced hospitalisation rates, lowered mortality, and generally improved patients' quality of life (Bopp et al., 2003). On the other hand, a number of negative side effects are also linked to this treatment, including exhaustion, nausea, pain, anxiety, sadness, a decrease in functional work ability, and low energy (Ibeneme et al., 2022). Therefore, there is still need for multi-sectoral approaches to reduce these side effects and prevent other infections that would increase pill burden and affect the adherence to ART. Other strategies that control the effect of the virus and increase public attention is needed (Uganda AIDS Commission, 2011). Treatment of HIV involves regular visits to the hospital mainly when unstable, that is; when one has low CD4 count 200 copies and below, high viral load and any other opportunistic infection. It is estimated that about 254,000/= to 524,000/= is spent on adults and 186,900/= to 190,000/= is spent on children in Uganda monthly (Moreland et al., 2013). This cost may be higher, depending on where they get their treatment. Moreover, many PLHIV travel long distances to get services where they are least known this also increases the cost of care.

Aerobic exercise is currently being explored as a means of dealing with symptoms, complications, and unwanted side effects that reduce the quality of life for chronic HIV infection (McIntyre et al., 2020). Aerobic exercise may be a helpful treatment for a variety of ART side effects and symptoms, according to studies from both healthy individuals and those with various

chronic illnesses (O'Brien et al., 2016). Therefore, aerobic exercise is now recommended by studies as one of the requirements in managing HIV positive clients. According to O'Brien et al. (2016), exercise therapy should start as soon as possible after an HIV infection diagnosis in an effort to postpone the onset of symptoms, lessen the severity of existing symptoms, and possibly postpone the progression of the disease and the subsequent onset of Non-Communicable Diseases (NCDs).

According to Okechukwu et al. (2022) aerobic exercise is a low- to moderate-intensity physical activity that uses oxygen in the metabolic processes to produce energy during exercise. Patients can engage in these activities for prolonged periods of time. Nystoriak and Bhatnagar (2018) further explained that regular aerobic exercise has several health benefits, including: strengthening muscles, improving circulation efficiency by strengthening heart muscle, and reducing blood pressure. These workouts also contribute to the body's overall red blood cell count, which facilitates oxygen delivery, lowers stress levels, decreases the risk of depression, and improves cognitive function (Bopp et al., 2003). O'Brien et al. (2016) in a study on the benefits of aerobic exercise for persons living with HIV/AIDS showed improvements in their health, mood, life satisfaction, and quality of life in addition to symptoms of anxiety and sadness.

According to a study, aerobic exercise raises CD4 and quality of life in HIV-positive people in Nigeria the experimental group improved by 36.9% while the control group improved by 6.8 (Ezema et al., 2014). Research also revealed that exercise increased CD4 counts in HIV patients receiving antiretroviral therapy by 107.5% (Maduagwu et al., 2017). People living with HIV (PLHIV) on ART get a greater increase in CD4 cell counts with appropriate exercises compared to non-exercising counterparts (Dang et al., 2018). However, despite several recommendations, casual observation indicates that clinicians in Uganda have not emphasised the use of aerobic exercise for PLHIV. Presently there is scanty literature on efforts to encourage HIV positive clients in Uganda to utilize aerobic exercise therapy to improve their standard of living during the course of treatment. This study addressed this gap in knowledge by investigating the implications of aerobic exercise on clinical outcomes for HIV positive clients in Uganda.

HIV/AIDS patients have also been reported to be overweight/obese with hypercholesteremia, and this is linked to an emergency NCDS that lowers their quality of life, (Moyo-Chilufya et al., 2023). Krupa et al. (2012) revealed that several characteristics were important indications of obesity/overweight, including older age, female sex, early stage of the illness, lower CD4 level, and mild to moderate physical activity. It was noted that as part of standard HIV therapy, clinicians should take into account implementing targeted weight management programs and be cognizant of the health consequences associated with obesity (Krupa et al., 2012).

In HIV management, there are key clinical outcomes that show client improvement or deterioration. Such clinical outcomes include, but are not limited to: (i) immunological measures, (ii) functional work capacity and (iii) psychosocial markers, (Vajpayee & Mohan, 2011). Immunological markers of HIV disease include cellular concentration of clusters of differentiation 4 (CD4+) and CD8+ T-lymphocytes, total lymphocyte count and immune activation measures obtained using proliferation assays, cytokine measurement, surface antigen expression, and cytotoxicity (Lu et al., 2021). Functional work capacity, which is the measure of a client's ability to carry out everyday tasks without undue fatigue, is mostly determined by looking at their maximal oxygen consumption or maximal aerobic capacity (VO_2 max) (mL/kg/min). As physical fitness increases, VO_2 max also increases (Maciejczyk et al., 2014) reflecting a general improvement in patient wellbeing as discussed before. Psychological markers are uncomfortable feeling by clients towards their HIV positive status. These include but not limited to: paranoid ideation, depression, neuroticism, anxiety and phobia. A decrease in these feelings is a clinical outcome that shows client improvement (Seid et al., 2020). Studies reviewed indicate that aerobic exercise can improve clinical outcome of PLHIV. However, most of the studies reviewed did not show exact details on how the exercises were done mainly regarding the specific exercises, the type, frequency and approach which this study addressed.

There was no indication of a comparable study conducted in Uganda to shed light on how

people living with HIV responded to exercise therapy in our context. Uganda has a young population dominated by youths, with a stable climate throughout the year and plenty of natural food which makes the population unique. This study determined how a 12-week aerobic exercise programme affected the Immunological measure, functional work capacity and psychological measures of people living with HIV on Antiretroviral Therapy (ART) in various regions of Uganda.

1.1 Problem Statement

There is no cure for HIV infection despite its high level of prevalence and scientific studies done. Antiretroviral Therapy (ARV) medications, which prevent the virus from multiplying and spreading among humans, are used to treat it. However, advanced HIV disease remains a difficulty in the HIV response, indicating poor clinical outcomes that exacerbate illness and death in some HIV-positive persons (Tugume et al., 2023). Antiretroviral treatment (ART) use is closely associated with negative changes, particularly morphologic and metabolic problems. A sedentary lifestyle, dietary imbalances, and obesity caused by lipodystrophy all exacerbate these alterations (Thet & Siritientong, 2020). In addition to improving patients' general health, health care utilization rate, and quality of life, aerobic exercise can reduce the requirement for extra drugs and the burden of those prescriptions (Bopp et al., 2003).

The Ministry of Health (MoH) developed prevention and treatment guidelines of HIV in Uganda in which use of ART is a pillar in management of PLHIV, (MoH, 2020). The guideline points out that PLHIV are more prone to psychological effects, NCDs such as depression that may affect their immunity and functional work capacity and recommends use of aerobic exercise as one of the interventions. In addition, sufficient details are not given regarding the specific aerobic exercises to be administered and the benefits they offer. Moreover, the document does not mention exercise as a potent means of treating and preventing depression. Given that the majority of Ugandan practicing clinicians are not sufficiently exposed to the science of exercise physiology and exercise prescription both of which are rarely covered in detail in medical school curricula at Ugandan

medical schools and institutions the lack of information regarding particular aerobic exercises and their advantages is problematic. It guidelines issued does not also sufficiently guide on the kind, level of intensity, and length of physical activity to be performed (Nalusiba, 2017). To date, there is no published study on the roles of exercise in enhancing clinical results of HIV positive clients on ART in Uganda.

1.2 General Objective

To establish aerobic exercise's effects on HIV-positive clients' clinical results while on ART in Uganda taking a case of General Military Hospital-Bombo.

1.3 Specific Objectives

The following objectives served as the study's guidelines:

1. To assess the effect of a 12 weeks aerobic exercise on immunological measures of HIV positive clients on ART at GMH-Bombo.
2. To evaluate the impact of a 12 weeks aerobic exercise on functional work capacity of HIV positive clients on ART at GMH-Bombo.
3. To determine the effects of a 12 weeks aerobic exercise on psychological markers of HIV positive clients on ART at GMH-Bombo.

1.4 Hypotheses of the Study

The study was guided by the following hypotheses:

Ho_1 There is no significant effect of aerobic exercises on immunological measures of HIV positive clients on ART.

Ho_2 There is no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART.

Ho_3 Aerobic exercises have no significant effect on psychological markers of HIV positive clients on ART.

1.5 Theoretical Framework

The study employed socio-ecological model which proposes that improving health may not need a single alteration in behaviour (Webel et al., 2013). These behaviours are the result of processes involving various combinations of environmental influences at different levels. This multi-level approach (such as individual, interpersonal, organizational, community, public policy, and environmental) were effective in improving participation in aerobic exercises and hence improving clinical implications in HIV positive clients. Mehtala et al. (2014) assert that socio-ecological elements play a crucial role in modifying self-management behaviours or behaviour modification interventions at the individual, interpersonal, and environmental levels of an individual's network. Clinical signs and symptoms are considered individual factors, while peer and family affiliations, drug adherence, structured exercise, and food habits are considered interpersonal factors. The physical layout of one's house, place of employment, retail establishments, and leisure areas are all considered environmental variables. The socioecological model provides a useful theoretical framework for developing a self-management intervention by applying it to one's everyday routine and influencing these multi-level components (Golden et al., 20I5). If the sociological factors are put in consideration, it is assumed that, aerobic exercises were conducted mainly basing on interpersonal relationship and organisational structures.

1.5.1 Conceptual Framework

This study was guided by the conceptual framework presented in Figure 1.1.

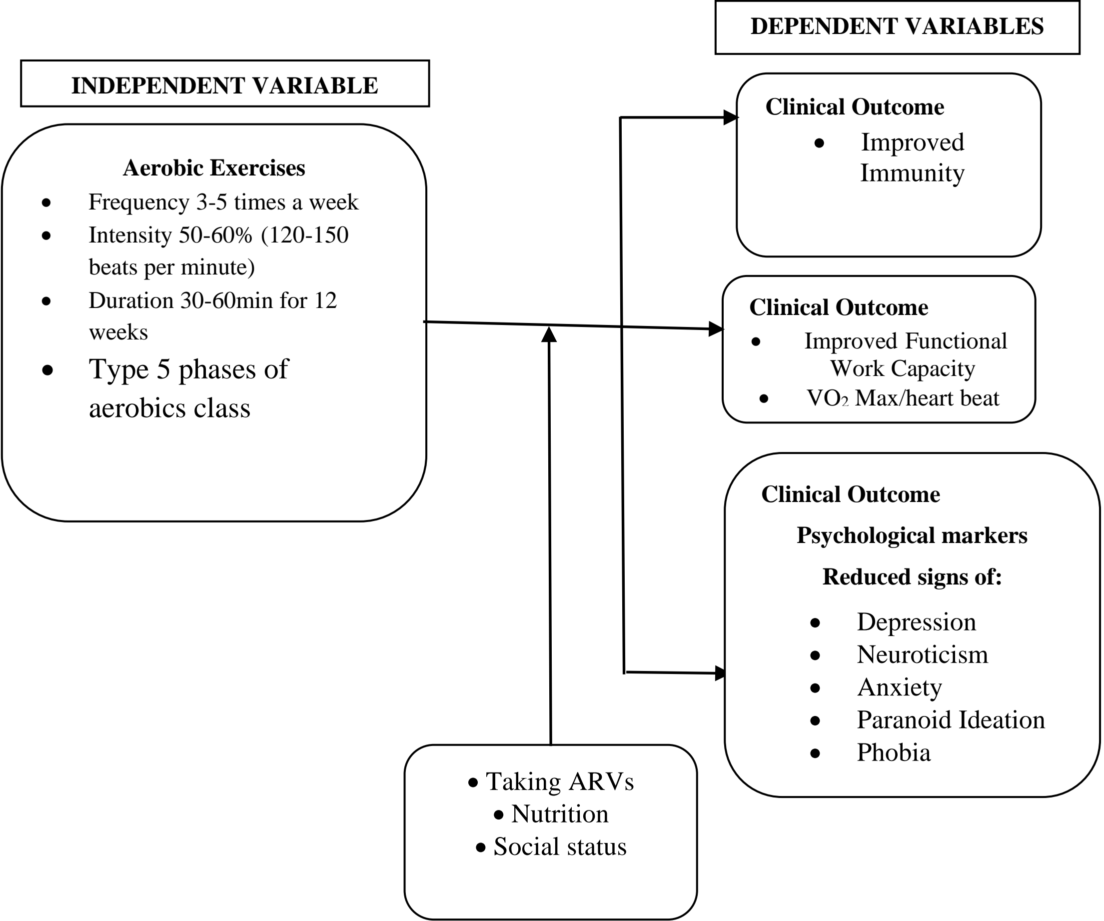

Figure 1.1: Conceptual Framework

Source: Adopted from Bowling, (2014) and modified by the researcher

The conceptual framework in Figure 1.1 shows that aerobic exercise performed for 12 weeks (Independent variable) affects clinical outcomes for HIV positive clients on ART in Uganda. The aerobics sessions had five parts to a workout: warm-up (5–10 minutes), stretching and flexibility (5–8 minutes), cardiovascular conditioning (25–30 minutes), muscular strength and conditioning (10–15 minutes) and cool-down (5–8 minutes).

The clinical outcomes (dependent variables) under study were firstly, CD4 cells count as the Immunological markers of HIV disease because it is the key determinants of immunity levels and treatment performance (MoH, 2020), secondly, functional work capacity measured by, heart rate and VO_2 max (mL/kg/ min) as an assessment of one's ability to operate at work; thirdly, psychological

markers such as anxiety, depression, neuroticism, sensitivity, and paranoid ideation. The mediating variables for the study were: adherence to ARV intake, nutrition, and social status of the participants.

1.6 Scope of the Study

Three aspects of the study scope discussed here include geographical, content, and time scope.

1.6.1 Geographical scope

The study was limited to one health facility in Uganda located in Bombo Town Council in Katikamu County in Luwero District. It is an accredited facility by Ministry of Health, which cares for individuals with multi-ethnic background from various regions of the Uganda. The study population included majorly the clients from Bombo Army barracks and the neighbouring communities.

1.6.2 Content scope

The study sought to ascertain the implications of aerobic exercises on clinical outcomes of HIV positive clients in Uganda. Three clinical outcomes that were studied included: immunological measures, functional work capacity and psychological markers. The study content, therefore, focused only on aerobic exercises and the three clinical outcomes as mentioned.

1.6.3 Time scope

The study took about four years from 2019 to 2023 the delay was escalated by the interruptions caused by COVID-19 that delayed the process of data collection.

1.7 Delimitations of the Study

This study was delimited to the HIV positive clients who are on ART for more than 12 months at GMH-Bombo during the period of 2020 to 2023. Participants were between 20 to 49 years which an active age category above adolescents. It was assumed that they accept and transport themselves to participate in the activity which was the case.

The clients were to have no any limitation of doing the prescribed exercise and this was established by use of Physical Activity Readiness Questionnaire (PAR-Q). The study was delimited to moderate intensity aerobic exercises controlled using musical beats (120-150 beats per minute (bpm)). It was also delimited to immunological measures determined by CD4 cells per ml of blood, Functional Work Capacity (FWC) measured using vo_{2max} and psychological markers where depression, neuroticism, anxiety, paranoid ideation and phobia was assessed.

1.8 Limitations of the Study

The clients volunteered to take part in the study however, those that would be the best choices could have been left out by the selection criteria. The study was focused on one intervention (aerobic exercise) which may not be the only factor that affected the clinical outcome in question, the dependent variable of exercise may not be the one of the variables that influences clinical outcomes.

The type of music used may have an appealing tones and negative affiliations to the psych of the participants. However, this was mitigated by asking the clients to suggest the song lists to be used during the aerobic exercise.

The duo responsibility of the research assistants may have also affected the outcomes of the study and this was mitigated by training them to understand research ethics especially not to attach feelings or emotions as they collect the data in the field.

The ART clinic at General Military Hospital Bombo was where the individuals were enrolled, hence the sample did not accurately represent the entire HIV-positive population receiving ART in Uganda.

The researcher did not evaluate the participants' nutritional intake because it was beyond his control. Therefore, the researcher is unable to determine the exact degree to which these patients' diets influenced the variables (particularly CD4 cell and FWC) examined in this study. This was mitigated by requesting the participants to stay in the same conditions they were staying in before the study.

1.9 Study Assumptions

The study was based on the assumptions that:

i. The study variables were likely to determine the clinical outcomes of HIV positive clients that were categorised as independent, dependent and intermediary variables.

ii. The clients were requested not to change their daily routine behaviour during the study period for example; nutrition, life style, other social factors and adherence to drugs that may have an effect on their clinical outcomes.

iii. The participants gave the right information while answering the questions during pre and post-test.

iv. The participants would not use additional therapies apart from the prescribed ART during the study period.

v. The participants would adjust their schedules to have time for the exercise classes

These assumptions were mitigated by asking the clients to stay in the same conditions as they were staying for the 12 weeks of intervention and also ensure adherence to their medications. Weekly calls to the control group to remind them that they are part of the study.

1.10 Significance of the Study

The Ministry of Health in Uganda is expected to benefit from this study's information on the effects of aerobic exercise on the clinical outcomes of HIV-positive patients in Uganda. The knowledge currently available on aerobic activities and their applicability in the care and treatment of HIV-positive patients in Uganda may be improved as a result. The value of exercise scientists in the treatment of HIV-positive patients may be further supported by this data.

This study generated knowledge and skills required when applying aerobic exercise to HIV positive clients, by outlining useful recommendations that medical exercise therapists should take into account before recommending physical activity for HIV positive clients. This may also help remove the myth where many HIV positive clients were found to believe that engaging in physical

activities would worsen the disease (Frantz and Murenzi, 2013).

This study is projected to improve the policy framing of Ministry of Health (MoH) by giving information and facts to service providers on the relevant exercises for HIV positive clients. Details may be used in treatment guidelines to make the work of clinicians easy.

It is also pictured that this study may inspire several researchers to conduct relevant studies in Uganda in the use of aerobic exercise as an alternative therapy in the care and treatment of chronic infections that will improve on the quality of services rendered to clients by health workers.

This study will bring to the understanding of scientists about the importance of aerobic exercise in helping to help patients age with HIV and combat many of the negative effects of antiretroviral drugs (ARVs) and HIV. It will further more provide the knowledge on how it boosts your high-density lipoprotein (HDL), the "good," cholesterol, and lowers the HIV patients' low-density lipoprotein (LDL), the "bad," cholesterol.

1.11 Operational Definitions

The following are some of the key words and terminologies that are used in this study.

Aerobic Exercises

These are moderate intensity exercises of 120 to 150 (50 to 60%) beats per minute that are undertaken for 30-50 minutes three to five times a week.

Anxiety

is a typical emotion that causes physical signs including an accelerated heartbeat, fear, and increased awareness.

Clients

people living with HIV on ART care who were the study population.

Clinical Outcomes

These are measurable indicators which show the outcomes of treatment of HIV positive people. In this study they include: immunological measures, functional work capacity, psychological markers.

Depression is a type of mood disorder marked by melancholy, poor mood, and a general lack of interest in activities.

Immunological measures

This is the measure of the immunity of the clients using Clusters of Differentiation 4 (CD4) cell count as the estimation of the T-cells.

Neuroticism, refers to people who are irritable and who suffer from loneliness, depression, guilt, envy, anxiety, concern, rage, and frustration.

Paranoid ideation, this is typified by the sensation of being targeted, persecuted, or manipulated. It can also refer to a widespread distrust of other people's intentions or motives.

Participants These are clients who took in the study both control and experimental groups.

Phobia, is an uncontrollable, irrational and persistent fear of specific situation

Psychological markers

These are measures of modifiable behaviours portraying the mental health status of an individual.

VO2max, refers to the most oxygen that a person may use when engaging in vigorous or maximal exercise.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter provides a summary of the key findings from the body of research on the relationship between aerobic exercise and clinical outcomes for HIV-positive patients as reported by other researchers. It captures relevant literature on: immunological measure, functional work capacity and psychological markers as associated with the study objectives.

2.1 Impact of Aerobic Exercises on people living with (HIV), on Antiretroviral Therapy (ART)

Antiretroviral Therapy (ART) like the Highly Active Antiretroviral Therapy (HAART), offers benefits to clients leading to improved quality and standard of life, reduced hospitalisation and mortality of PLHIV, (Eggleton and Nagalli, 2020). On the other hand, there could be a number of negative side effects connected to this treatment. These include; fatigue, nausea, depression, pain, anxiety, reduction in functional work capacity and reduced energy (Ibeneme et al., 2022). Other side effects are neuropsychiatric, and some of the examples include; peripheral neuropathy, headache, insomnia hepatotoxicity, dizziness, increased appetite, anaemia and bone marrow suppression, myopathy, cardiomyopathy, pancreatitis, hyperpigmentation and alterations in blood lipids, such as triglycerides and cholesterol, that are typically linked to protease inhibitors (PIs) (Eggleton and Nagalli, 2020). Gastrointestinal disturbances, fatigue, vomiting, diarrhoea and raised liver enzyme levels also occur (Talwani et al., 2011). These signs may manifest clinically and the level of their effects can be measured.

Exercises positively impact on many aspects of the physical and mental health of HIV-infected clients as an alternative therapy, the most commonly used of which are aerobic exercises of low intensity and long duration (Jaggers & Hand, 2016). It was discovered that exercise matched the signs and consequences of a long-term HIV infection without having the excruciating side effects

(Jaggers & Hand, 2016). Exercise may be a helpful treatment for a variety of symptoms and side effects of ART that HIV-positive people may suffer, according to samples from other chronic diseases (O'Brien et al., 2016). In a study examining the effectiveness of aerobic exercise in adults living with HIV/AIDS, for example, the results of individual studies' psychological measures showed improvements in general health, mood, life satisfaction, and quality of life among those in the exercise intervention groups, along with a decrease in anxiety and depression (O'Brien et al., 2016).

Significant increases in CD4 counts were observed in the exercise group that was on antiretroviral therapy (ART), suggesting that individuals living with HIV who are on ART benefit more from adequate exercise than those who are not on ART and do not exercise (Asogwa et al., 2022). When one exercises, the antibodies circulate more rapidly so they could detect illnesses earlier than they might have before. Despite all these studies, in Uganda, aerobic exercises have not been emphasized by clinicians despite them being listed as one of interventions of managing HIV positive clients. Currently, there is scanty information on the efforts of HIV positive clients utilizing exercise therapy to improve their clinical outcomes while they undergo treatment.

According to Ciccolo and Jowers (2004), "the use of HAART has served to highly reduce the mortality and mobility of HIV-infected patients". They emphasized that many HIV/AIDS patients are employing aerobic exercise regimens to enhance clinical results while undergoing treatment, as opposed to relying on conventional pharmaceutical treatments for its effects. In order to examine the impact of exercise on the most commonly self-reported clinical outcomes of HIV and AIDS, such as biological measures, psychological markers, functional work capacity, immunological measures, and body composition, O'Brien et al. (2016) have consistently listed aerobic exercise as one of the most popular self-care therapies. Exercise has the potential to be a helpful treatment for a variety of symptoms and side effects that HIV-positive people suffer, according to research done on healthy patients (Agbonlahor & Kubeyinje, 2020). These in turn greatly improves the quality of life of

clients living with HIV and are on ART. The other benefits are reduced mortality, morbidity, cost of medication and pill burden.

Alebel et al. (2022), note that poor nutrition also significantly shortens time to develop Opportunistic Infections (OIs) in adults living with HIV. This shows that several affordable nutritional interventions, such regular nutritional assessments and education, can reduce the incidence of OIs in this susceptible population. These OIs affect the wellbeing of individuals living with HIV (Alebel et al., 2022). High viral load is another problem that reduces standard and quality of life; its primary cause is noncompliance with ART. When someone has a high viral load defined as more than or equal to 1000 Ribose Nucleic Acid (RNA) copies per millilitre and has been receiving treatment for at least six months, the World Health Organization (WHO) suggests enhanced or intensive adherence and counselling and repeat the viral load after three consecutive good adherence session scores done a month apart, (Nyagupe et al., 2019). On the other hand, not much is known regarding the results of improved adherence counselling (Alebel et al., 2022).

These studies, however, tended not to indicate instances in which exercise was unable to enhance the quality of life for clients who were HIV positive. In the moderate-intensity exercise group, their higher-intensity group, or the control group, Hand et al. (2009) stated that Terry et al. discovered no significant modifications from baseline CD4+ cell count, CD8+ cell count, leukocytes, or lymphocytes. Additionally, they stated that Assefa et al. (2023) replicated their protocol in 30 healthy HIV-positive individuals with lipodystrophy and dyslipidemia, and they found that after 12 weeks of aerobic exercise, three days a week for 30 minutes at a maximal heart rate of 70% to 85%, no significant changes in immunological variables were found in any groups.

Exercise is well recognized to boost mitochondrial biogenesis and function. It is also known that regular physical activity improves energy metabolism and general health. Exercise has also been demonstrated to have favourable effects on mental health, such as lowering stress levels, elevating mood via increased serotonin (the happy hormone) secretion, and lowering stress-related cortisol hormone secretion. Exercise can also aid with weight management, which improves the

quality of life for clients who are HIV positive by lowering the risk factors for non-communicable diseases (Ndirangu-Mugo et al., 2022).

2.2 Clinical Implications of aerobic exercise on HIV positive clients

The use of aerobic exercises as one of the therapies in the management of symptoms of HIV infection is so much recommended. It is also recommended that clients who do not have severe infections or wasting start aerobic exercise therapy as soon as they are diagnosed with HIV. This can postpone the onset of symptoms lessen the severity of those that are already present, and possibly the progression of the illness and other comorbidities that may result from ARVs (Grace et al., 2015). By extending the asymptomatic phase of the illness and lowering drug use and healthcare use rates, aerobic exercise therapy lowers the overall cost of treating HIV-positive patients (Bopp et al., 2003). It is advised that therapeutic aerobic exercise regimens be customized for each HIV-positive client based on their unique symptomology and functional capabilities. Moderate-intensity aerobic exercises involving big muscle groups, such walking, cycling, and rowing, are recommended forms of exercise. The above-described progressive resistance training can be started after five to six weeks of aerobic exercise.

A list of physical activities and their related metabolic equivalent (MET) levels was compiled by Ainsworth et al. (2000) to illustrate the range of oxygen consumption intensities. A certain activity's metabolic cost, expressed in millilitres per kilogram of oxygen utilized, can be divided by 3.5 millilitres per kilogram of oxygen at rest to determine the activity's MET level. Exercise at a three- to six-meter intensity level is recommended for those with HIV/AIDS since even those without symptoms have a decreased functional capacity (VO_2 max = 28 mL/kg/min, 8 METs). This intensity range include low-intensity jogging, walking at 3 mph on a level surface, dancing, water aerobics, bicycling at speeds under 10 mph, low-intensity sports like badminton, fencing, and golf, as well as regular gardening (Etnier, 2023).

2.3 Effects of Exercise on Immunological Measures

According to MoH (2011), measurements of immune activation and cellular concentration of HIV illness are determined by measuring CD4+ T-lymphocytes. Measurements of energy, immunological activation, total lymphocyte count, CD8+ T-cells, and other cellular components. Due to their importance in determining immunity, CD4 cells were the focus of this investigation. For instance, a 12-week aerobic exercise program increased the lipid profile and CD4 cell counts, two immunological indicators of HIV infection (Maduagwu et al., 2015). However, health care professionals and/or exercise specialists may enhance immune function in the HIV community by emphasizing proper nutrition and adherence to antiretroviral treatment (Maduagwu et al., 2015). Acute, moderate-intensity exercise produces neutrophil proliferation, the production of cortisol and adrenaline, a brief drop in lymphocyte counts, an increase in natural killer cells, and elevated levels of cytokines (IL-I, TNF-a, and IL-6) in otherwise healthy people who are HIV-negative. After just one exercise session, this reaction is diminished in HIV-positive people (Bopp et al., 2003). Exercises with greater intensity reduce immune system function, increasing the risk of opportunistic infections in people without HIV (Bopp et al., 2003). Because of this, moderate-intensity exercise that ranged from 130 to 150 beats per minute was utilized in this study instead of high-intensity activity that exceeded 150 beats per minute.

For HIV-positive patients, several immunological factors are crucial, including HIV-I ribonucleic acid viral load and CD4 cell count. According to Bopp et al. (2003) research, after 12 weeks of mixed resistance and aerobic training or 12 weeks of aerobic exercise, there was no change in the viral load or CD4 count. Bopp et al. (2023) found an adverse connection between viral load and degree of physical exercise. According to Maduagwu et al. (2015), HIV patients' CD4 cell counts significantly increased after engaging in aerobic exercise. According to Maduagwu et al. (2017), HIV-positive people who self-reportedly worked out had CD4 levels that were 107.5% higher than those of HIV-positive people who denied ever working out. In comparison to non-exercisers, those who exercised also showed reduced rates of mortality, fewer symptomology, and a

slower pace of disease progression to AIDS. Bopp et al. (2003) found a connection between reduced CD4 cell counts and exercise regimen noncompliance. All the above studies mentioned exercises in general terms without clearly stating which exercises are recommended for clients who are living with HIV. This study sought to clearly state which exercises were used in an exercise protocol.

In contrast to Dianatinasab et al. (2018), who conducted a 12-week combination exercise program on CD4 count and mental health among HIV-positive women, the majority of the examined literature indicates a significant change in CD4 counts among HIV-positive patients. In a few studies involving fairly extreme exercise (marathons and ultramarathons), Gleeson (2007) reported that a single acute bout of prolonged, strenuous exercise has a temporary depressive effect on immune function and has been linked to an increased incidence of infection that may be caused by hormonal changes during prolonged exercise.

2.4 Effects of Exercise on Functional Work Capacity

A typical way to estimate functional work capacity is to use maximal oxygen consumption or VO_2 max (mL/kg/min). In healthy persons without HIV infection, VO_2 max rises in tandem with physical fitness. A healthy male with no training typically has a $\dot{V}O_2$ max of 35–40 mL/(kg. min). According to Scribbans et al. (2016), the average untrained healthy female has a $\dot{V}O_2$ max of about 27–31 mL/(kg. min). Teens living with HIV had average VO_2 max values in the upper 20s, placing them in the “well below average” group when compared to age-matched, HIV-negative controls (Keyser et al., 2000). Webel et al. (2019) discovered that HIV-positive patients had lower VO_2 max values than an uninfected control group, both at the anaerobic threshold and throughout maximal exercise. This means they needed to aerobic exercise in order to improve their VO_2 max values significantly increased in functional capacity following 12 weeks of exercise Bopp et al. (2003) and 24 weeks of aerobic endurance activity. The implications of this improvement in functional capability, however, have scarcely been assessed in Ugandan HIV-positive individuals. According to additional research, patients’ capacity to carry out activities of daily living improved steadily by

40% in a group receiving cardiac rehabilitation (Bopp et al., 2003). Greater functional capacity may lessen HIV-related symptoms and provide a higher quality of life in individuals with HIV infection, if this association is present.

The Rating of Perceived Exertion (RPE), a fifteen-point category scale, is a commonly used method to quantify the level of physical strain encountered during aerobic exercise (Eston and Williams, 1986). The results of studies on effort perception showed that assessments of adults' exercise intensity were highly correlated with physiological indices that were also collected at the same time, including heart rate, oxygen uptake, and blood lactate build-up (Hansen et al., 2022). According to Eston et al. (2013), the RPE approach was utilized for training load monitoring validity, ecological utility, and affecting factors. With men and women of diverse ages and skill levels, they verified the validity, reliability, and internal consistency of the session RPE approach in sports and physical activities. The conclusion was that, while some suggested integrating it with other physiological indicators like heart rate, this method can be utilized independently for training load monitoring.

Williams (2017), asserts that a "Danish study which looked at the use of the Borg CR10 scale in assessing levels of fatigue at midday and at the end of the shift in workers". It was shown that during the course of a workday, there was a strong correlation between high felt levels of physical activity and high neck muscular tension. On the Borg CR10 scale, a score of at least four (4) appeared to suggest that there was significant muscle loading taking place. VO_2max has also been predicted using RPE. McCulloch et al. (2015) examined VO_2 max in research to validate a submaximal test to predict maximal oxygen consumption for individuals with spinal cord damage. It was found that an RPE-based approach for VO_2 max prediction is feasible and can produce VO_2 max values in the able-bodied population that can be predicted with accuracy. This study serves as a proof of concept for the use of a whole-body recumbent stepper in a submaximal test protocol to predict VO_2 max in healthy adults.

Heart rate may also be determined using RPE. That is to say, the heart rate is calculated as follows: 12 x 10 = 120 beats per minute if the person's rating of perceived exertion (RPE) is 12. But the heart rate determined by this technique is merely an estimate. Age and physical state can have a significant impact on the real heart rate. For people using drugs that alter heart rate or pulse, the Borg Rating of Perceived Exertion is the recommended way to measure intensity (CDC, 2022). A preferred scale is used by the exerciser to rate their effort on a range of either 0–10 (very light effort = 10–20 maximal exertion) or 6–20 (very light effort = 6-9 maximal exertion) (CDC, 2022). Engaging in frequent physical activity, your heart becomes more efficient at pumping blood. This increased efficiency means that with each beat, your heart can pump a larger volume of blood, allowing it to beat less frequently while still maintaining an adequate blood flow to meet the body's demands. VO_2 max also increases in healthy adults (Brooks et al., 2017). Overall, basic research on effort perception has shown that adult judgments of exercise intensity are highly correlated with physiological indices that are obtained concurrently, such as heart rate, oxygen uptake, blood lactate accumulation, and others (Hansen et al., 2022).

The exercise group in the systematic review and meta-analysis utilizing the Cochrane Collaboration protocol ended the 20-minute multi-stage shuttle run test (20mMST) with a higher heart rate and Rate of Perceived Exertion (RPE). When compared to non-exercisers, exercisers' VO_2 max significantly improved, as indicated by the results of the 20-meter multi-shuttle run test (MST). The modified Borg Rate of Perceived Exertion (RPE) scale is used to measure the common field measure of VO_2 max. The patients showed more progress after a specific load was applied until they felt muscle failure, or were unable to perform any more repetitions (O'Brien et al., 2016). In this study a ten minutes aerobic exercise was used at moderate intensity. Whoever got exhausted was asked to rest and time spent was also recorded on a modified Borg RPE. This was used to assess both pre and post-test to determine the difference in functional work capacity.

The Duke Activity Status Index (DASI), which was created by Ravani et al. (2012) as a quick and low-cost substitute for VO_2 max, measures a person's capacity for exercise by asking twelve (12) questions about their ability to undertake activities of daily living. Participants in the DASI were expected to select "yes" or "no" for each question. The DASI score is calculated by multiplying the total number of "yes" replies by 0.43, adding 9.6, and calculating the estimated maximum oxygen consumption (VO_2 max) with 81% reliability. There is a range of 0 to 58.2 points in the final score. The functional capacity scores improve with higher scores (Olatunbosun et al., 2021). Ferguson and Shulman (2021) found a weak connection between peak VO_2max and the DASI score. The DASI's predictive power for a peak $VO_2 > 15$ mL/kg/min is moderate. Four or five questions in a condensed, modified version of the DASI questionnaire (m-DASI) may be sufficient to identify patients with at least modest functional capacity.

The DASI has criterion validity of 0.34 when associated with measured VO_2 peak, indicating that it can predict functional capacity in individuals with chronic obstructive pulmonary disease. A small number of studies suggest that there is a moderate link between the VO_2 peak and the DASI in the perioperative context (Riedel et al., 2021). When measuring a patient's functional capacity for heart failure, DASI scores also showed a strong correlation with peak oxygen uptake (Grodin et al., 2015). In this study the DASI score was associated with improved functional work capacity if the score increases it indicates improvement. Specifically, DASI was used to triangulate the results of functional work capacity in HIV positive people got where RPE was used with an assumption that improvement in oxygen uptake VO_2 max will mean improvement functional work capacity.

2.5 Effects of Exercise on Psychological Markers

When HIV positive patients are on antiretroviral therapy (ART), psychological signs such as anxiety, sadness, neuroticism, and paranoid ideation are most frequently observed. When HAART became accessible, Seid et al. (2020) investigated the health impacts of chronic depression in

individuals living with HIV. Compared to individuals who had never experienced depression, clients with chronic depressive symptoms had a roughly two-fold increased risk of poor treatment results and, ultimately, death from AIDS; the consequences of depression were especially noticeable in women who had low CD4 cell counts at the start of the research. There was also a higher fall in CD4 count in those with depression.

Numerous indications and symptoms of anxiety and despair are frequently present in people living with HIV. It is often known that insomnia, which is characterized as inadequate sleep-in terms of either amount or quality (Nokes & Kendrew, 2001), can result from HIV disease. Stress and HIV disease development have been linked by a number of writers. Research such as those conducted by Antoni et al. (2002) showed that stress management helps prevent secondary infections and slow the progression of HIV-positive people's condition. It has not clearly quantified the effect on most of the psychological markers.

In comparison to sedentary clients in the control group, Bopp et al. (2003) found that clients who engaged in aerobic training were shielded against stress-related immune function damages. "Exercises may produce beneficial physiological changes in the HIV-infected population such as improved body composition and increases in both strength and endurance," according to researchers like (Antoni et al. 2002). Similarly, it has been demonstrated that exercise has a good impact on psychological illnesses like anxiety and depression, hence enhancing quality of life (Demers, 2013).

Smith and Merwin (2021) used a mental and health test in another investigation. It was discovered that after receiving combination massage and exercise treatment for twelve (12) weeks, there was a considerable increase in mental or emotional health. Exercise therapy may have a good impact on the psychological well-being of clients living with HIV by addressing the underlying symptoms that lead to depression (Bopp et al., 2003). Exercise seemed to lessen anxiety symptoms in those with anxiety disorders, although it was not as successful as antidepressant drugs. The clinical impression results improved when depression medication and exercise were taken together.

The results of the anxiety inventory are then decreased when exercise is coupled with occupational therapy and lifestyle modifications. They came to the conclusion that while exercise seems to be a useful supplementary treatment for anxiety disorders, it is not as successful as antidepressant therapy. Exercise, both aerobic and non-aerobic, appears to lessen symptoms of anxiety (Jayakody et al., 2014). It is therefore clear that the combination of the two anti-depressants and exercise will improve the quality of life for patients' anxiety disorders.

Training in aerobic exercise provides antidepressant and anxiolytic properties, as well as protective properties against negative effects of stress. The benefits of antidepressants and anxiolytics have been most clearly shown in subclinical disorders, and there is still room for clinical use. Nonetheless, the manner in which data supports the hypothesis that fitness instruction activates a mechanism that bestows long-lasting stress resilience (Salmon, 2001). Cardiovascular Work has been demonstrated to lessen sensitivity to overall fear. It might furthermore lessen sensitivity to anxiety by exposing the wearer to uncomfortable bodily sensations. In 2004, Broman et al. conducted research on how aerobic exercise affected the susceptibility to unease. It was discovered that self-ratings of anxiety sensitivity, dread of physiological symptoms associated with anxiety, and generalized anxiety were gathered before, after, and one week after therapy. The findings showed that exercise, whether high- or low-intensity, decreased anxiety sensitivity. On the other hand, compared to low-intensity exercise, high-intensity exercise resulted in more treatment responders and more quickly decreased levels of anxiety sensitivity across the board. Exercise at a high intensity was the only way to lessen fear of anxiety-related physical symptoms.

Exercise at a higher intensity resulted in a greater number of treatment responders and a quicker decrease in a global sensitivity to anxiety measure when compared to low-intensity exercise (Askari et al., 2020). Zarshenas et al. (2013) investigated how short-term aerobic exercise affected Iranian women's perceptions of their bodies and symptoms of sadness. The control group was instructed to wait for the following four weeks, whereas the experimental group underwent an

aerobic exercise program for four weeks. It was shown that the experimental group's depression symptoms were much lower than those of the control group. Significant improvements in appearance orientation, health orientation, and illness orientation were also noted in the evaluation of appearance for the body image as a dependent variable in the aerobic exercise group (Zarshenas et al., 2013). As a multifaceted supplementary treatment added to standard care, aerobic exercise has been demonstrated to further enhance all three categories of physical, emotional, and cognitive symptoms of depression. This is particularly true because it enhances the social connection and mental health aspects of life quality (Askari et al., 2020).

The impact of flexibility training on suicidal thoughts in depressed adult Korean women: Compared to the participants who did not engage in flexibility exercise, the participants who performed flexibility exercises were probably less stressed and suicidal ideation was less common. It was determined that, for Korean adult women with depressive disorders, flexibility exercises are crucial in lowering and preventing stress and suicidal thoughts (Koo and Kyungjin, 2020). Meta-analytic evaluations indicate that physical exercise and conscientiousness are positively correlated, with some mixed evidence suggesting a slight negative correlation with neuroticism (Rhodes and Boudreau, 2017). According to Rhodes and Boudreau (2017), the effect seems to be more noticeable while engaging in intense physical activity and less noticeable when engaging in lower-intensity lifestyle activities. The results of this study provide credence to the advantages of physical fitness on psychological well-being. More specifically, individuals with higher levels of corticotrophin releasing factor showed a reduced correlation between neuroticism and depression. For teenagers with greater levels of neuroticism, encouraging physical fitness may be quite helpful (Yeatts et al., 2017).

Lower levels of depressive symptoms are linked to regular physical activity (Torres et al., 2010). Research has demonstrated that upping one's daily physical exercise might effectively mitigate symptoms of depression (Conn, 2010). Panic attacks and panic disorder are known to precede anxiety sensitivity, which is the misinterpretation of anxiety-related symptoms. Aerobic

exercise has been shown to reduce anxiety in general and may also reduce anxiety sensitivity by exposing participants to physiological sensations that they find distressing (Broman et al., 2004). High-intensity exercise also produced greater treatment responders and faster reductions in a global measure of anxiety sensitivity than low-intensity exercise did. According to Broman et al. (2004), fear of anxiety-related physical symptoms was only lowered by intense exercise.

In all these studies by different researchers, it is evident that exercise can boost most of the parameters of psychological markers. However, there is no evidence of study done in Uganda on PLHIV and in most studies, it was also not clear how exercise was done and which specific exercises clients engaged in for clinicians to benchmark on them. This study sought to design exercises, specify their intensity and duration in order to determine their effects on participants.

2.6 Recommended Exercise for HIV-Infected Clients

HIV infection became a chronic condition due to medical advances in the use of HAART to treat it; this has been associated with a number of comorbidities, disability, problems coping with day-to-day living, and a decrease in exercise capacity (Eggleton and Nagalli, 2020). Because of their longer lifespans in the HAART era, HIV-positive patients' rates of death and morbidity have dramatically dropped. Nsagha et al. (2015) found that although HAART has dramatically reduced the prevalence of immunosuppression and wasting syndrome in HIV patients, it is associated with anthropometric and metabolic abnormalities such as insulin resistance, dyslipidaemia, and aberrant body fat distribution.

Exercise is a critical management strategy employed by rehabilitation health professionals when it comes to HIV/AIDS clients' rehabilitation and health promotion. Exercise can help reduce a number of HIV-related side effects as well as the cardiometabolic and morphological problems that come with HAART, such as inflammation, oxidative stress, and mitochondrial dysfunction (Grace et al., 2015). Exercising can slow down the disease's progression, enhance quality of life, increase

aerobic capacity, enhance functional ability, improve oxidative stress, improve lipid profiles, improve muscle strength, and lower the cardiovascular disease risk in people living with HIV, according to a substantial body of scientific research. According to Jaggers & Hand (2016), it is noteworthy that aerobic exercise is generally recognized as safe and that there is no evidence that regular moderate-intensity exercise would affect immune function in both symptomatic and asymptomatic HIV/AIDS patients. Exercise studies on clients with HIV/AIDS show that aerobic exercise (AE) and progressive resistive exercise (CARE) together enhance a number of health indices in HIV-infected clients more effectively than using either strategy alone (O'Brien et al., 2010). The American College of Sports Medicine has recently used and recommended CARE (Nweke et al., 2022).

All exercise sessions with an HIV-positive client should be supervised by a clinical exercise physiologist with the appropriate training or by other health professionals knowledgeable in exercise until the client shows that they can handle the recommended workload (Fletcher et al., 2001). When recommending exercise to an HIV client, a number of things need to be taken into account, including the client's drug regimen, symptoms, functional ability, and disease stage. Enhancing body composition, increasing functional work capacity, and building muscle strength and endurance should all be objectives of the workout regimen (Bopp et al., 2003).

The number of weekly workouts should be increased using the steady progression technique until the client is able to handle three to five sessions per week. Each session should last longer until one is working out for 20 to 60 minutes every time. The client's sessions may end abruptly if they are incapacitated. For instance, the client could work through three 10-minute sessions until they can finish a 30-minute session in place of just one. Moderate intensity exercise was performed at 50% to 85% of peak heart rate, between 45% - 85% V02 max, or between 11 and 14 on the Borg Rating of Perceived Exertion Scale (Turner et al., 2018). It is recommended that the client finish four to six weeks of aerobic training prior to beginning a weight training regimen. This will reduce the

likelihood of immunological problems early in the exercise regimen by enhancing fitness and preventing overtraining. Large muscular groups including the chest, biceps, brachia, quadriceps, and hamstrings should be the main emphasis of moderately intense resistance training.

The client should choose a weight that allows them to comfortably complete 8–12 repetitions. More sets of 8 to 12 repetitions should be added as soon as the client is able to tolerate the increased exertion, or resistance should be raised as the 8 to 12 repetitions start to feel less taxing. It is advised against using free weights when doing resistance training due to the higher risk of injury (Bopp et al., 2003). Because HIV clients have a wide range of symptoms, Jaggers et al. (2014) advised that all clients obtain medical clearance from their doctors before starting exercise programs. It is also advised to do an exercise stress test under physician supervision, as there are a number of potential limiting factors that could be present. HIV clients are more likely to experience dehydration and electrolyte abnormalities due to diarrhoea, poor diet, and poor nutrient absorption. These conditions can result in cramping in the muscles and irregular heartbeats. Increased exhaustion and a reduced ability to exercise can result from anaemia and muscle atrophy. Particular care should be taken if a patient has had pneumocystis pneumonia in the past, as residual lung scarring may lower alveolar capacity.

2.7 Related Studies

In order to compare various levels of exercise intensity, the safety and effectiveness of aerobic exercise in older HIV-positive males were investigated in a randomized experiment. Exercise endurance increased in both groups. Changes in VO_2 peak was clinically observed in the experimental group. No negative effects linked to exercise were seen (Araujo et al., 2021).

PLHIV CD4 cell (T-cell) count and cardiovascular parameters were examined in relation to the impact of an eight-week aerobic exercise program. The study's conclusions showed that a moderately intensity, continuous exercise training program had a significant impact on CD4 cell count and VO_2 max. The Pearson correlation test revealed a significant relationship between changes

in VO_2 max and an increase in CD4 cell count. According to Ezema et al. (2014), PLHIV can benefit from additional therapy that lowers blood pressure and increases CD4 cell count, such as moderate intensity aerobic exercise (Ezema et al., 2014).

Numerous researches have examined the impact of consistent aerobic exercise training on the immune systems of individuals living with HIV. The duration of most training programs was six to twelve weeks of regular aerobics, bicycle or treadmill exercise. Either moderate or heavy intensity was present (60-80% V02 max). At least three training sessions a week, lasting between fifty and sixty minutes each, were held. For the majority of HIV positive clients, this regular aerobic exercise training program returns the maximal oxygen uptake and lactic acidosis threshold to nearly normal levels. Exercise intensities, thereby reducing one's capacity for exercise (Bopp et al., 2003). Diverse range of HIV patients' symptoms. Furthermore, it was discovered that an appropriately structured aerobic exercise training program improved immune system indices or function. Ultimately, an exercise intervention improved depression symptoms and quality of life (O'Brien et al., 2016).

2.8 Chapter Summary

Some health care providers still advise their HIV-positive patients not to engage in structured physical activity, even in the face of evidence that exercise boosts CD4 cell counts and has no detrimental effects on immune measures (Anecdotal source). The findings indicate that aerobic exercise can boost Immunity, functional work capacity, muscular strength, endurance, and the ability to reverse muscle and fat wasting in HIV-positive persons. It can also improve some psychological parameters. These benefits of exercise are obtained without the high expense and perhaps dangerous side effects of pharmaceutical and medical procedures.

Since the curricula for medical training in Ugandan medical schools and institutions do not cover these disciplines in detail, the majority of practicing clinicians in the country are not adequately exposed to the science of exercise physiology and exercise prescription. This presents a problem with the lack of detail about the specific aerobic exercises and the benefits they confer.

Training in Ugandan medical Schools and institutions do not cover these disciplines in detail. This is why the researcher opted to conduct a study on clinical implications of aerobic exercises on HIV positive client on ART in Uganda (Anecdotal sources).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter contains the following sub-sections: research design, study area, research variables, target population, sampling technique, data collection instruments, data collection procedure, tools for data collection, data quality control (validity and reliability), data analysis and presentation, inclusion and exclusion criteria, and ethical considerations.

3.1 Research Design

A quasi-experimental research design was used in the study. Quasi-experimental study designs, often known as nonrandomized, pre-post intervention studies, are widely utilized in the medical informatics field (Harris et al., 2006). This is different from experimental design because; experimental design has a high level of controls over the variables. While quasi experimental lacks the same controls and random assignments because often cannot assign participants randomly due to ethical or practical constraints. Like in this case HIV positive clients that may have stigma and need to incur some costs to come to the facility daily for exercises.

To measure the effect of the independent variable (IV) on the dependent variable (DV), the same manipulations as in a real experiment were made. There was a control group, though, and the participants were assigned at random only after being chosen for the study through volunteerism and purposeful selection. The participants were selected according to particularly required characteristics like being on treatment for 12 months or more and being adults who can commit time to participate in the exercise this was necessary in the research situation (Martínez-Mesa et al., 2016). The age group was selected considering the nature of the participants being HIV positive clients with stigma and the transport cost involved to come to the facility at least three times a week. This study design consists of studying the experimental and control samples at two different points in time in order to establish change in a phenomenon or variables in order to establish the

impact of an intervention (Estrada & Pardo, 2019). Using one or more experimental variables is what this is all about (Seel et al., 2012). This design provided an opportunity for the variables to be measured at the start of the study and after subjecting the experimental group to a twelve weeks' aerobic exercise.

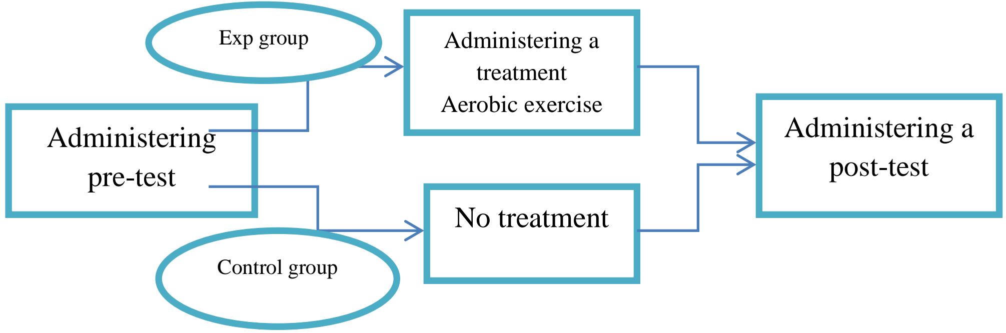

Figure 3.1 Pre-test and Post-test flow of activities

Adopted from Dimitrov and Rumrill Jr (2003) with modifications

All groups were given a pre-test, the experimental group underwent aerobic exercise, and there was no treatment given to the control group at all just a follow-up call to ensure they didn't feel abandoned. After that, each group received a post-test. This provided an opportunity to determine the clinical effects of aerobic exercise on immune markers, psychological indicators, and the ability of HIV-positive clients receiving ART to perform their jobs.

3.2 Location of the Study

The study was conducted at General Military Hospital (GMH) Bombo in Luwero District, central Uganda which is 33.8 kilometre (kms) (21miles) from Kampala the capital city of Uganda. The hospital is situated in Bombo Town Council, on the grounds of Bombo Military Barracks, the Land Forces of the UPDF's headquarters. It is roughly 32 kilometres north by road of Mulago National Referral Hospital. Bombo Military Hospital's coordinates are 0°35'11.0"N, 32°32'10.0"E (a longitude: 32.536111; latitude: 0.586389). From mile 21 trading centre one branches to the right at a sign post of Bombo Army Secondary school which is about 800 metres to the facility. The hospital is a military facility that provides referral services to the UPDF's several medical units.

Yet, the hospital treats residents of the surrounding areas due to the great need in those communities.

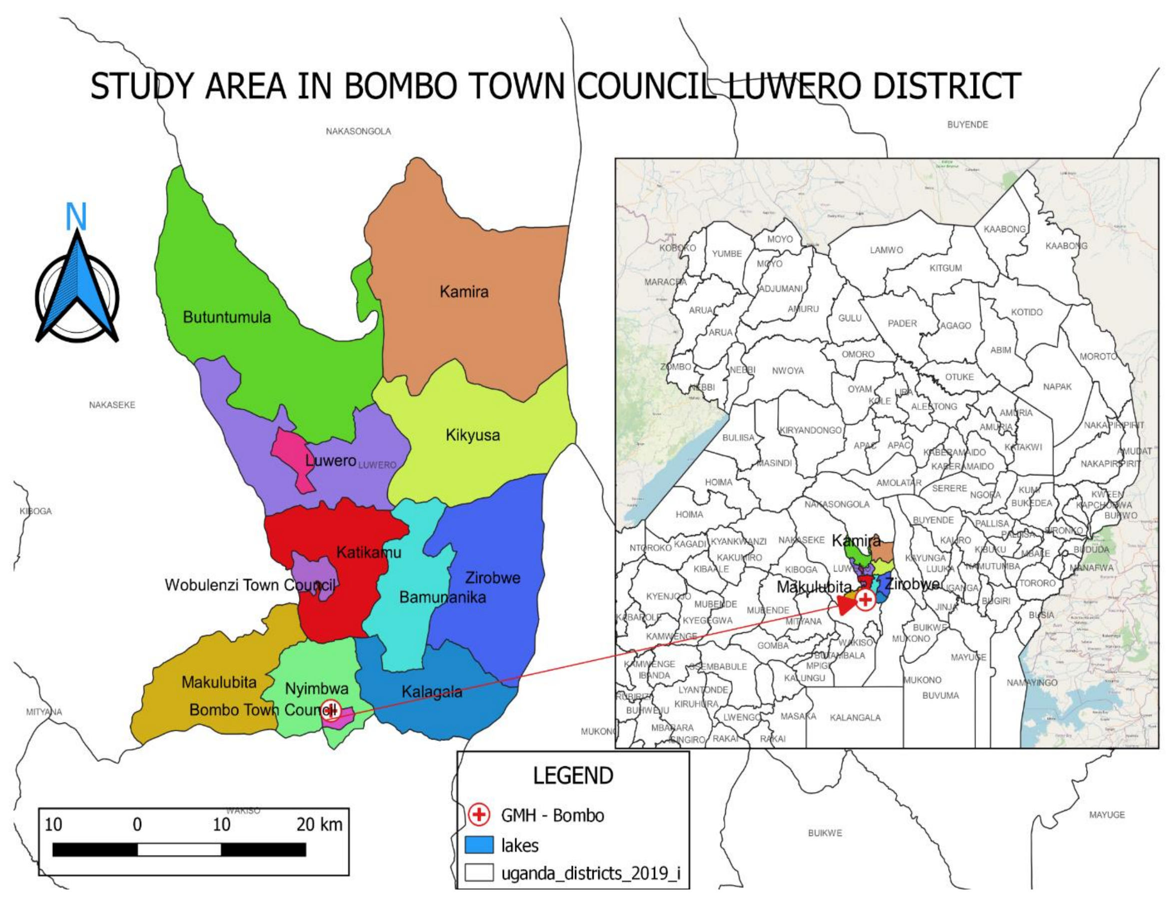

Figure 3.2: The Study Area in Uganda, (https://www.luwero.go.ug/lg/location-size).

The district is located between latitudes 20 north of the equator and east between 320 and 330, to the north of Kampala. The Luwero district encompasses an area of roughly 2577.49 square kilometres. The district is bounded to the south by Mukono and Wakiso, to the west by Nakaseke, to the north by Nakasongola, and to the east by Kayunga District. The study was conducted in Nyimbwa sub-county Bombo military barracks as indicated.

3.3 Target Population

HIV-positive patients receiving care at General Military Hospital-Bombo made up the target demographic. Particularly, men and women who were receiving care for a minimum of 12 months and were 20 years of age an above. That category of clients formed the majority of the 4150 clients that were receiving ART treatment at GMH, (DHIS2, 2019). The age range was selected with an

assumption that majority of them were adults, out of schools and could allocate time for the aerobic exercise classes.

3.3.1 Inclusion and exclusion criteria

The inclusion criteria for this study were: HIV positive clients taking their ART treatment from Bombo Military Hospital, who were on treatment for 12 months and more, without any limitation for exercise, asymptomatic, 20 years of age and above, volunteering to come for aerobic exercise session for 3 times or more a week and adhering to their ART. Besides the 12 months of ART treatment and 20 years of age and above, the clients were also included based on their willingness to participate in the study.

Exclusion criteria were: clients with known limitation to exercise, clients with opportunistic infections, those with signs and symptoms of the HIV disease, children, adolescents and new clients less than 12 months on ART treatment. The clients' who were not willing to participate in the aerobic exercise and had not spent 12months plus on ART treatment and above 20 years of age were not eligible to participate.

3.4 Sampling Procedure and Sample Size

3.4.1 Study sample size

After health education sessions that took more than six months about the study, out of 4150 clients 3300 met the inclusion criteria and 135 volunteers were willing participants in the study as per the defined criteria and were enrolled. This gave an adequate sample as compared with Yemen's formula of determining the sample size using a level of confidence of 10%. The formula is defined as follows:

$$n = \frac{N}{1 + Ne^2} \qquad (1)$$

Where:

N is the population size

n is the sample size

e Margin of error
the formulae gave the study n = 99 participants.

135 were participants who were involved in the study. This was regarded as a good sample since it was greater than the 99 minimum calculated from Yemen's formulas. Yemen's formulas work best when a large population is involved and a representative sample size is desired by the researcher (Chanuan et al., 2021).

3.4.2 Sampling procedure

Purposive sampling procedure was employed, the participants were sampled on the basis of their duration on treatment, and absence of signs and symptoms that would not allow them to take part in exercise. According to Odiya (2009), participants were selected purposively, because they possess the characteristics being sought, or because they were the only ones in their respective categories. That category of clients 20 years and above who formed majority of the 4150 clients on ART care at GMH (DHIS2, 2019). The age range was selected with an assumption that majority of them were out of schools and would allocate time for the aerobic exercise classes. They should have been on care for 12 months and more to select both the experimental and the control groups. Because these clients were expected to be stable on treatment and their schedules would make them reliable to attend the exercise sessions. Volunteerism was used this method was found appropriate because of the stigma associated with HIV infection, time, and money for transport to come for the aerobic exercise sessions. In a related study, Maduagwu et al. (2017) evaluated the effects of volunteering on CD4 cell counts and quality of life in HIV-positive individuals in Nigeria.

3.5 Research Instruments

The following instruments were employed for data collection:

3.5.1 Modified Physical Activity Readiness Questionnaire (PAR-Q)

The Physical Activity Readiness Questionnaire (PAR-Q) was adapted and used as an instrument to screen physical activity readiness (Appendix VI). The physical activity readiness

questionnaire was modified by adding venue for training, preferred gender of a trainer and demographic information which helped the clients in decision making. This was used to determine the readiness of the participants to take part in aerobic exercise it also helped to eliminate those with exercise limitations. The PAR-Q is a tool that was used to determine whether the participants were healthy to participate in exercise or whether were to consult a doctor to ensure that they are in good health status, (Quinn, 2015).

3.5.2 Point of care CD4 analyser (Pima Machine)

Point of care CD4 analyser, Pima machine was used for counting CD4 cells that helped in determining the immunological measures (CD4 cells).

3.5.3 Rate of Perceived Exhaustion scale

Rate of Perceived Exhaustion scale (RPE), (Appendix VIII) was used to determine maximum oxygen consumption (VO_2 max) which is a common measure of functional work capacity (Haddad et al., 2017). Nystoriak and Bhatnagar (2018), alludes that regular exercise benefits cardiovascular system like, strengthening the heart muscle. It is a fifteen-point category scale introduced by Borg in 1971. In this study a 10-minute moderate intensity aerobic dance at 150 beats per minute was used to check the RPE for clients using the RPE scale by (Eston and Williams, 1986).

3.5.4 Self report physical activity status

Duke Activity Status Index (DASI) (Appendix IX) was also used to triangulate with the results of functional work capacity from RPE. Another method McCarthy et al. (2015) uses to test VO_2max in physical activity and functional capacity in women is the DASI. The primary outcome measures included cardiac risk factors, CAD, and functional capacity as assessed by core laboratory-determined parameters during symptom-limited exercise treadmill testing. Measured physical activity using postmenopausal progesterone and oestrogen levels. Functional capacity as determined by the Duke Activity Status Index (DASI) questionnaire was connected with functional

capacity as assessed in Metabolic Equivalents (METS) (McCarthy et al., 2015). This helped to reinforce the results got from RPE scale.

3.5.5 Determining psychological markers

Psychosocial assessment tool was used to assess the psychosocial markers of the participants (Appendix X).

3.5.6 Exercise protocol

Exercise protocol included a list of exercises that was followed in administering exercises showing the type, intensity and duration of each exercise (Appendix IV).

3.6 Validity and Reliability of the Instruments

3.6.1 Validity

The researcher used face and content validity to assess the authenticity of the data collection tools. To ensure face validity, the tools were availed to the supervisors who then were able to express their opinions regarding the instruments' clarity and coherence. This was based on the fact that face validity is used to estimate whether a tool appears to measure a certain criterion or not and that it relates to whether a test appears to be a good measure or not. All the tools used in this study namely, (i) the Physical Activity Readiness Questionnaire (PAR-Q); (ii) CD4 Cell Results Template; (iii) the Borg RPE Scale for Rating Perceived Exertion; (iv) the Duke Activity Status Index (DASI Questionnaire); and (v) the Psychosocial Assessment Tool, passed the face validity test. This was so possibly because they are all standard tools that have been validated by their inventors and that they have been used severally by other researchers.

Content validity on the other hand, was ensured by requesting two professionals to review all the questionnaire items for readability, clarity and comprehensiveness. Thereafter, content validity index was established by calculating the content validity index (CVI) using the formula:

$$CVI = \frac{\text{Number of items declared to be correct}}{\text{Total number of items in the Tool}}$$

Using the above formula, the CVI for the three tools that were used, that is, Physical Activity Readiness Questionnaire (PAR-Q); Duke Activity Status Index (DASI Questionnaire); and the Psychosocial Assessment Tool, the findings were as shown in the Table below.

Table 3.1 Validity Test Results

SN	Data Collection Tool	Number of correct Items	Total Number of Items	CVI
1.	Physical Activity Readiness Questionnaire	18	21	0.86
2.	Duke Activity Status Index	12	12	1.00
3.	Psychosocial Assessment Tool	24	24	1.00

Source: Primary Data

The results show that all the tools were rated as being able to collect valid data consider that their content validity indices were all about the minimum accepted level on 0.7. The Physical Activity Readiness Questionnaire (PAR-Q); Duke Activity Status Index (DASI Questionnaire) had indices of 1.0 because these are standard tools which were just adopted for this study meaning that they are validated tools, (Ekementeabasi et al., 2020).

3.6.2 Reliability

To ensure reliability, a sample of five participants, who were not part of the study sample were requested to fill in the questionnaires to test the reliability of the questions. The reliability of the collected data was established by conducting the Cronbach's Alpha test of reliability using the Statistical Package for Social Sciences (SPSS) software and which is based on the following formula:

$$\alpha = \frac{k}{1-k}\left(1 - \frac{\sum_{i=1}^{k}\sigma_{Y_i}^2}{\sigma_X^2}\right)$$

Where:

σ_X^2 = the variance of the observed total test scores; $\sigma_{Y_i}^2$ = the variance of component i for the current sample of persons. According to this test, a Cronbach alpha coefficient equal to 0.7 or more is considered to be reliable. The specific reliability test results for this study were as follows:

Table 3.2 Cronbach's Alpha Test of Reliability Results

SN	Tool		Cronbach's Alpha Coefficient	Number of Items
1.	Physical Activity Readiness Questionnaire		0.843	21
2.	Duke Activity Status Index		0.791	12
3.	Psychosocial Assessment Tool:	Section (a) Paranoid Ideation	0.774	5
		Section (b) Depression	0.820	5
		Section (c) Neuroticism	0.707	4
		Section (d) Anxiety	0.913	5
		Section (e) Phobia	0.885	5

Source: Primary Data

According to the results as shown in the Table 3.2, all the tools that were used in this study passed the reliability best considering that the lowest acceptable Cronbach's alpha coefficient value is supposed to be 0.7 and all tools recorded values above this.

3.6.3 Point of Care CD4 Analyser

Point of care (POC) CD4 analyser, Pima machine was accredited on 22 Mar 2016 as one of the acceptable machines for conducting CD4 count (Pham et al., 2016). The recent results of quality assurance done weekly were relied on for validity. However, quality assurance tests were also conducted as per the MoH requirement during data collection and all the results were satisfactory.

Alere PIMA, the CD4 machine that was utilized, had a repeatability of 175.6 cells/ml and a coefficient of variability of 10.3%. The BD FACS Calibur (r^2 = 0.762, mean bias 264.8 cells/ml) and the BD FACS Count TM (r^2 = 0.874, mean bias 7.8 cells/ml) were not comparable to it. It was discovered to have a sensitivity of 89.6% and a specificity of 86.7% in individuals five years of age and older when compared to the FACS Calibur TM at a cut off of 350 cells/ml (Kw = 0.7566). In individuals five years of age and older, the BDFACS Count TM demonstrated a 79.4% sensitivity

and an 83.4% specificity (Mwau et al., 2013). So, the PIMA became a more reliable machine and was used in assessing immunity using CD4 cells tests.

3.6.4 Rate of Perceived Exertion (RPE) for functional work capacity

RPE scale (Appendix VIII) is used by YMCA of the USA in predicting VO_2 max and access cardiorespiratory endurance see details in (Appendix XX). This test was compared with other laboratory tests and found to give consistence results (Yu et al., 2021). Additionally, it was suggested that RPE be utilized as a rough indicator of exercise intensity. Eston et al. (2013) have demonstrated that the repeatability of work capacity based upon an RPE at 13 and 17 is as excellent as that based upon a heart rate of 130 and 170 beats/min in both healthy volunteers and cardiac patients. Also, it was noted that HR, RPE, and VO_2 max percentage were closely related (Yu et al., 2021). Adult studies have found that, for the majority of participants, an RPE between 12 and 14 corresponds to 60–80% VO_2 max (Yu et al., 2021) when performing running or cycling exercises. In their investigation, comparable RPE levels were noted at 60% VO_2 max. This was therefore a useful method to estimate work capacity since it had a linear relationship with VO_2 max.

3.6.5 Duke Activity Status Index (DASI) (Appendix IX)

To triangulate the results of functional work capacity DASI was used in this study. DASI determines exercise capacity it uses 12 questions to assess a person's ability to perform activities of daily living. These questions need a yes or no the participants were asked to answer the questions to ascertain their capacity to do daily work. Several researchers have employed the DASI, such as (McCarthy et al., 2015) who measured women's functional ability and physical activity. The primary outcome measures included cardiac risk factors, CAD, and functional capacity as assessed by core laboratory-determined parameters during symptom-limited exercise treadmill testing. Measured physical activity using postmenopausal progesterone and oestrogen levels. Functional capacity as determined by the Duke Activity Status Index (DASI) questionnaire and the

intervention physical activity questionnaire (PEPI-Q) were linked with functional capacity as determined by metabolic equivalents (METS) (McCarthy et al., 2015).

3.6.6 Psychological assessment tool for establishing psychological markers (Appendix X)

Psychosocial assessment tool that was used is a standard tool by MoH Uganda which has been used and provided credible results. Content validity was undertaken to ascertain whether the content of the questionnaire was appropriate and relevant to the study for psychosocial assessment was done because of the modifications done. According to Koller et al. (2017), content validity is the degree to which the content encompasses all of the attributes being studied and is often produced by seven or more experts. In this study, the content validity was estimated by seven experts, and the researcher explicitly stated the goal of the questionnaire. Seven carefully selected specialists in the research fields were requested to assess the questionnaires and provide feedback. Using a 4-point Likert scale (1 being not relevant, 2 being somewhat relevant, 3 being relevant, and 4 being very relevant), each reviewer separately assessed how relevant each question was to the goal. The Content Validity Index (CVI) was used to estimate the validity of the items. The experts were selected based on qualification and experience in psychosocial work of clinical psychology.

3.7 Data Collection Procedure

Eight research assistants were trained on what was involved in the study, and then the participants were selected using appropriate methods as earlier indicated.

Five A's psychological counselling framework Bardonian model was used to prepare clients for the exercise and also ensure adherence to the aerobic exercise programme (Appendix XIX), (HIV prevention and treatment guideline, 2020). A study risk mitigation plan was developed Appendix XVIII to ensure safety and reduce the risk of Covid-19 transmission.

The clients were briefed on their rights and asked to sign informed consent. They were asked to fill self-administered physical activity readiness questionnaire (PAR-Q) to ascertain their readiness to exercise and if there any exercise limitations.

They were informed about what was involved in the exercise. The exercises included brisk walking, jogging and aerobic dance at moderate intensity. The days that the participants chose to attend, knowing that they would have time, determined how they were grouped. At least three times a week, each subject attended under the careful supervision of the research assistants and the researcher for twelve weeks. The researcher motivated the participants by making the physical activities fun and talking to the clients during the aerobic exercises for 12 weeks.

The 12 weeks was chosen because scientifically it is said that changes caused by aerobic exercises can be noticed between 8 to 12 weeks (Amaro-Gahete et al., 2019). The researcher therefore chose 12 weeks which was the maximum duration to observe the noticeable actual change. Water was available for use during the sessions, and for those who needed it afterward, there was a handy restroom. All sessions included 5 minutes of warm up followed by stretching, not less than 25 minutes of exercising (aerobic dance), as well as 5 minutes of relaxation activities to cool down. All types of exercise training were done according to the ACSM guidelines (Colberg et al., 2016).

3.7.2 Immunological measures

In K3 EDTA vacutainers, a venous blood sample of three (3) millilitres was obtained. Using a lancet finger stick, a capillary blood sample was taken from the fingertip. To obtain adequate capillary blood flow, a blade-style lancet punctured the skin at a depth of 1.8 mm. Using an Aleles PIMA CD4 analyser, the venous or finger prick samples were examined in the lab, and the centre retained the test results. The corresponding reference procedures were utilized to process the samples. The PIMA results were hidden from the technicians who used the reference technique to estimate the CD4 count. The clients received copies of the absolute CD4 counts that were produced using the reference method.

3.7.3 Measuring functional work capacity using rate of perceived exertion (RPE)

This was done by using Borg RPE scale which uses a scale of six to twenty. This was designed to give a fairly good estimate of the actual heart rate and after getting the score you multiply by 10 to get the estimate. The clients were taken through a 10-minute non-stop exercise by the instructors guided by music of 150 beats per minute and then the research assistants helped them to complete the RPE scale. There after the results were kept ready for analysis.

The researcher also used the Duke Activity Status Index (DASI) to triangulate the results of functional work capacity from RPE. DASI a self-administered the clients were provided with this questionnaire and asked to complete it with assistance from the research assistant.

3.7.4 Assessing psychosocial markers

Each client in the study was asked questions in the modified MoH psychosocial assessment tool by a technical staff that had the ability to understand and interpret the answers given by the clients.

Sub-groups were formed according to the days selected and the time of exercise set with the participants. Exercises included brisk walking, jogging and aerobic dance which was at least 30 minutes 5 days a week at moderate intensity with uplifting music we started with a tempo of about 120 BPM (beats per minute) for 2 weeks then went to 130BPM to 140BPMand then to 150 BPM the last 6 weeks.

3.8 Data Analysis and Presentation

The data collected using a PAR-Q was analysed using predictive analytics to determine the participants' engagement in physical activities. Where the information given in the questionnaire were categorised, classified, summarised, tabulated and thereafter participants that did not meet the criteria were replaced. Quantitative data was analysed using two sample t-test to compare the means for two different samples namely experimental and control group. A p-value ≤ 0.05 was considered

statistically significant. All analysis was performed using the Statistical Package for Social Sciences (SPSS) version 20.0.

3.9 Ethical considerations

The study proposal was approved by Kyambogo University Faculty of Science, Higher Degree Committee and recommendation was given by Kyambogo University Directorate of Research and Graduate Training (Appendix XIII). The presentation was made to an institutional review board, Lacor Hospital Institutional Research and Ethics Committee (LHIREC). his was renewed due to expiry (Appendix XIV & XV), Research and Ethical Committee of UPDF for administrative approval (Appendix XVI) and then to Uganda National Council for Science and Technology (UNCST) (Appendix XVII) for review to ensure protection of the rights of the participants and relevancy of the study to the body of knowledge.

The data collected was restricted to the study team in order to protect participant confidentiality and rights. The names of the participants were kept private on consent forms, which were stored in a locked, secure file and kept apart from all other study documentation. The clinic registrations and data collection instruments were not used to gather or extract names or other personally identifiable information. All information was kept on file and made available to the study monitors, authorized officials, and the evaluation team. Administrative records and study logs were destroyed through shredding.

The research assistants explained to the participants that their involvement in the study was completely voluntary and that they could discontinue at any time while continuing to receive their usual medical care. The participants were fully informed that this was an entirely voluntary activity and that they could stop at any time, no explanation needed. All participants had to verbally state that they understand and agree to all of the items contained in the information sheet and sign informed consent Appendix XI. Once the participant granted consent, they were signed the consent form in the appropriate space. The participant that could not sign their name or are illiterate, they

were provided with a witness to ensure that informed consent form was being read correctly to the participant. Illiterate participants were asked to sign the informed consent by using their thumb print. The information sheet and consent form were translated into Kiswahili.

The principle of beneficence was also observed, which is a moral obligation to act for the benefit of others. The clients benefited from free trainings on the importance of exercise and the exercise sessions themselves, the methods that were used, where simple and the clients closely monitored to ensure they learn.

There was also the principle of no maleficence. It was a duty to refrain from doing harm to other people. First do no harm, or “premium non nocere”, was closely linked to it. To guarantee that the research participants suffered no harm, the trainers followed the training principles, which primarily involved progressive progression.

CHAPTER FOUR

PRESENTATION AND DISCUSSION OF RESULTS

4.0 Introduction

This chapter presents the findings of the study as established during the analysis. The chapter starts with the presentation of the response rate of study participants followed by a description of their background information. The results are then presented and discussed in accordance with the goals; the primary goal of the study served as the guidance. To determine the effects of aerobic exercise on the clinical results of HIV-positive patients receiving antiretroviral therapy in Uganda, using General Military Hospital-Bombo as a case study. The objectives of the study were to: (i) assess the effect of a 12 weeks aerobic exercise on immunological measures of HIV positive clients on ART at GMH-Bombo; (ii) evaluate the impact of a 12 weeks aerobic exercise on functional work capacity of HIV positive clients on ART at GMH-Bombo; and (iii) determine the effects of a 12 weeks aerobic exercise on psychological markers of HIV positive clients on ART at GMH-Bombo. The following hypotheses were tested:

Ho_1: There would be no significant effect of aerobic exercise on immunological measures of HIV positive clients on ART.

Ho_2: There would be no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART.

Ho_3: Aerobic exercises have no significant effect on psychological markers of HIV positive clients on ART.

Data was gathered using a quasi-experimental design. The results presented to illustrate the differences between the experimental and control groups following the aerobic exercises.

4.1 Presentation of Study Findings

4.1.1 Response rate of study participants

Out of a total of 135 participants who had voluntarily accepted and qualified to take part in the study were randomly allocated in the experimental and control groups each taking 67 participants. A total of 18 participants dropped out from the experiment group because they didn't have enough time to engage in the aerobic exercise and thus created an elimination measure and 18 results from the control group were selected randomly and dropped for easy statistical comparison. This gave an attrition rate of 27% which was good enough for the experimental study considering that Meyer et al. (2022) indicate that a response rate of 70% and above is acceptable.

4.2 Demographic Information of Participants

Table 4.1: Demographic information of participants

SN	Variable	Parameter	Experimental Group		Control Group		TOTAL (Both groups)	
			Freq	**Percent**	**Freq**	**Percent**	**Freq**	**Percent**
1.	Gender of participants	1. Male	33	67.3	35	71.4	68	69.4
		2. Female	16	32.7	14	28.6	30	30.6
		Total	**49**	**100.0**	**49**	**100.0**	**98**	**100.0**
2.	Age (years)	1. 20-27	3	6.1	1	2.0	4	4.1
		2. 28-37	12	24.5	15	30.6	27	27.6
		3. 38-47	33	67.3	25	51.0	58	59.2
		4. 48-57	1	2.0	8	16.3	9	9.2
		Total	**49**	**100.0**	**49**	**100.0**	**98**	**100.1**
3.	Marital status	1. Married	30	61.2	38	77.6	68	69.4
		2. Single	12	24.5	5	10.2	17	17.3
		3. Divorced	6	12.2	6	12.2	12	12.2
		4. Widowed	1	2.0	0	0.0	1	1.0
		Total	**49**	**100.0**	**49**	**100.0**	**98**	**100.0**
4.	Education	1. Primary	17	34.7	13	26.5	30	30.6
		2. Secondary	22	44.9	28	57.1	50	51.0
		3. Tertiary	10	20.4	8	16.3	18	18.4
		4. Others	0	0.0	0.0	0.0	0	0.0
		Total	**49**	**100.0**	**49**	**100.0**	**98**	**100.0**

Source: Primary Data (2023)

Table 4.1 shows that the majority (67.3%) of participants in the experimental group were males while the females constituted 32.7%. Similarly, for the control group the males constituted 71.4% and the females 28.6%. This is a fair reflection of the member of the study population

(clients attending the ART Clinic at Bombo Military Hospital) where the males are slightly above 2,490 (>60%) and female are slightly below 1,660 (<40%).

The results also show that majority of the participants were between the age of 38-47 years although those in experimental group had a slightly higher number (67.3%) compared to 51% in the control group. This is true because most of the young soldiers are HIV negative since they are recruited when they are negative. The least number of participants (2%) who participated in the survey from the two categories were in different age, the experimental group were in the age bracket of 48-57 years and control group were in the age bracket of 20-27 years. The study furthermore revealed that there were participants who were above the age of 57 years. This therefore implies that all the participants in the study were adults and had knowledge regarding the problem under investigation.

The majority of participants in the control group (77.6%) and experimental group (61.2%) were married. This is in line with Pettee et al. (2006) who established that, married men and women unlike those who were single reported higher median levels of exercise participation than singles.

Regarding education, the majority (51%) of the participants had a secondary education, followed by 30% who had primary education. In this study, the participants ' educational background was also deemed to be significant. All these findings imply that all participants had attained some level of formal education and so they were expected to be conversant with aspects to do with physical activity aspects and also to understand the questions given to them during data collection. The fact that all participants had some formal education could partly be explained by the fact that the study was conducted in a military setting whereby academic credentials are necessary for one to be enlisted.

4.3 Physical Activity Readiness Questionnaire (PAR-Q)

Data on the study participants ' physical activity readiness and any barriers preventing them from engaging in physical exercise were gathered using the Physical Activity Readiness Questionnaire (PAR-Q). The background information included in the data collection is what has been presented in sections 4.3.1 - 4.3.7.

4.3.1 Current engagement in physical exercise and type of exercise

The study sought to establish whether the participants were engaged in any regular physical activity at the time of conducting this study and if so which type of activity. The findings are presented in Table 4.2.

Table 4.2: Current Engagement in Physical Activity and Type of Activity

SN	Variable	Parameter	Experimental Group		Control Group		TOTAL (Both groups)	
			Freq	**Percent**	**Freq**	**Percent**	**Freq**	**Percent**
1.	Currently engaged in any regular physical activity	1. Yes	12	24.5	3	6.1	15	15.3
		2. No	39	75.5	46	93.6	83	84.7
		Total	**49**	**100.0**	**49**	**100.0**	**98**	**100.0**
2.	Type of Physical Activity Engaged in	1. Aerobic	7	58.3	2	50.0	9	60.0
		2. Jumping	3	25.0	0	0.0	3	20.0
		3. Roadwork	0	0.0	1	25.0	1	6.7
		4. Other	2	16.7	0	0.0	2	13.3
		Total	**12**	**100.0**	**3**	**100.0**	**15**	**100.0**

Source: Primary Data (2023)

The test group reported a total of 24.5% (n=12) of regular, non-organized physical activity, compared to 6.1% (n=3) of the control group, according to the results. 84.7% of the participants in the study did not participate in any physical activities at all. The physical activities that those who exercised participated in included roadwork at 6.7%, jumping at 20%, and aerobics at 60%.

As to whether they were engaged in physical exercise prior to joining this study, it was established that the majority of the participants were not engaged in any exercises. The results also show that very few of the experimental group participants and control group participants, engaged in regular an organised physical activity. This, however, was not considered to be a problem as

such, since it was a baseline analysis before the experimental group was subjected to the aerobic exercises as was the objective of this study.

The results further show that very few of the experimental and control group members engaged in regular un-structured physical activities, and the few who did, none of them did so for more than 2 hours. Specifically, very few participants engaged in digging, fetching water, jogging, playing football or netball. Apparently, some participants indicated that they last participated in physical activity over a year ago prior to this study.

According to Vancampfort et al. (2018), "Globally, the physical activity status of HIV patients varies between countries, on average 32% fall into the low physical activity category, the moderate and the high category, each accounting for 33%, as defined by the International Physical Activity Questionnaire (IPAQ)" and the results presented show that HIV clients are not very active.

The participants were also asked if they played any games, went digging, or went fetching water. The findings as computed from those who responded to the questions posed were as presented in Table 4.3.

Table 4.3: Engagement in Digging, Fetching Water, Jogging and other Games

	Activity Engaged in	Parameter	Experimental Group		Control Group		Total (both groups)	
			Freq	**Percent**	**Freq**	**Percent**	**Freq**	**Percent**
1.	Digging for more than 3 times a week	1. Yes	4	8.5	1	2.0	5	5.5
		2 No	43	91.5	48	98.0	91	94.5
		Total	**47**	**100.0**	**49**	**100.0**	**96**	**100.0**
2.	Fetching water daily in more than 1km	1. Yes	2	4.5	0	0.0	2	2.2
		2. No	42	95.5	0	0.0	88	97.8
		Total	**44**	**100.0**	**0**	**0.0**	**90**	**100.0**
3.	Jogging, playing football or netball for more than 3 days a week	1. Yes	6	13.3	2	4.2	8	8.6
		2. No	38	84.4	46	95.8	84	90.3
		3. Other	1	2.2	0	0.0	1	1.1
		Total	**45**	**100.0**	**48**	**100.0**	**93**	**100.0**

Source: Primary Data (2023)

The aforementioned findings indicate that a relatively small percentage of participants in both the experimental and control groups dug more than three times per week, collected water every day from sources more than one kilometre distant, or participated in jogging, football, or netball for

more than three days per week. It appears that only 5.5% (n=96), 2.2% (n=90), and 8.6% (n=93) of the population participated in each of these three categories of physical activity.

The findings above provide additional evidence that HIV-positive clients are typically not active, as reported by Vancampfort et al. (2018) and Tegene et al. (2022). It is evident that the participants performed menial tasks like playing games and jogging, as well as domestic chores like fetching water and general economic activities like digging.

Frequency of engagement in physical exercise, for the participants who indicated that they are currently engaged in any regular physical activity, they were further asked to indicate how many times a week they did so and for how long per day. The findings are presented in Table 4.4.

Table 4.4: Frequency of Engagement in Physical Activities

Frequency per week	Experimental Group (n = 49)		Control Group (n = 49)		Total (Both groups)	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
1	1	8.3	0	0.0	1	6.2
2	0	0.0	0	0.0	0	0.0
3	0	0.0	0	0.0	0	0.0
4	1	8.3	3	75.0	4	25.0
5	3	25.0	0	0.0	3	18.8
6	0	0.0	0	0.0	0	0.0
7	7	58.3	1	25.0	8	50.0
Total	**12**	**100.0**	**4**	**100.0**	**16**	**100.0**

Source: Primary Data (2023)

The results show that, while the majority (58.3%, n=12) of the experimental group engaged in regular un structured physical activities seven times a week, the majority (75.0%, n=4) of the control group did so four times a week. According to these results, the exercises to which the participants engage in being unstructured implies that they may not in the long run be very meaningful in attaining a specific goal. The fact that the majority of individuals living with HIV and on ART have low levels of physical activity may help to explain this approach to exercise (Tegene et al., 2022). The situation is worse among female patients, those living in urban areas, and those undergoing longer intervention durations. The general population is relatively inactive, and this is especially true for HIV positive clients.

4.3.2 Date when last engagement in physical exercises

Participants, who said that they do not do physical exercises regularly, were asked to indicate when they last participated in physical activity. The findings as presented in Table 4.5

Table 4.5: Duration When Last Engaged in Exercise

SN	Last date of Activity	Experimental Group		Control Group		Total (both groups)	
		Freq	**Percent**	**Freq**	**Percent**	**Freq**	**Percent**
1.	1 month prior to Study	0	0.0	0	0.0	0	0.0
2.	Over 1 year prior to Study	12	92.3	0	0.0	12	92.3
3.	Other	1	7.7	0	0.0	1	7.7
	Total	**13**	**100.0**	**0**	**0.0**	**13**	**100.0**

Source: Primary Data (2023)

The majority of those who do not currently participate in physical activity (92.3%, n=13) had not done so for more than a year, according to the results; 7.7% of those who did not participate in physical activity confirmed that they had, but they were unsure of the exact date. Based on the results, it appears that all of these participants were part of the experimental group, and none of the control group indicated that they had ever engaged in physical activity. The majority of those who do not currently participate in physical activity (92.3%, n=13) had not done so for more than a year, according to the results; 7.7% of those who did not participate in physical activity confirmed that they had, but they were unsure of the exact date. Based on the results, it appears that all of these participants were part of the experimental group, and none of the control group indicated that they had ever engaged in physical activity.

4.3.3 Problems experienced upon exercising

The findings on whether participants experienced shortness of breath, fatigue, chest pain, pressure over the heart when exercising such as climbing stairs were as presented in Figure 4.1.

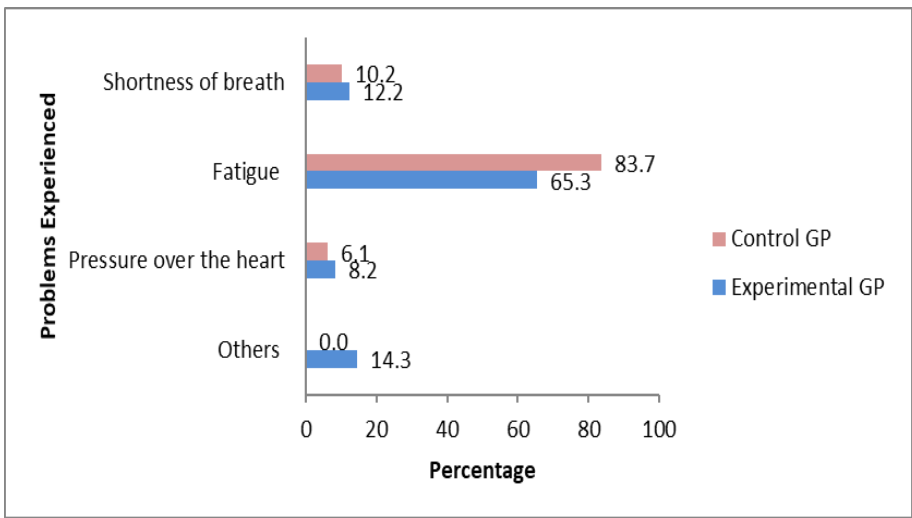

Figure 4.1: Problems Experienced by Participants during Exercising

Source: Primary data (2023)

Figure 4.1 shows that majority of the participants from both experimental group and control group considered fatigue to be the major problem experienced by participants during exercising. However, the experimental group had slightly a lower number (65.3%) as compared to 83.7% of the control group. The results also reveal that the least number of participants from both experimental group and control group considered pressure over the heart and they constituted 8.2% and 6.1% respectively. The findings furthermore reveal that there were no participants from the control group that mention other problems experienced by the participants during exercising. The results therefore imply that participants that are always engaged in exercising experience different challenges that are inevitable during the exercising process.

The above results, which can be interpreted negatively for the participants, could be held accountable for the study's participants' lack of physical activity. As can be seen, the main complaint from both the experimental and control groups was fatigue, with many of them indicating that they felt they did not have enough energy to participate in any physical activities. This could be the rationale behind the general belief that sick people are frail.

These results corroborate those of Gebreyesus et al. (2020), who showed that fatigue is a prevalent health issue among adults living with HIV and recommended that health care services

address the risk factors by offering integrated care and encouraging physical activity to reduce exposure to fatigue and slow the disease's progression.

The problems as experienced were not a surprise considering that it was earlier reported that most of the participants were hardly engaged in any physical exercises and so they were physically inactive. To this effect, any exertion would result in one form of pain or discomfort. This being a baseline result was critical as it was expected that after the experiment, there would be a distinction between the two groups upon being exposed to any form of exertion.

4.3.4 Purpose for engaging in exercises

Asked to state what their personal exercise programme goals would be should they engage in physical exercises; the responses of the participants were as shown in Figure 4.2.

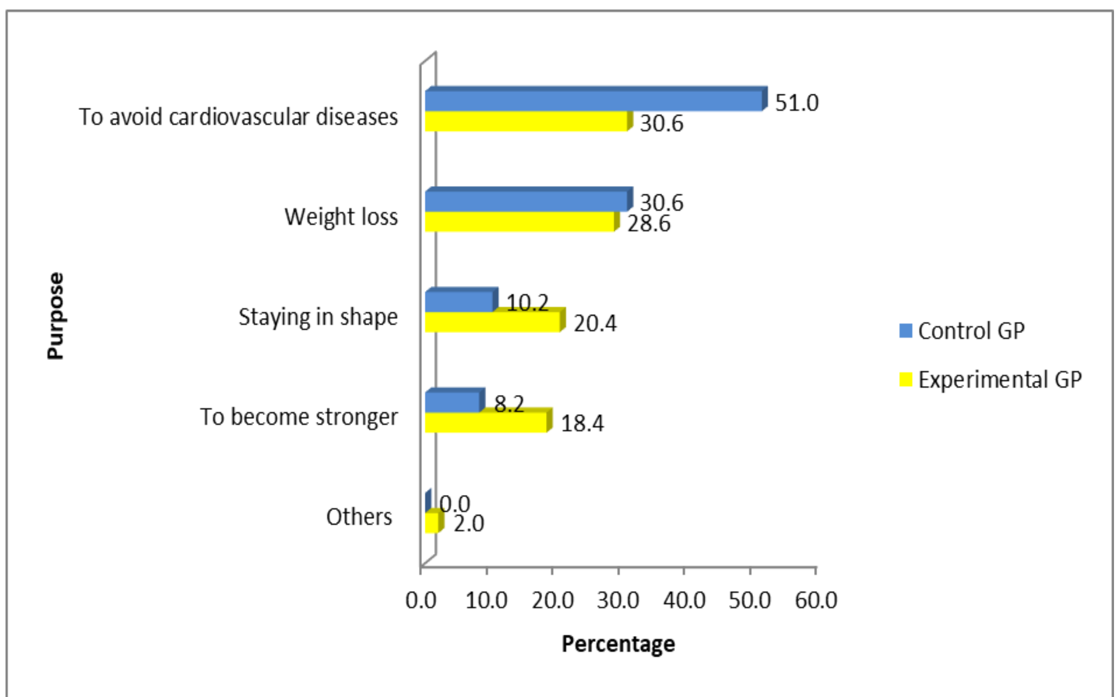

Figure 4.2: Purpose for Engaging in Physical Exercises

Source: Primary data (2023)

Figure 4.2 shows that majority of the participants in both experimental group and control group considered doing exercises to avoid cardiovascular diseases and they were constituting 30.6% and 51% respectively, followed by those who considered weight loss in both experimental group and control with 28.6% and 30.6% respectively, whereas only 2% in the experimental group

mentioned other reasons for doing physical exercise and only 8.2% in the control group considered doing physical exercise to become stronger. The results therefore imply that different participants always do physical exercises for different reasons depending on want one would love to achieve.

Based on the results above, it is evident that the participants were aware of the health benefits of exercise, it is possible that they learned them from health professionals who may have encouraged them to maintain their physical fitness or from the general public's understanding that exercise is beneficial for controlling body weight and maintaining a healthy heart. The results align with the research conducted by Orozco and Rosario (2020), which demonstrated that long-term physical activity can enhance immune system performance, muscular strength, and cardiovascular health in individuals living with HIV.

4.3.5 Number of days per week preferred for exercises

The numbers of days per week participants wished to engage in physical exercises are presented in Figure 4.3

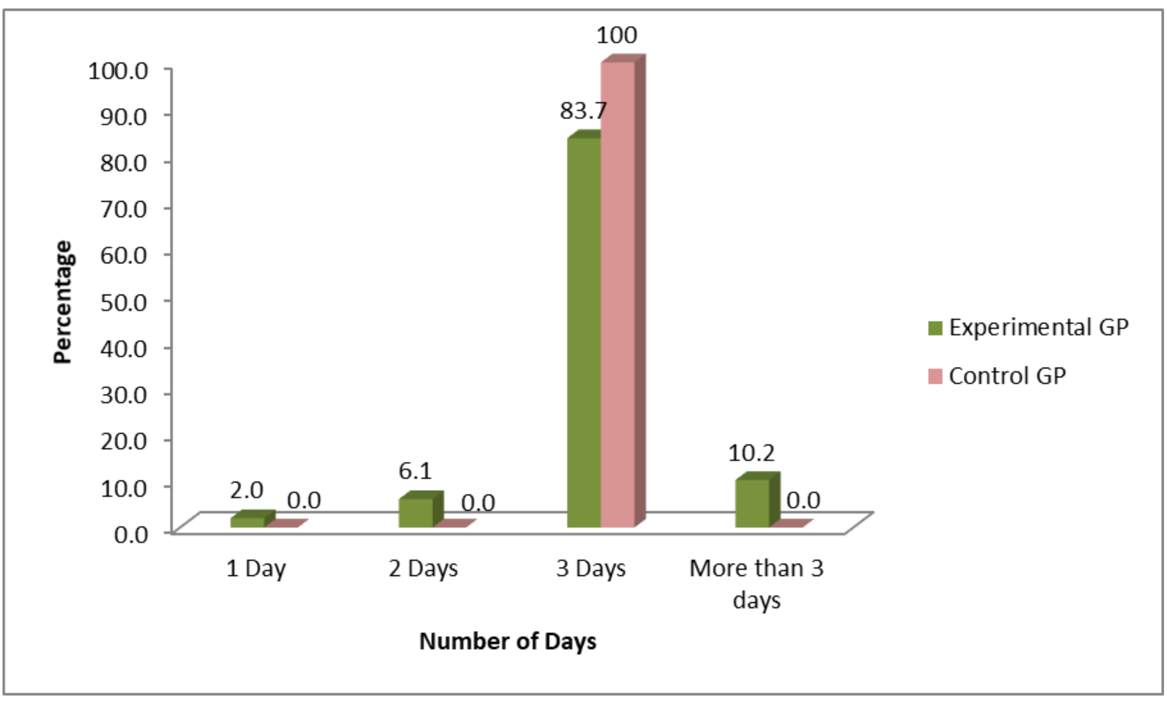

Figure 4.3: Number of Days Participants Preferred for Exercises

Source: Primary data (2023)

Figure 4.3 indicates that the majority of participants in both the experimental and control groups preferred exercising three days a week. The results reveal that 83.7% participants in experimental group preferred conducting the exercises for three days compared to the control group where all preferred. Only 2% of the participants in the experimental group preferred conducting the exercises for one day. The results furthermore reveal that most participants in both categories preferred conducting exercises for three or more days, implying that for one to be physically fit they must have more days of exercising.

These findings point out to the fact that all participants were keen on engaging in exercises but for only a few days considering that three days may not be adequate to have a great impact on one's physical wellbeing. The fact that they indicated that they would prefer to do exercises, for whatever period, was considered as a positive point that with encouragement they would be able to practice for a longer period.

4.3.6 Preferred Gender of trainers

As far as the preferred sex of the trainer was concerned, the participants gave their opinions and these were as summarised in Figure 4.4.

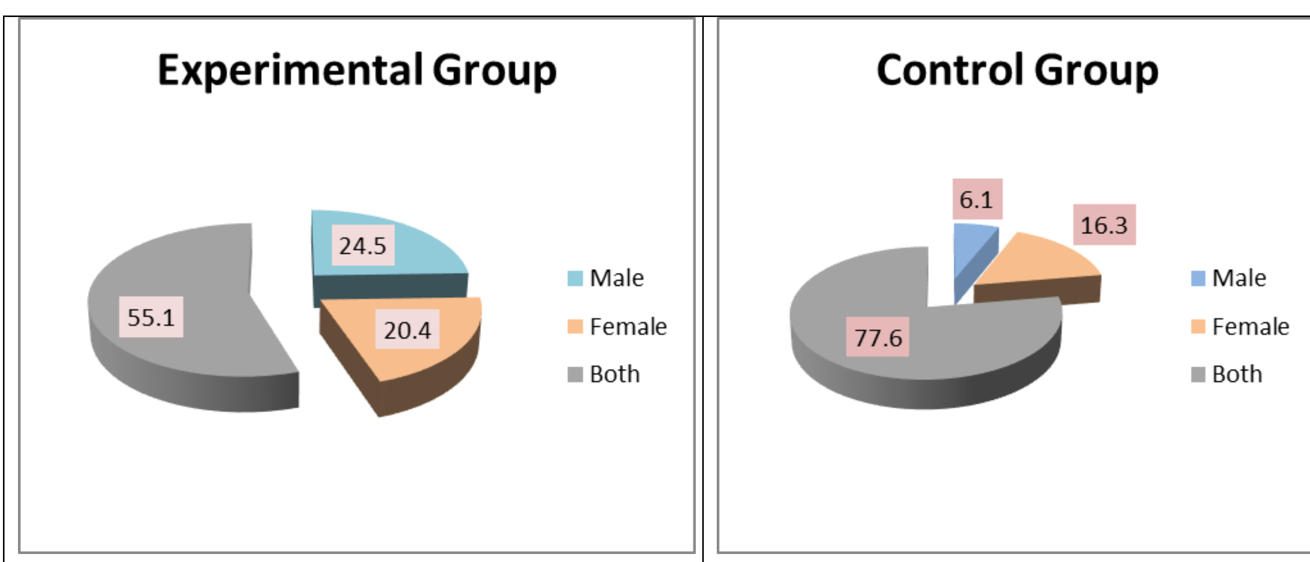

Figure 4.4: Preferred gender of Trainer

Source: Primary data (2023)

Figure 4.4 shows that majority of the participants, both experimental group and control group preferred both male and female trainers and they composed 55.1% and 77.6% respectively. Those who preferred male were the least participants for both experimental group and control group constituting 24.5% and 6.1% respectively. These results imply that participants that engage in physical exercises always prefer having both male and female trainers at the training ground as opposed to having one gender conducting the training session.

4.3.7 Preference of the training venue

The participants were asked to indicate where they would prefer to conduct their training and the responses were captured as presented in Figure 4.5.

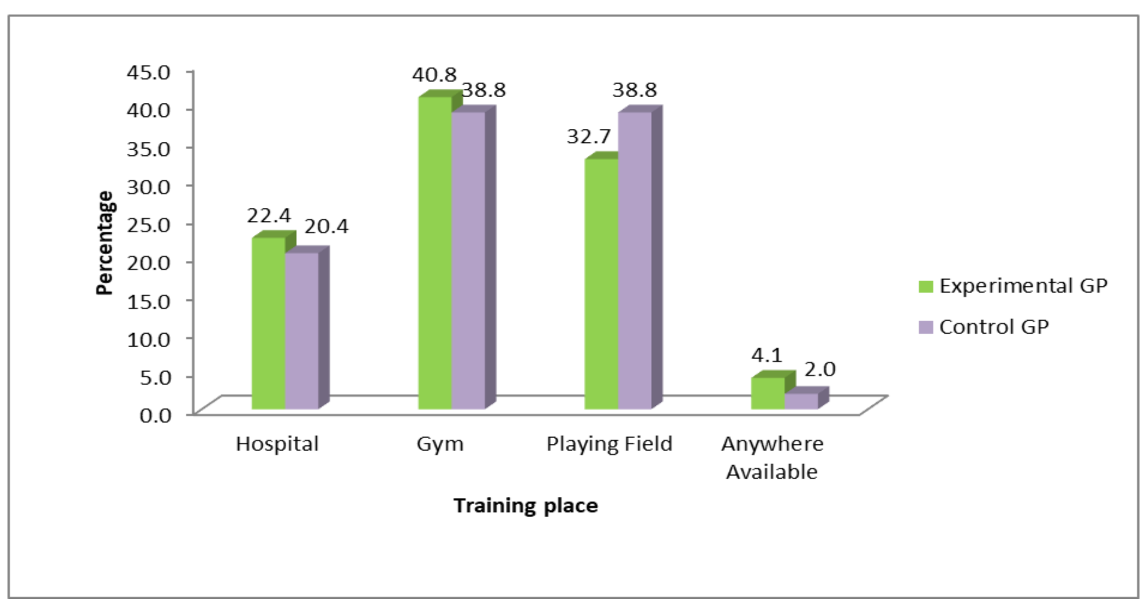

Figure 4.5: The preferred training venue for the clients

Source: Primary data (2023)

Figure 4.5 shows that many of the participants (40.8%) in experimental group considered gym to be the most preferable place for training whereas 38.8% in control group considered both gym and playing field to be the most preferred place for the training. The least number of participants from both experimental group and control group preferred anywhere available and the constituted 4.1% and 2% respectively. The results therefore imply most of the people prefer gazetted sports areas to conduct the trainings of the physical exercises.

Their residence in the Army barracks and the hospital, which served as the study site, may be the reason for this. Given that the participants were not questioned about why they favoured working out primarily in a gym or on a playing field, it is likely that they saw working out as a formal activity that was exclusive to these locations. This illustrates how having a designated space for exercise can serve as a motivator for those who would rather engage in physical activity.

4.3.9 Restrictions to engagement in physical exercises

Though many of the participants did not exercise, only one from the experimental group and none from the control group reported being placed under any kind of exercise restriction. On the other hand, this particular subject never clarified the type of restriction or its purpose. These findings suggest that the treating or supervising physicians have not placed any limitations on the clients' ability to exercise, allowing them to engage in physical activity. This may be because these doctors recognize the health benefits of exercise for their HIV-positive patients.

4.3.10 Summary on physical activity readiness

The experimental and control groups of participants were found to be physically prepared to participate in the study, which looked at the impact of aerobic exercise on the clinical outcomes of HIV-positive patients receiving antiretroviral therapy (ART) at the General Military Hospital-Bombo in Uganda, based on the previously mentioned PAR-Q results. These results suggest that most of the participants lead relatively sedentary lives, which can be considered a common phenomenon when considering the greater Ugandan population, regardless of whether they have chronic illnesses or not**.** This is demonstrated by a study conducted in 2019 by Haruna, which found that students at Gulu University did not meet the daily recommended activity threshold for each individual. While exercises are good at keeping the body in a healthy state, this study was of the view that the aerobic exercise can also improve the health status of client on ART. This claim is based on research by Maduagwu et al. (2015), which showed that a 12-week aerobic exercise program increased the participants' CD4 cell counts. However, emphasising proper food and

adherence to antiretroviral therapy may also strengthen the immune system of the HIV population. However, it should be mentioned that greater intensity exercise sessions reduce immune system efficacy, which increases the risk of opportunistic infections in HIV-free people (O'Brien, 2010). Only moderate-intensity aerobic exercise is therefore advantageous.

4.4 Empirical Study Findings

The empirical findings are presented here in accordance with the study's objectives, which included: (i) evaluating the effect of aerobic exercise on HIV positive clients' immunological measures while on antiretroviral therapy (ART); (ii) assessing the impact of aerobic exercise on clients' functional work capacity while on ART; and (iii) figuring out the impact of aerobic exercise on clients' psychological markers while on antiretroviral therapy (ART). The results, both descriptive and inferential, are presented.

4.4.1 Effect of aerobic exercises on immunological measures of HIV+ clients on ART

The first objective of this study was to assess the effects of aerobic exercise on Immunological measures (CD4 count) of HIV+ clients on ART for at least 12 months. While the test group participated in aerobic exercise, the control group did not. For both groups, the CD4 cell counts were determined twice, at the beginning (pre-test) and at the end of the intervention (post-test) detailed data is shown in Appendix I. The pre and post-test CD4 cell count difference is presented in Table 4.6.

To examine the changes that might be related to the workouts the study participants did, the CD4 cell count T-test was utilized.

Table 4.6: Changes in CD4 Count

Subject Category	Gender	Post-test CD4 count	Pre-test CD4 count	Change in CD4 (post-test – pre-test)	% Change in CD4 count
Experimental	F	679.2	490.1	189.1	38.6
	M	658	500.6	157.4	21.4
	Mean	644.9	497.2	147.7	29.7%
	Std. Deviation	177.381	185.921		
Control Group	F	435.9	485.6	-49.7	-10.2
	M	413.1	425	-11.9	-2.8
	Mean	438.35	468.27	-29.92	-6.4%
	Std. Deviation	178.990	221.575		

Source: Primary Data, (2023). F=female, M=male

Table 4.6 shows that on average there was an increase of the mean CD4 count of the experimental group by 147.7 points while that of the control group seems to have slightly dropped by 29.92 points. In terms of percentages, the experimental group recorded a 29.7% increase in the CD4 count upon the participants participating in the aerobic exercises while the control group which was not subjected to the exercises reported a slight decline of 6.4%. This implies that the control group actually had a negligible change in the CD4 count. Since the higher the level of CD4 count the higher is considered to be the level of immunity and good clinical outcomes, it follows that the aerobic exercises in this study had a positive effect on the immunity of the participants.

This was supported by Maduagwu et al. (2015) who established that CD4 counts were 107.5% higher in HIV-positive individuals who self-reported exercising than in those who denied having ever done so. A control group that had the same amount of CD4 cells 49 as the test group was also included in the trial to see whether the workouts were the cause of any discernible changes in the CD4 counts.

As highlighted by Asogwa et al. (2022), PLHIV on ART may be able to get a greater impact on their CD4 counts with appropriate exercise compared to PLHIV who are not taking ART. These

results were consistent with a meta-analysis of primary studies that found a significant improvement in CD4 counts in the exercise group that were on ART.

When the percentage change in CD4 count between the two groups was compared by gender, it was found that the female experimental participants' change was substantially higher (38.6%) than the female control group participants' change (-10.2%). Similarly, the males in the experimental group participants were substantially higher (21.4%) than those in the control groups (-2.8%).

As far as the effects of the exercises on CD4 count was concerned, the results showed that there is a general difference between the patterns of the results of the experimental group compared to those of the control group. The variance graph was established to be far lower in the case of the control group compared to the experimental group implying that there was a marked improvement of the CD4 levels of the experimental group the variation is shown in Appendix II.

The study hypotheses were tested in order to do the inferential analysis. To do this, a paired-samples t-test was conducted. The following was the hypothesis for the first objective.

Ho1 There is no significant effect of aerobic exercises on immunological measures of HIV positive clients on ART.

The outputs of this test comprised of three tables as shown below. The first one is the Paired samples statistics; the second is the paired samples correlations; and the third is the Paired sample test results.

Table 4.7: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	post-test CD4 count c/ml	664.94	49	177.381	25.340
		pre-test CD4 count c/ml	497.16	49	185.921	26.560
Control Group	Pair 1	post-test CD4 count c/ml	438.35	48	178.990	25.835
		pre-test CD4 count c/ml	473.94	48	220.295	31.797

Source: Primary Data, 2023

The mean of the post-test to the pre-test for the experimental group was 167.78 (664.94 - 497.16), which is significantly different from the control group's mean of -35.59 (438.35 - 473.94). The standard deviations of the results of the two groups, are not exactly the same but are relatively close to assuming equal variances. This large variation in standard deviation implies a big variation in the results given within a sample.

The paired samples correlation results were as presented in Table 4.8

Table 4.8: Paired Samples Correlation Table

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	post-test CD4 count c/ml & pre-test CD4 count c/ml	49	.507	<0.0010
Control Group	Pair 1	post-test CD4 count c/ml & pre-test CD4 count c/ml	48	.595	<0.001

Source: Primary data (2023)

Table 4.8 shows that there was a correlation between the experimental and control groups' pre-test and post-test CD4 counts. Given that the post-test CD4 reading for each individual participant was correlated with the corresponding pre-test reading, this suggests a linear relationship between the pre-test and post-test outcomes.

Determining if the computed sample mean falls within the confidence interval was the next crucial step. Table 4.9 (Paired Samples Results) displays the results for this.

Table 4.9: Paired Samples Results

Groups		Paired Differences					T	df	[P value] Sig. (2-tailed)
		Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Experimental Group	post-test CD4 count c/ml - pre-test CD4 count c/ml	167.776	180.614	25.802	115.897	219.654	6.502	48	0.001
Control Group	post-test CD4 count c/ml - pre-test CD4 count c/ml	-35.583	183.444	26.478	-88.850	17.683	-1.344	47	0.185

Source: Primary Data, 2023

According the results in Table 4.9, the experimental group's computed mean was 167.776; the 95% CI for the difference was between 115.897 and 219.654. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the interval varied from -88.850 to 17.683, the computed mean for the control group, which was -35.583, fell equally within the 95% CI.

Checking the *p*-value, a measure of the likelihood that the observed value was the result of chance, was the last step. Because the *p*-value of 0.001 is less than 0.05, the experimental group's t-test was determined to be statistically significant. The findings are as follows: *p*-value = 0.001, t(48) = 6.502. However, the results showed that the control group's t-test was not statistically significant (t (47) = 1.433, *p* =.185, which is > 0.05).

Given that the experimental group's *p*-value in this instance was less than the alpha level (0.05) due to the 5% level of significance used in this test, the null hypothesis that "There is no significant effect of aerobic exercises on immunological measures of HIV positive clients on ART" is rejected. Table 4.6 shows that the experimental group’s percentage changes in CD4 count were 29.7%, while the control group’s was -6.4%.

The findings imply that moderate intensity aerobic exercises have a positive implication on immunological markers for HIV positive clients on ART on both males and females. This was justified by the fact that there was an improvement in CD4 levels and that improves the quality of life of HIV positive clients on ART. The present findings are consistent with a meta-analysis of primary studies that demonstrated improved CD4 counts after engaging in interval exercise for 41 to 50 minutes three times a week. Research revealed that the exercise group receiving ART had significantly higher CD4 counts. Finally, they concluded that individuals living with HIV who are on ART might benefit more from appropriate exercise in terms of their CD4 counts than individuals living with HIV who are not on ART (Asogwa et al., 2022).

The present study's outcomes are consistent with those of Sujianto (2021), who examined the impact of aerobic exercise on CD4 counts in individuals living with HIV. Sujianto's study revealed a statistically significant difference in the mean CD4 counts between the intervention group and the control group following the intervention, indicating that aerobic exercise is a useful strategy for raising CD4 counts in HIV patients. They concur with Heissel et al.'s (2019) findings as well, which show that a four-week aerobic exercise program can raise CD4 cell counts in HIV/AIDS patients. In a similar vein, the results of this investigation corroborate those of Heissel et al.'s (2019) study, which demonstrated that a four-week aerobic exercise regimen can raise an HV/AIDS patient's CD4 cell count. Additionally, the study's findings are in line with those of Stanley et al. (2017), who discovered that the experimental group's CD4 cell counts significantly increased following 12 weeks of moderate-intensity aerobic exercise. The study looked at how exercise affected CD4 cells and quality of life in the HIV positive population.

In addition to the aforementioned, this study's findings support Dianatisanab et al. (2018)'s finding that there was a substantial change in the number of CD4 cells following aerobic exercise. They also support those of Nosrat et al. (2017), but apart from establishing an increase the CD4 count in HIV patients after being engaged in aerobic exercises, there was also reduced the levels of depression

On the contrary the results of this study, however, were different from those of O'Brien et al. (2016) who as much as in their study acknowledged that exercise is a key strategy that may improve or sustain health for people living with HIV, instead found no significant differences in the change in the CD4 cell count and viral load of the HIV positive clients that were subjected to exercises. These results suggest that it is not any kind of exercise that is conducted anyhow that will have the positive results but that which is well organised, timed and well scheduled.

4.4.2 Effect of aerobic exercise on Functional Work Capacity

The second objective of the study was to establish the effect of aerobic exercises on functional work capacity of HIV positive clients on ART. Functional work capacity was measured using the seven-point Borg Rate of Perceived Exertion (RPE) see details in (Appendix XX) Scale and Duke Activity Status Index (DASI). The results are presented in the following sub-sections. The aerobic exercises considered included the intensity of the exercise, the duration and the type using a 5 phase of aerobics classes. This objective was guided by the hypothesis that, "there is no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART".

4.4.2.1 Rate of Perceived Exertion Findings - descriptive and inferential

The study participants were subjected to a 10 minutes aerobic exercise at 150bpm. They were asked to rate how difficult the exercise was at each stage of exercise using the seven-point Borg RPE Scale. The scale rates feeling of exertion under the continuum, very very light; very light; fairly light, somewhat hard; hard; very hard; and very very hard. The findings by segregating the experimental group from the control group before the exertion (pre-test) are presented in Figure 4.6 and those after the exertion (post-test) in Figure 4.7.

To assess the parameters of the aerobic exercise as conducted, the Rating of Perceived Exertion (RPE) scale was utilized. This scale has been presented differently by different scholars although with the same message. For instance, Lea et al. (2022) used it to study the convergent of ratings of perceived exertion during resistance exercise in healthy participants.

The results upon conducting the ten minutes exercise were clear that the post-test scores for the experimental group of the perceived exertion shifted the higher scales of 'hard to very hard' to the lower part of the scale of 'very light to fairly light' expressing that the subject were more physically fit than before. This was confirmed by the fact that the pre-test and post-test results of the control group remained fairly the same.

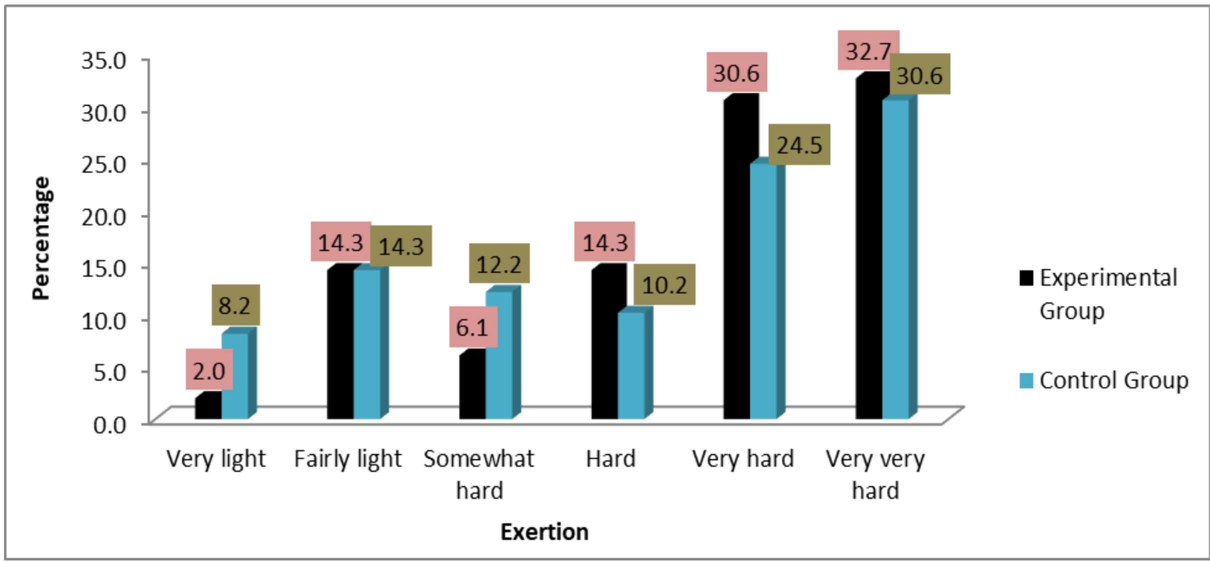

Figure 4.6: Pre-test Results of Perceived Exertion Rate

Source: Primary data (2023)

Figure 4.6 shows pre-test results it was found out that majority of the participants about (33%) in experimental considered exertion rate to be very very hard and majority (30.6%) in control group considered the exertion rate to be both very hard and very very hard. The least number of participants in both the experimental group and control group considered the exertion rate to be very light and they constituted 2% and 8.2% respectively.

On comparing the findings of the experimental group and those of the control group after the physical exercises, the results were as presented in Figure 4.7

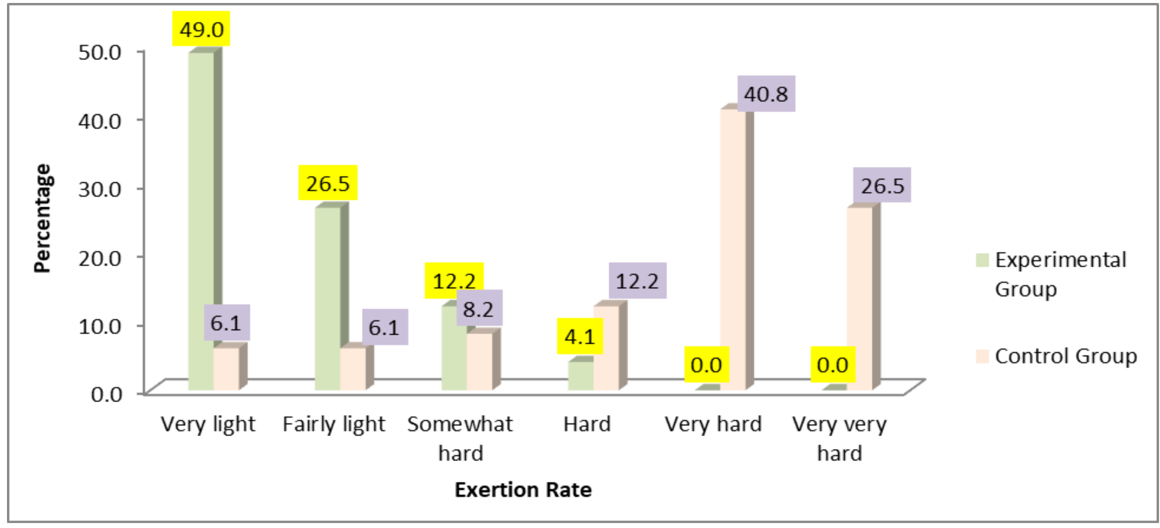

Figure 4.7: Post-test Results of Perceived Exertion Rate

Source: Primary data (2023)

Figure 4.7 shows that the experimental group ratings shifted more towards the left indicating that the participants rated the exertion to be much lighter than before the exercises. The post-test results revealed that majority of the participants (49%) from experimental group were perceived to give very light ratings whereas 40.8% from the control group were perceived to give very hard. Only 4.1% of them gave a rating of “Hard” while none gave a rating of either “very hard” or “very, very hard” for the experimental group while only 6.1% gave ratings of very light and fairly light for the control group.

The scale shows either 1-10 1-10 being very, very light meaning the exercise was simple, and 10 being maximum effort or being very light, 10-20 being maximal exertion very, very hard (CDC, 2022). Figure 4.7 shows there was a shift for the experimental group from the side of very, very hard to very, very light. This indicates there was improvement in VO_2 max hence improved performance.

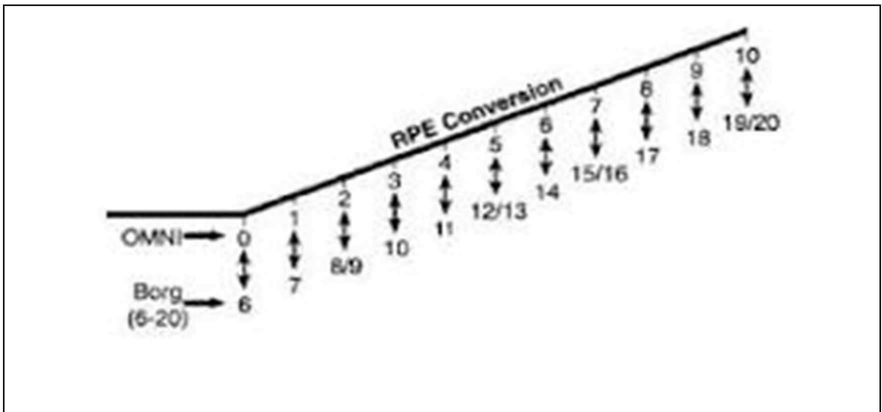

Figure 4.8: Scale Converter Borg 1-10 scale to Borg 6-20 scale

Source: Panzak, (2012)

Figure 4.8 shows that on converting the readings from the 1-10 scale to 6-20 scale and multiplying with 10 to establish the approximate heart rate, the following graph was developed (The workout is appended; appendix III). Figure 4.9 shows how the heart varied for both the control and experimental groups. The right side shows control group while the left side shows experimental group while the blue line shows pre-test and red shows post-test results.

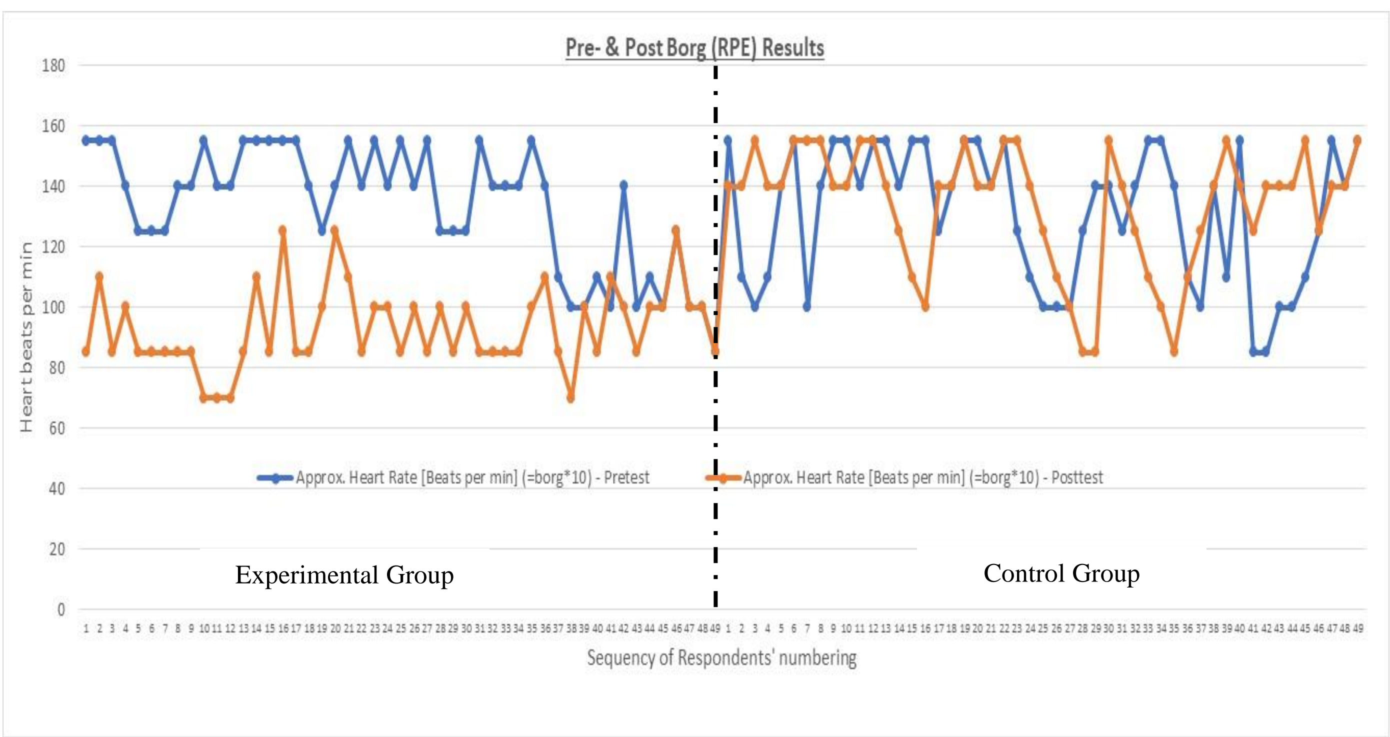

Figure 4.9 Results of the heart beat

Source: Primary Data (2023)

Figure 4.9 shows that on the left side are results of the experimental group and the right-side control group. The results indicate that there was a lowered heart rate for the experimental group in post-test compared to control group. Nystoriak and Bhatnagar (2018), alludes that regular exercise has numerous benefits for the cardiovascular system, including strengthening the heart muscle. Engaging in regular physical activity, makes the heart become more efficient at pumping blood. This increased efficiency means that with each beat, the heart can pump a larger volume of blood, allowing it to beat less frequently while still maintaining an adequate blood flow to meet the body's demands. What should be noted is that, a strong heart muscle is a crucial component in improving oxygen uptake and VO_2 max it pumps more blood that makes oxygen delivery better, (Zheng et al., 2022).

Inferential statistical test which involved conducting a paired-sample t-test was conducted to test the hypothesis of the second objective of this study that:

Ho_2 There is no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART.

The findings of this test were Table 4.10, table 4.11 and Table 4.12 which were about paired samples statistics. The first one was the Paired samples statistics and the second was the Paired sample test results.

Table 4.10: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Functional work capacity - Perceived exertion	2.53	45	.968	.144
		Functional work capacity - Perceived exertion	5.76	45	1.317	.196
Control Group	Pair 1	Functional work capacity - Perceived exertion	5.51	47	1.458	.213
		Functional work capacity - Perceived exertion	5.30	47	1.614	.235

Source: Primary Data, 2023

The mean of the post-test to the pre-test for the experimental group was -3.222 (2.53 – 5.76), which is significantly different from the control group's mean of 0.21 (5.51 – 5.30). There were also variations in the standard deviations of the results of the two groups.

The paired samples correlation findings were as presented in Table 4.11

Table 4.11: Paired Samples Correlation

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Functional work capacity - Perceived exertion & Functional work capacity - Perceived exertion	45	.033	.828
Control Group	Pair 1	Functional work capacity - Perceived exertion & Functional work capacity - Perceived exertion	47	-.020	.895

Source: Primary Data (2023)

There was no correlation between the experimental and control groups' functional work capacity findings on the pre-test and post-test. This suggests that the findings from the pre-test and post-test do not correlate linearly.

It was then crucial to determine if the computed sample mean was within the confidence interval. The findings for this are shown in Table 4.12.

Table 4.12: Paired Samples Results

		Paired Differences							
					95% Confidence Interval of the Difference				
	Group	Mean difference	Std. Deviation	Std. Error Mean	Lower	Upper	T	df	[P value] Sig. (2-tailed)
Experimental Group	Functional work capacity - Perceived exertion - Functional work capacity - Perceived exertion	-3.222	1.608	.240	-3.705	-2.739	-13.442	44	<0.001
Control Group	Functional work capacity - Perceived exertion - Functional work capacity - Perceived exertion	.213	2.196	.320	-.432	.858	.664	46	.510

Source: Primary Data, 2023

According to Table 4.12, the experimental group's computed mean was -3.222, with a 95% CI of the difference falling between -3.7705 and -2.739. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the computed mean for the control group was 0.213 and the interval varied from -0.432 to 0.858, it fell equally inside the 95% confidence interval.

Since the experimental group's t-test *p*-value was less than 0.05 (0.001), it was determined to be statistically significant. The findings are *p*-value 0.001 and t(44) = -13.442. However, the control group's t-test was not statistically significant because the findings showed that t(46) = 0.664, *p* =.510, which is greater than 0.05.

The null hypothesis that "there is no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART" is rejected because the experimental group's *p*-value in this instance was less than the alpha level (.05), which was taken into consideration at the 95% level of significance. These findings confirm that there is a difference between the pre- and post-test results, and that the functional work capacity increased while the post-test mean declined in relation to perceived exertion.

These results imply that the aerobic exercises indeed improve the functional work capacity of HIV positive clients on ART. This was similar to studies that looked at the effectiveness of

aerobic exercise for adults with HIV: a systematic review and meta-analysis using the Cochrane Collaboration protocol found that the exercise group had higher heart rates and rates of perceived exertion (RPE) at the end of the 20-minute multi-stage shuttle run test (20mMST). The 20mMST showed that exercisers' VO2 max considerably increased in comparison to non-exercisers. Intensity was measured using the modified Borg Rate of Perceived Exertion (RPE) scale. PRE: Three sets of eight to twelve repetitions, with a one to three minutes rest interval in between each set and a five to ten minutes cool-down, accounted for 45 to 50 minutes of resistive activity. Intensity: 60–80% of the maximum repetitions (1 RM) for the leg press and bench press. The subjects showed more progress after lifting a specific weight 8–12 times until they reached muscle failure (unable to perform more repetitions) (O'Brien et al., 2016).

4.4.2 Duke Activity Status Index (DASI) Results – descriptive and inferential

To further assess whether exercise had an effect on VO_2 max, the DASI was used. The participants were required to rate DASI questions using the scale: Extremely Difficult or unable to perform activities = (0); Quite a bit difficulty = (1); Moderate difficulty = (2); A little a bit of difficulty = (3); and No difficulty at all = (4). The findings were as presented in Table 4.13 shows the results of the DASI rating

The descriptive results using the percentage responses were as presented in Table 4.13.

Table 4.13: Duke Activity Status Index (DASI)

SN	Question	Type of Test	EXPERIMENTAL GROUP (%)					CONTROL GROUP (%)				
			(0)	(1)	(2)	(3)	(4)	(0)	(1)	(2)	(3)	(4)
1	Take care of yourself easily, that is, eating, dressing, bathing or using the toilet?	Pre-test	0.0	2.0	10.2	44.9	42.9	0.0	4.8	14.3	14.3	66.7
		Post-test	0.0	0.0	0.0	0.0	100.0	0.0	0.0	27.9	48.8	23.3
2	Walk indoors, such as around your house with ease?	Pre-test	0.0	0.0	24.5	44.9	30.6	0.0	7.1	40.5	35.7	16.7
		Post-test	0.0	0.0	0.0	0.0	100.0	0.0	0.0	37.2	37.2	25.6
3	Are you able to walk around or climb stairs with ease?	Pre-test	0.0	2.1	18.8	50.0	29.2	0.0	7.1	47.6	28.6	16.7
		Post-test	0.0	0.0	0.0	0.0	100.0	0.0	2.3	46.5	32.6	18.6
4	Can you run a short distance with ease?	Pre-test	2.0	0.0	22.4	51.0	24.5	0.0	7.3	53.7	22.0	17.1
		Post-test	0.0	0.0	0.0	0.0	100.0	0.0	4.7	37.2	39.5	18.6
5	Can you do light work around the house like mopping, washing dishes and slashing around?	Pre-test	0.0	2.0	22.4	46.9	28.6	0.0	7.1	54.8	21.4	16.7
		Post-test	0.0	0.0	0.0	0.0	100.0	0.0	0.0	44.2	41.9	14.0
6	Are you able to do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	Pre-test	2.0	26.5	24.5	28.6	18.4	0.0	0.0	66.7	21.4	11.9
		Post-test	0.0	0.0	0.0	2.0	98.0	0.0	0.0	44.2	41.9	14.0
7	Can you easily do yard work like raking leaves, weeding, or pushing a power mower?	Pre-test	0.0	8.2	24.5	42.9	24.5	0.0	14.3	57.1	16.7	11.9
		Post-test	0.0	0.0	0.0	0.0	100.0	0.0	0.0	41.9	44.2	14.0
8	Are you able to have sexual relations with un due fatigue?	Pre-test	6.1	14.3	24.5	36.7	18.4	2.4	33.3	28.6	21.4	14.3
		Post-test	0.0	0.0	0.0	18.4	81.6	0.0	4.7	48.8	34.9	11.6
9	Participate in moderate recreational activities like soccer, jogging, dancing, swimming, or throwing a baseball or football?	Pre-test	46.9	49.0	4.1	0.0	0.0	50.0	35.7	2.4	2.4	9.5
		Post-test	0.0	0.0	22.4	38.8	38.8	34.9	48.8	16.3	0.0	0.0
	Average Pre-test		6.3	11.6	19.5	38.4	24.1	5.8	13.0	40.6	20.4	20.2
	Average Post-test		0.0	0.0	2.5	6.6	90.9	3.9	6.7	38.2	35.7	15.5
	Variance		**-6.3**	**-11.6**	**-17.1**	**-31.9**	**66.8**	**-1.9**	**-6.2**	**-2.4**	**15.2**	**-4.6**

Scale: (0) = Extremely Difficult or unable to perform activities; (1) = Quite a bit difficulty; (2) = Moderate difficulty; (3) = A little a bit of difficulty; and (4) = No difficulty at all

Source: Primary Data, 2023

Table 4.13 confirms that the participants in DASI were expected to select "yes" or "no" for each question. The DASI score is calculated by multiplying the total number of "yes" replies by 0.43, adding 9.6, and calculating the estimated maximum oxygen consumption (VO_2 max). There is a range of 0 to 58.2 points in the final score. The functional capacity scores improve with higher scores (Olatunbosun et al., 2021). Total of the questionnaire answers equals DASI. (mL/kg/min) x VO_2 max = 0.43 x DASI + 9.6. METs (in metabolic equivalents) = VO_2 max / 3.5.

This study considered the middle points to determine improvement in functional work capacity.

Table 4.14 VO2max values calculated from DASI

	Pre-Test Results			Post-test Results		
	Total (DASI)	VO_2 max	METs	Total (DASI)	VO_2 max	METs
Test Group	36.12	25.13	7.18	57.19	34.19	**9.77**
Control Group	20.72	18.51	5.29	29.44	22.26	6.36

Source: Primary Data, 2023

For the Experimental Group, the VO_2 max (in mL/kg/min) significantly improved from 25.13 to 34.19 mL/kg/min while that of the control group only changed slightly from 18.51 to 22.26 mL/kg/min. As indicated the DASI score ranges from 0 to 58.2 points, the higher the scores, the better the functional work capacity as indicated in Table 4.14. Figure 4.10 shows a clear variation between the pre-and post-test result of experimental group. The results show an improvement in oxygen consumption as indicate on the left side of Figure 4.10 where the experimental group are on the left and the control group on the right. The blue line on figure 4.10 is pre-test while the pink is post-test. These findings are consistent with those of O'Brien et al. (2016), who discovered that engaging in aerobic exercise, or a mix of aerobic and resistive exercise, three times a week for five weeks or more, is safe and can enhance the quality of life, strength, body composition, and cardiorespiratory fitness in adults living with HIV.

Figure 4.10 VO2max results

Source: Primary Data (2023)

The inferential analysis on DASI was conducted by undertaking a paired-sample T-test using the SPSS version 20 and the results were as presented in the next two subsequent tables.

Table 4.15: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-duke	3.88	48	.104	.015
		Pre-duke	2.62	48	.657	.095
Control Group	Pair 1	Post-duke	2.53	41	.545	.085
		Pre-duke	2.36	41	.766	.120

Source: Primary Data (2023)

The initial step involved determining whether the mean values of the pre-test and post-test results differed from one another. According to table 4.15, the experimental group's post-test mean to pre-test mean was 1.26 (3.88 – 2.62), which is significantly different from the control group's mean of 0.17 (2.53 – 2.36). Table 4.16 displays the results of the paired correlations.

Table 4.16: Paired Samples Correlation

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Post-duke & pre-duke	48	.170	.249
Control Group	Pair 1	Post-duke & pre-duke	41	.301	.056

Source: Primary Data (2023)

The pre-test and post-test Duke findings showed no correlation between the experimental and control groups. The fact that the post-test Duke results for any particular subject were unrelated to the corresponding pre-test reading suggests that there is no linear link between the pre-test and post-test outcomes.

After the aforementioned test, it was crucial to determine whether the calculated sample mean was statistically significant and whether it fell within the confidence interval. The outcomes are shown in Table 4.17.

Table 4.17: Paired Samples Results

Group to which subject belongs			Paired Differences: Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	t	df	[P value] Sig. (2-tailed)
Experimental Group	Pair 1	Post-duke – pre-duke	1.257	.647	.093	1.069	1.445	13.457	47	<0.001
Control Group	Pair 1	Post-duke – pre-duke	.163	.795	.124	-.088	.414	1.309	40	.198

Source: Primary Data, 2023

The experimental group's computed mean, as indicated in Table 4.17, was 1.257, with a 95% CI of the difference falling between 1.069 and 1.445. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the computed mean for the control group was 0.163 and the 95% CI ranged from -0.088 to 0.414, it fell inside the interval evenly.

Since the experimental group's t-test p-value was less than 0.05 (<0.001), it was determined to be statistically significant. The findings show that $t(47) = 13.457$, $p < 0.001$. However, the control group's t-test was not statistically significant because the findings showed that $t(40) = 1.309$, $p =.198$, which is greater than 0.05.

Given that the experimental group's *p*-value was less than the alpha level (.005) in this instance and that the test was conducted at a 95% level of significance, the null hypothesis that "There is no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART" is rejected. This indicates that the aerobic exercises significantly increased the HIV positive clients' capacity for oxygen consumption (functional work).

The results imply that oxygen consumption in the experimental group increased and therefore the functional work capacity. The clients living on HIV in the experimental group found the post-test exercise easy despite the fact that it was the same intensity compared to the clients in the control group. Therefore, well-structured aerobic exercises improve functional work capacity for HIV positive clients on ART in Uganda. It is known that oxygen uptake kinetics determines

exercise tolerance by determining the rate of carbohydrate (CHO) oxidation and/or the rate of heat storage in exercise (Burnley & Jones, 2007). This clearly explains how oxygen consumption improves functional work capacity. These results agree with a study of Riedel et al. (2021), where there was an improvement in functional work capacity measured using the DASI, and that of (O'Brien et al., 2016). Where the participants exhibited a greater improvement in functional work capacity.

The study's findings, which as summarized, are consistent with those of O'Brien et al. (2016), who found that doing aerobic exercise three times a week for at least five weeks can improve an adult with HIV's strength, body composition, cardiorespiratory fitness, and quality of life. The findings corroborate previous findings by Warburton et al. (2006) and Penedo (2005) that exercise does, in fact, have a good effect on strength, cardiovascular function, and psychological status even in non-patients. In a similar vein, O'Brien et al. (2008) had also shown that persons with HIV could benefit from aerobic exercise.

The findings of this study were also in line with those of Stanley et al. (2017), who demonstrated that physical activity enhances the general health and well-being of the HIV population, and Jaggers et al. (2014), who discovered that physical activity and exercise are safe and efficient means of enhancing the metabolic profile, cardiorespiratory fitness, and quality of life of individuals with HIV.

The argument of O'Brein et al. (2016) based on other studies as a concern exercising is that the exercise does not positively restrict viral replication or improve the immune system of PLHIV, but instead, it can elicit improvements in cardiorespiratory fitness, strength, body composition, and overall quality of life. In fact, according to Aweto et al. (2016), aerobic exercise improves the functioning of the pulmonary system and also alleviates respiratory and depressive symptoms in younger HIV positive clients.

Apparently though, in 2017 Stanley et al. (2017) in their study to examine the effectiveness of a 12-weeks exercise on quality of life and CD4 cells of HIV population established that there was an insignificant change in the quality of life of the HIV positive clients. At the same time, according to Stanley et al. (2017), there seems to be no study that has indicated that moderate intensity exercise can lead to deterioration in the health status of HIV sero-positives on HAART.

4.4.3 Effects of aerobic exercise on psychological markers of HIV+ clients on ART

The final objective of this study was about the establishing the contribution of aerobic exercise on psychological makers of HIV positive clients on ARVs. The aerobic exercises included the frequency of exercising, the intensity of the exercise, the duration and the type 5 phases of aerobics classes. The psychological markers included: paranoid ideation, depression, neuroticism, phobia and anxiety. To assess the psychosocial markers of the study participants, a Psychosocial Assessment Tool was adopted from Client Health Questionnaire with modification by Spitzer, Kroenke et al. (2001). Participants were required to indicate how often in the previous two weeks before the study they were bothered by psychosocial problems such as paranoid ideation, depression, neuroticism, anxiety and phobia.

The inferential analysis was conducted by testing the study hypotheses using the paired-samples T-test. The hypothesis for the first objective read as follows:

Ho_3 Aerobic exercises have no significant effect on psychological markers of HIV positive clients on ART.

The findings were as presented in the following subsections.

4.4.3.1 Effects of aerobic exercise on paranoid ideation

The findings on the effects of aerobic exercises on the paranoid ideation in the study participants were as presented in Table 4.14. The table shows the rating for each statement; and both the pre-test and post-test for both the experimental and control groups. The scale used was; (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day.

The descriptive results percentage responses on the effects of aerobic exercises on paranoid ideation were as shown in Table 4.18.

Table 4.18: Effects of Aerobic Exercises on Paranoid Ideation

Statement: How often in the previous 2 weeks you felt the following?	Type of Test	Experimental Group Responses (%)				Control Group Responses (%)			
		(0)	(1)	(2)	(3)	(0)	(1)	(2)	(3)
1. Perpetual/continuous feelings of being bored and/or empty	Pre-test	2.0	59.2	38.3	0.0	2.2	59.2	38.3	0
	Post-test	85.8	8.2	6.1	0.0	38.6	20.4	51.0	0
2. Intense love-hate relationships with others	Pre-test	0.0	55.1	44.9	0.0	0.0	31.7	68.3	0
	Post-test	81.6	12.2	6.1	0.0	24.5	34.7	40.8	0
3. Extreme efforts to avoid real or perceived rejection or abandonment by others	Pre-test	0.0	40.8	59.2	0.0	2.4	41.5	56.1	0
	Post-test	83.7	2.0	14.3	0.0	26.5	38.8	34.7	0
4. A feeling of disconnection with your body and/or your mind and paranoid/suspicious thoughts that are made worse by any stress.	Pre-test	0.0	46.9	53.1	0.0	5.0	52.5	42.5	0
	Post-test	79.6	14.3	6.1	0.0	32.6	34.7	34.7	0
5. Anger issues, such as becoming extremely angry in inappropriate situations, exploding in rage/temper, or being unable to control your anger, followed by feeling guilty or ashamed.	Pre-test	0.0	57.1	42.9	0.0	17.0	46.3	36.6	0
	Post-test	78.6	16.3	6.1	0.0	34.7	30.6	34.7	0
Average Pre-test		0.4	51.8	47.7	0.0	5.3	46.2	48.4	0.0
Average Post-test		81.9	10.6	7.7	0.0	31.4	31.8	39.2	0.0
Variance		**81.5**	**-41.2**	**-39.9**	**0.0**	**26.1**	**-14.4**	**-9.2**	**0.0**

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day

Source: Primary Data, 2023

According to the results above, there was a general improvement as the participants reported less of the paranoid ideation problems they experienced prior to the aerobic exercises for the experimental groups.

From 0.4% of the participants who indicated that they there were more experimental group participants who indicated that they did not at all have any of the paranoid ideation feeling two weeks prior to the study, to 81.9% giving a positive percentage improvement of 81.5%. The rating of the control group on the other hand improved from 5.3% to 31.4% (a variance of 26.1%). The fact that there was more significant improvement among the experimental subject implies that the

aerobic exercises have a positive contribution to the psychological status of HIV positive clients on ART.

When asked to indicate how often in the previous two weeks before the study they were bothered by paranoid ideation (a psychosocial problem on the majority of the participants (49.2%) stated that this happened more than half a day followed by 48.1% who stated that they on their part experienced it for half a day. Lastly, 2.7% said never experienced it while none of the participants indicated having experienced it nearly every day. These findings imply that most of the subject had experienced some form of paranoid ideation.

Using SPSS version 20, a paired-sample T-test was used to do the inferential analysis. The test's outcome included two tables, which are displayed below. The first one was the Paired samples statistics and the second was the Paired sample test results.

Table 4.19: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-paranoid	.71	49	.770	.110
		Pre-paranoid	2.47	49	.145	.021
Control Group	Pair 1	Post-paranoid	1.91	40	.848	.134
		Pre-paranoid	2.46	40	.188	.030

Source: Primary Data, 2023

The experimental group's post-test mean differed significantly from the pre-test mean, ranging from -1.76 (0.71 to 2.47), while the control group's mean was only -0.55 (1.91 to 2.46). Looking at the standard deviations of the results of the two groups, they are not exactly the same but are relatively close to assuming equal variances.

Table 4.20: Paired Samples Correlation Table

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Post-paranoid & pre-paranoid	49	-.032	.828
Control Group	Pair 1	Post-paranoid & pre-paranoid	40	.067	.682

Source: Primary Data (2023)

There was no correlation between the experimental and control groups' pre-test and post-test paranoid outcomes, as shown in Table 4.20. This suggests that the pre-test and post-test results do not have a linear connection.

It was therefore crucial to determine whether the results were statistically significant and whether the computed sample means were within the confidence ranges. The findings are shown in Table 4.21.

Table 4.21: Paired Samples Results

Group to which subject belongs			Paired Differences					t	df	[P value] Sig. (2-tailed)
			Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Experimental Group	Pair 1	Post-paranoid – pre-paranoid	-1.759	.788	.113	-1.986	-1.533	-15.619	48	<0.001
Control Group	Pair 1	Post-paranoid – pre-paranoid	-.550	.857	.135	-.824	-.276	-4.061	39	<0.001

Source: Primary Data, 2023

According to Table 4.21, the experimental group's computed mean was -1.759, with a 95% CI of -1.986 to -2.533 for the difference. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the computed mean for the control group was -0.550 and the 95% CI interval spanned from -0.824 to -0.276, it fell within the interval evenly.

Since the experimental group's t-test *p*-value was less than 0.05 (<0.001), it was determined to be statistically significant. The findings are as follows: $p < 0.001$, t (48) = -15.619. Additionally, the control group's t-test was statistically significant, with the following results: t (39) = -4.061, $p =$ <.001, which is less than 0.05.

Given that a 95% level of significance was used in this test and the experimental group's p-value was less than the alpha level (.05) at <.001, the null hypothesis that "Aerobic exercises have no significant effects on psychological markers (paranoid ideation) of HIV positive clients on ART"

is rejected. These findings suggest that aerobic exercise can help HIV-positive individuals on ART experience fewer paranoid thoughts.

The findings on the effects of aerobic exercises on the paranoid ideation in the study participants show that there was a general improvement as the participants reported less of the paranoid ideation problems they experienced prior to the aerobic exercises for the experimental groups. The hypothesis test results show that, indeed, the aerobic exercises statistically significant decrease paranoid ideation in HIV clients. These findings were in agreement with those of Koo & Kyungjin (2020) who established that the flexibility exercises play an important role in reducing and preventing stress and suicidal ideation in Korean adult women with depressive disorder.

These results imply that there are benefits to be drawn by HIV positive clients engaging in aerobic exercises. These results corroborate a study conducted by (Orlando et al., 2002) which found that people living with HIV experience more episodes of psychiatric illnesses, which negatively impacts their quality of life compared to those who are not infected. They also concur with the findings of Camara et al. (2018), who noted that the two most common symptoms of HIV positive individuals are anxiety and depression, with the remaining symptoms being exhaustion, phobia, loss of focus, memory loss, sleeplessness, and so on. Heckman et al. (2002) reported that approximately 25% of older HIV seropositive individuals suffer from moderate to severe depression, whereas Penzak et al. (2000) found that depression prevalence among HIV-positive individuals ranges from 22% to 45%.

4.4.3.2 Effects of aerobic exercise on depression

Table 4.22 shows the descriptive results on the effects of aerobic exercises on depression in the study participants at the pre-test and post-test stages for both the experimental and control groups.

Table 4.22: Effects of Aerobic Exercises on Depression

Statement: How often in the previous 2 week you felt the following?	Type of Test	% Experimental Group Responses				% Control Group Responses			
		(0)	(1)	(2)	(3)	(0)	(1)	(2)	(3)
1. Persistent sadness or low mood; and/or marked loss of interests or pleasure	Pre-test	2.0	59.2	38.8	0.0	17.1	53.7	29.3	0.0
	Post-test	83.7	8.2	8.2	0.0	34.7	18.4	46.9	0.0
2. Decreased or increased appetite and/or weight	Pre-test	6.1	49.0	42.9	2.0	20.0	45.0	35.0	0.0
	Post-test	79.6	18.4	2.0	0.0	30.6	32.7	36.7	0.0
3. Poor concentration or indecisiveness	Pre-test	22.4	30.6	42.9	4.1	12.2	39	48.8	0.0
	Post-test	83.3	12.5	4.2	0.0	31.3	35.4	33.3	0.0
4. Feelings of worthlessness or excessive or inappropriate guilt	Pre-test	61.2	34.7	4.1	0.0	22	26.8	51.2	0.0
	Post-test	91.8	6.1	2.0	0.0	41.7	35.4	22.9	0.0
5. Worry or slowing of movements	Pre-test	45.8	50	4.2	0.0	36.6	31.7	31.7	0.0
	Post-test	91.8	6.1	2.0	0.0	36.7	12.2	51.0	0.0
Average Pre-test		27.5	44.7	26.6	1.2	21.6	39.2	39.2	0.0
Average Post-test		86.0	10.3	3.7	0.0	35.0	26.8	38.2	0.0
Variance		**58.5**	**-34.4**	**-22.9**	**-1.22**	**13.4**	**12.4**	**-1.0**	**0.0**

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day

Source: Primary Data (2023)

The results show that there was a general improvement in the relief of the symptoms of depression by 58.5% this can be evidenced by a shift towards zero which depicts the reduction of signs of depression. At the post-test level, 86.0% of the participants reported not experiencing depression compared to 27.5% at the pre-test stage. This was against a variance of 13.4% as for the control group. These results imply that there was a significant improvement among the experimental subject upon engaging in the aerobic exercises.

The inferential analysis was conducted by running paired-samples t-test and the outputs of this test comprised of three tables 4.23, 4.24 and 4.25. The first one was the Paired samples statistics and the second was the Paired sample test results.

Table 4.23: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-depression	.61	47	.513	.075
		Pre-depression	1.57	47	.232	.034
Control Group	Pair 1	Post-depression	1.75	38	.874	.142
		Pre-depression	2.10	38	.368	.060

Source: Primary Data, 2023

The data indicate that the experimental group's post-test mean differed significantly from the pre-test mean of -0.96 (0.61 – 1.57), while the control group's mean was only -0.35 (1.75 – 2.10). Looking at the standard deviations of the two results, there were also differences with that of the post-test being higher.

Table 4.24: Paired Samples Correlation

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Post-depression & pre-depression	47	-.311	.034
Control Group	Pair 1	Post-depression & pre-depression	38	.351	.031

Source: Primary Data (2023)

There was no correlation between the experimental and control groups' pre-test and post-test depression results, as shown in Table 4.24. This suggests that the pre-test and post-test results do not have a linear connection.

It was also crucial to determine whether the results were statistically significant and whether the computed sample means were within the confidence ranges. The findings are shown in Table 4.25 (Paired Samples Results).

Table 4.25: Paired Samples Results

			Paired Differences							
						95% Confidence Interval of the Difference				
Group to which subject belongs			Mean difference	Std. Deviation	Std. Error Mean	Lower	Upper	T	df	[P value] Sig. (2-tailed)
Experimental Group	Pair 1	Post-depression – pre-depression	-.957	.625	.091	-1.141	-.774	-10.495	46	<0.001
Control Group	Pair 1	Post-depression – pre-depression	-.347	.821	.133	-.617	-.078	-2.608	37	.013

Source: Primary Data (2023)

As shown in Table 4.25, the experimental group's computed mean was -0.957, and the 95% CI for the difference was between -1.141 and -0.774. This demonstrates that the computed mean

does, in fact, fall inside the confidence interval. Given that the calculated mean for the control group was -.347 and the 95% CI ranged from -0.617 to -0.078, it fell inside the interval evenly.

With a p-value of less than 0.05 (<0.001), the experimental group's t-test was determined to be statistically significant. The findings are $p < 0.001$ and t (46) = -10.495. Because the control group's t-test findings were t (37) = -2.608, $p = 0.013$, which is > 0.05 but not at the 99.0% threshold of significance, the test was also statistically significant.

Given that a 95% level of significance was taken into account in this test and that the experimental group's *p*-value in this instance was $p <.001$, which was below the alpha level (.05), the null hypothesis that "Aerobic exercises have no significant effects on psychological markers (depression) of HIV positive clients on ART" is rejected. These results imply that aerobic exercises have an effect of reducing the depression in HIV positive clients on ART.

Both the descriptive and inferential analysis results reported an improvement in terms of alleviation of depression symptoms upon taking part in the aerobic exercises. Similarly, the hypothesis test results indicate that aerobic exercises statistically significant decreases depression in HIV positive clients.

These findings support those of Bopp et al. (2003), who hypothesized that by addressing the underlying symptoms that lead to sadness, exercise therapy may improve the psychological health of clients with HIV. Moreover, aerobic exercise training guards against the negative effects of stress and has antidepressant and anxiolytic properties. Askari et al. (2020), claim that when aerobic exercise is utilized as a comprehensive adjuvant treatment in addition to standard care, it can further enhance all three categories of physical, affective, and cognitive symptoms of depression. This is especially true because aerobic exercise improves the psychological health and social relationships domains of quality of life. This is also similar to what Jaggers et al. (2014) found out that, engaging in regular aerobic exercise can have positive effects on mental health including reducing symptoms

of depression. They specifically used a six weeks moderate intensity exercise for six minutes twice a week.

These results are also in line with Sujianto's (2021) study, which looked at how aerobic exercise affected depression in people with HIV. The mean depression score before and after the aerobic exercise intervention differed significantly, according to Sujianto's study, indicating that aerobic exercise can help HIV patients feel less depressed. They also concur with the findings of Nosrat et al. (2017), which shown notable variations in depression levels among these customers, and Heissel et al. (2019), who demonstrated that a four-week aerobic exercise program can, in fact, lessen symptoms of anxiety and sadness in PLWHA. They also support those of Nosrat et al. (2017) but apart from establishing that aerobics reduce the levels of depression, they also increase the CD4 count of HIV patients.

The present study's results, however, were consistent with those of O'Brien1 et al. (2016), who reported that among PLWHIV, there are noteworthy improvements in depression symptoms and quality of life, along with enhanced oxygen consumption, exercise duration, knee flexion, and body composition as measured by lean body mass and percent body fat.

4.4.3.3 Effects of aerobic exercise on neuroticism

The descriptive findings on the effects of aerobic exercises on the feeling of neuroticism by the study participants were as presented in Table 4.26.

Table 4.26: Effects of Aerobic Exercises on Neuroticism

Statement: How often in the previous 2 week you felt the following?	Type of Test	% Experimental Group Responses				% Control Group Responses			
		(0)	(1)	(2)	(3)	(0)	(1)	(2)	(3)
1. Often feel vulnerable or insecure	Pre-test	0.0	100.0	0.0	0.0	14.6	48.8	36.6	0.0
	Post-test	84.8	8.7	6.5	0.0	44.6	31.9	23.4	0.0
2. Get stressed easily	Pre-test	0.0	0.0	100.0	0.0	10.0	32.5	57.5	0.0
	Post-test	81.6	12.2	6.1	0.0	26.5	32.7	40.8	0.0
3. Struggle with difficult situations	Pre-test	0.0	95.9	4.1	0.0	17.1	36.6	46.3	0.0
	Post-test	79.6	8.2	12.2	0.0	30.6	30.6	38.8	0.0
4. Have mood swings	Pre-test	0.0	2.0	98.0	0.0	4.9	39.0	56.1	0.0
	Post-test	77.1	12.5	10.4	0.0	24.5	32.7	42.9	0.0
Average Pre-test		0.0	49.5	50.5	0.0	11.7	39.2	49.1	0.0
Average Post-test		80.8	10.4	8.8	0.0	31.6	32.0	36.5	0.0
Variance		**80.8**	**-39.1**	**-41.7**	**0.0**	**19.9**	**-7.3**	**-12.7**	**0.0**

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day

Source: Primary Data

The results above reveal that at the pre-test stage, all the experimental group participants reported experiencing some form of neuroticism. However, after the aerobic exercises, 80.8% of the experimental study participants reported having been relieved of the symptoms. This was against a variance of 19.9% in the case of the control group. These results suggest that the aerobic exercises were of a benefit to the participants by relieving the feelings that had reported about earlier.

The inferential results start with a paired-samples t-test was conducted and the outputs were as presented in the three Tables 4.27, 4.28 and 4.29

Table 4.27: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-neuroticism	.78	45	.842	.126
		Pre-neuroticism	2.51	45	.037	.006
Control Group	Pair 1	Post-neuroticism	1.84	39	.929	.149
		Pre-neuroticism	2.29	39	.486	.078

Source: Primary Data, 2023

According to the findings in Table 4.27, there was a discrepancy between the mean values of the pre-test and post-test results. The mean of the post-test to the pre-test for the experimental group was -1.73 (0.78 – 2.51), which is significantly different from the control group's mean of -0.45

(1.84 – 2.29). Comparing the standard deviations of the two results, it was further observed that, the experimental group was higher than that of the control group. This shows a significant improvement in the clients of the experimental group.

Table 4.28: Paired Samples Correlation

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Post-neuroticism & pre-neuroticism	45	-.051	.738
Control Group	Pair 1	Post-neuroticism & pre-neuroticism	39	-.093	.574

Source: Primary Data (2023)

The neuroticism results from the pre-test and post-test in the experimental and control groups did not correlate, as shown in Table 4.28. This suggests that the pre-test and post-test results do not correlate linearly.

The findings in Table 4.29 show whether or not the computed sample means are statistically significant and whether or not they fall within the confidence ranges.

Table 4.29: Paired Samples Results

			Paired Differences							
						95% Confidence Interval of the Difference				
Group to which subject belongs			Mean difference	Std. Deviation	Std. Error Mean	Lower	Upper	T	df	[P value] Sig. (2-tailed)
Experimental Group	Pair 1	Post-neuroticism – pre-test neuroticism	-1.722	.845	.126	-1.976	-1.468	-13.675	44	<0.001
Control Group	Pair 1	Post-neuroticism – pre-test neuroticism	-.455	1.088	.174	-.808	-.102	-2.612	38	.013

Source: Primary Data, 2023

According to Table 4.29, the experimental group's computed mean was -1.722, with a 95% CI of -1.976 to -1.468 for the difference. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the computed mean for the control group was -0.455 and the CI varied from -0.808 to -0.102, it fell equally inside the 95% confidence interval.

Given that the experimental group's p-value in this instance was less than the alpha level (.05) and that the test was conducted at a 95% level of significance, the null hypothesis that "Aerobic exercises have no significant effects on psychological markers (neuroticism) of HIV positive clients on ART" is rejected. These results imply that aerobic exercises have an effect of reducing neuroticism in HIV positive clients on ART.

Both the descriptive and the paired-samples t-test results pointed out that the aerobic exercises were of a benefit to the participants by relieving the neuroticism feelings that they had reported about earlier before the exercises. The hypothesis test results concurred with the above results as it was established that the aerobic exercises statistically significant decrease neuroticism in the study participants. These results are comparable to those of Baldwin et al. (2016), who found a substantial statistical correlation between physical activity and enjoyment of exercise. Compared to less active participants, highly active individuals self-reported considerably higher extraversion and reduced neuroticism.

Neuroticism is "a broad personality trait dimension representing the degree to which a person experiences the world as distressing, threatening, and unsafe," according to Weed and Kwon (2007). They go on to say that everyone can be found somewhere along this personality dimension, ranging from extremely chaotic to absolutely stable emotions. They claim that people with high levels of neuroticism are often unstable, tense, labile, and reclusive, whereas people with low levels of neuroticism are typically stable, self-assured, and under less stress. Being neurotic is linked to distress and a lack of happiness with oneself and life, even to the point of describing minor health issues as serious ones. They are also more prone to anxiety, depression, anger, and guilt.

According to the results of this study aerobic exercises reduced neuroticism, it follows that they also reduce anxiety because Kotov et al. (2010) opine that neuroticism is strongly associated with anxiety. It also follows that there will be reduced psychopathology, shame, psychological

inflexibility, and emotion dysregulation may explain the association between neuroticism and anxiety which according to Paulus et al. (2016) are associated with neuroticism.

The present study's findings corroborate those of Hausenblas and Giacobbi (2004), who investigated the correlation between personality traits and primary symptoms of exercise dependence. Their findings indicated that extraversion, neuroticism, and agreeableness were predictive factors of exercise dependence symptoms.

4.4.3.4 Effects of aerobic exercise on anxiety

The findings on the effects of aerobic exercises on anxiety as experienced by the participants prior to the study were as presented in Table 4.30.

Table 4.30: Effects of Aerobic Exercises on Anxiety

Statement: How often in the previous 2 week you felt the following?	Type of Test	**% Experimental Group Responses**				**% Control Group Responses**			
		(0)	(1)	(2)	(3)	(0)	(1)	(2)	(3)
1. Do you experience intense anxiety or worry and find it difficult to control?	Pre-test	4.1	77.6	18.4	0.0	19.6	38.6	43.9	0.0
	Post-test	65.6	20.4	4.1	0.0	37.5	33.3	29.2	0.0
2. Does worry or anxiety make you feel fatigued or irritable?	Pre-test	0.0	40.8	59.2	0.0	4.9	56.1	36.6	2.4
	Post-test	77.5	10.2	12.2	0.0	25.5	40.4	34.0	0.0
3. Does worry or anxiety interfere with your sleep or ability to concentrate?	Pre-test	4.1	26.5	69.4	0.0	17.5	40.0	42.5	0.0
	Post-test	70.8	18.8	10.4	0.0	32.6	18.4	49.0	0.0
4. Do you experience repetitive and persistent thoughts that are upsetting and unwanted?	Pre-test	0.0	62.5	37.5	0.0	7.3	39.0	53.7	0.0
	Post-test	77.1	20.8	2.1	0.0	24.4	36.7	38.8	0.0
5. Do you ever avoid places or social situations for fear of your status?	Pre-test	2.0	81.2	36.7	0.0	14.7	36.6	48.8	0.0
	Post-test	81.6	10.2	8.2	0.0	27.6	46.8	25.5	0.0
Average Pre-test		2.0	57.7	44.2	0.0	12.8	42.1	45.1	0.5
Average Post-test		74.5	16.1	7.4	0.0	29.5	35.1	35.3	0.0
Variance		**72.5**	**-41.6**	**-36.8**	**0.0**	**16.7**	**-6.9**	**-9.8**	**-0.5**

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day

Source: Primary Data (2023)

According to the results above, there was a variance of 72.4% (74.5% - 2.0%) as for the experimental group while that for the control group was 16.7% (29.5 – 12.8%) suggesting that there

was general improvement in the relive of anxiety upon participating in the aerobic exercises. These results imply that, HIV positive clients on ARVs can relive any feelings of anxiety by undertaking aerobic exercises. The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution.

Using SPSS version 20, a paired-sample t-test was used to do the inferential analysis. The test's outcome included two tables, which are displayed below.

Table 4.31: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-anxiety	.85	46	.744	.110
		Pre-anxiety	2.42	46	.147	.022
Control Group	Pair 1	Post-anxiety	1.89	36	.755	.126
		Pre-anxiety	2.34	36	.227	.038

Source: Primary Data (2023)

The purpose of the study was to determine whether the mean values of the pre-test and post-test results differed. The experimental group's post-test mean to pre-test mean was -1.57 (0.85 – 2.42) ±0.147, which is significantly different from the control group's mean of -0.45 (1.89 – 2.34) ±0.227. Looking at the standard deviations of the two results, there were also differences with that of the post-test being higher. The wider variation of the standard variation indicates differences in characteristics of the participants which was wider in the control group.

Table 4.32: Paired Samples Correlation Table

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Post-anxiety & pre-anxiety	46	-.091	.549
Control Group	Pair 1	Post-anxiety & pre-anxiety	36	-.182	.289

Source: Primary Data (2023)

Pre-test and post-test anxiety scores in the experimental and control groups did not correspond, as shown in Table 4.32. This suggests that the pre-test and post-test results do not have a linear connection.

The results of the computed sample means are displayed in Table 4.33 together with the degree of significance and the confidence intervals.

Table 4.33: Paired Samples Results

Group to which subject belongs			Paired Differences: Mean difference	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	t	df	[P value] Sig. (2-tailed)
Experimental Group	Pair 1	Post-anxiety – pre-anxiety	-1.574	.771	.114	-1.803	-1.345	-13.841	45	<0.001
Control Group	Pair 1	Post-anxiety – pre-anxiety	-.450	.827	.138	-.730	-.170	-3.264	35	.002

Source: Primary Data, 2023

The experimental group's computed mean was -1.574, with a 95% CI of -1.803 to -1.345 for the difference, according to Table 4.33. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the computed mean for the control group was -0.450 and the 95% CI interval varied from -0.730 to -0.170, it fell within the range.

Since the experimental group's t-test p-value was less than 0.05 (<0.001), it was determined to be statistically significant. $t(45) = -13.841$, $p < 0.001$ are the findings. The results showed that the control group's t-test was similarly statistically significant, with $t(35) = -3.3264$ and $p = .002$, both of which are less than 0.05.

Given that the experimental group's p-value in this instance was less than the alpha level (.05) and that the test was conducted at a 95% level of significance, the null hypothesis that "Aerobic exercises have no significant effects on psychological markers (anxiety) of HIV positive clients on ART" is rejected. These results imply that aerobic exercises have an effect of reducing anxiety in HIV positive clients on ART.

In summary, according to the results, there was general improvement in the relief of anxiety upon participating in the aerobic exercises. These results imply that, HIV positive clients on ARVs can be relieved of any feelings of anxiety by undertaking aerobic exercises. This was supported by

the paired-samples t-test which showed that the post-test results indicated that the participants had lower levels of anxiety compared to the time before the exercises (pre-test). Similarly, the hypothesis test also indicated that aerobic exercises reduce anxiety in HIV positive clients on ART.

These outcomes are consistent with research by Jayakody et al. (2014), which showed that anxiety symptoms appeared to be reduced by both aerobic and non-aerobic exercise. Even if the exercise seems to lessen anxiety symptoms, antidepressant medicine works better than it does. The outcomes also agreed with a study by Heidarya et al. (2011), which found that aerobic exercise significantly decreased anxiety in the experimental group and that stress levels decrease with increasing physical fitness. As it stands, researches by Antoni et al. (2002) they also suggest that stress management can prevent secondary infections and slow the progression of HIV-positive individuals' disease. Meanwhile, Askari et al. (2020) suggests that high-intensity exercise reduces anxiety sensitivity more quickly than low-intensity exercise and produces more individuals who respond to treatment. According to Broman et al. (2004), aerobic exercise has been demonstrated to lessen anxiety in general and may also lessen anxiety sensitivity by exposing participants to physiological sensations that they find frightening.

The findings of this study corroborate those of Heissel et al. (2019), who demonstrated a lower level of anxiety in patients with HIV who were participating in aerobic exercises in a meta-analysis they carried out to look at the effects of exercise on depression and anxiety in PLHIV. Heissel et al. (2019) also demonstrated that professional supervision, the type of exercise, and its frequency were important factors in reducing anxiety and depression symptoms in PLHIV. According to their research, exercise interventions are effective in lowering symptoms of anxiety and depression in people with mental illness and extremely frequent exercise three or more times a week seems to be moderately to significantly helpful in lowering these symptoms in PLHIV.

The results of this study, as well as others, are crucial because, according to Heissel et al. (2019), the prevalence of depression and anxiety in PLHIV is two to four times higher than in

people without the virus, and both HIV and HAART are associated with an increased prevalence of depression in comparison to people without HIV/AIDS.

4.4.3.5 Effects of aerobic exercise on phobia

The participants were asked to indicate how often in the previous two weeks before the study the participants were bothered by psychosocial problems such as phobia participants gave their responses and these were as summarised in Table 4.34.

Table 4.34: Effects of Aerobic Exercises on Phobia

Statement: How often in the previous 2 week you felt the following?	Type of Test	**% Experimental Group Responses**				**% Control Group Responses**			
		(0)	(1)	(2)	(3)	(0)	(1)	(2)	(3)
1. Feeling overwhelming anxiety or fear	Pre-test	2.1	41.7	56.2	0.0	10.0	55.0	35.0	0.0
	Post-test	81.7	12.2	6.1	0.0	36.8	22.4	40.8	0.0
2. Knowing that your fear is irrational, but feeling powerless to overcome it	Pre-test	12.2	38.8	49.0	0.0	12.5	35.0	52.5	0.0
	Post-test	81.6	10.2	8.2	0.0	38.7	32.7	28.6	0.0
3. Fear of losing control of the situation	Pre-test	20.0	44.4	35.6	0.0	12.5	35.0	52.5	0.0
	Post-test	84.7	4.3	10.9	0.0	23.4	42.6	34.0	0.0
4. Feeling an intense need to escape	Pre-test	100.0	0.0	0.0	0.0	22.0	39.0	39.0	0.0
	Post-test	91.9	6.1	2.0	0.0	35.5	16.7	47.9	0.0
5. Chest pain or tightness	Pre-test	89.8	10.2	0.0	0.0	33.9	29.3	26.8	0.0
	Post-test	95.9	4.1	0.0	0.0	44.9	22.4	32.7	0.0
Average Pre-test		44.8	27.0	28.2	0.0	18.2	38.7	41.2	0.0
Average Post-test		87.2	7.4	5.4	0.0	35.9	27.4	36.8	0.0
Variance		**42.3**	**-19.6**	**-22.7**	**0.0**	**17.7**	**-11.3**	**-4.4**	**0.0**

Scale: (0) = Not at all; (1) = Half a day; (2) = More than half a day; and (3) = Nearly every day

Source: Primary Data (2023)

The results above show that there was a general improvement as more experimental participants reported not experiencing any phobia after participating in the aerobic exercises. The experimental group reported a variance of 42.3% (87.2 – 44.8%) compared to the control group whose variance was 17.7% (35.9 – 18.2%). The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution.

To conduct inferential analysis, paired-samples t-test was run using the SPSS version 20 and the outputs of this test were as shown in Table 4.35, 4.36 and Table 4.37.

Table 4.35: Paired Samples Statistical Results

Group to which subject belongs			Mean	N	Std. Deviation	Std. Error Mean
Experimental Group	Pair 1	Post-phobia	.60	41	.616	.096
		Pre-phobia	1.54	41	.217	.034
Control Group	Pair 1	Post-phobia	1.72	36	.831	.139
		Pre-phobia	2.17	36	.375	.062

Source: Primary Data (2023)

The mean of the post-test to the pre-test for the experimental group was -0.94 (0.60 – 1.54), which is significantly different from the control group's mean of -0.45 (1.72 – 2.17). Looking at the standard deviations of the two results, there were also differences with that of the post-test being higher.

Table 4.36: Paired Samples Correlation

Group to which subject belongs			N	Correlation	Sig.
Experimental Group	Pair 1	Post-phobia & pre-phobia	41	.137	.392
Control Group	Pair 1	Post-phobia & pre-phobia	36	-.130	.449

Source: Primary Data (2023)

Table 4.36 shows that there was no correlation between the experimental and control groups' pre-test and post-test phobia scores. This suggests that the pre-test and post-test results do not have a linear connection.

Finding out if the computed sample means are statistically significant and fall within the confidence intervals was the next result of the aforementioned test. The results are displayed in Table 4.37.

Table 4.37: Paired Samples Results

Paired Samples Test										
			Paired Differences							
						95% Confidence Interval of the Difference				
Group to which subject belongs			Mean difference	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	[P value] Sig. (2-tailed)
Experimental Group	Pair 1	Post-phobia – pre-phobia	-.932	.624	.097	-1.129	-.735	-9.563	40	<0.001
Control Group	Pair 1	Post-phobia – pre-phobia	-.450	.955	.159	-.773	-.127	-2.826	35	.008

Source: Primary Data (2023)

The experimental group's computed mean, as indicated in Table 4.37, was -0.932, with a 95% CI of the difference being between -1.129 and -0.735. This demonstrates that the computed mean does, in fact, fall inside the confidence interval. Given that the computed mean for the control group was -0.450 and the 95% CI interval varied from -0.773 to -0.127, it fell inside the interval evenly.

Since the experimental group's t-test *p*-value was less than 0.05 (<0.001), it was determined to be statistically significant. The findings are as follows: $p < 0.001$, t(40) = -9.563. With the following results, the control group's t-test was likewise statistically significant: t(35) = -2.826, p =.008, which is less than 0.05

Given that the experimental group's *p*-value in this instance was less than the alpha level (.005) and that the test was conducted at a 95% level of significance, the null hypothesis that "Aerobic exercises have no significant effects on psychological markers (phobia) of HIV positive clients on ART" is rejected. These results imply that aerobic exercises have an effect of reducing phobia in HIV positive clients on ART.

In summary, this study established that there was a general improvement as far as phobia is concerned as more experimental participants reported not experiencing any phobia after participating in the aerobic exercises. The paired-samples t-test results in terms of both the mean

values and the standard deviations of the pre-test results compared to the post-test results indicate that the study participants exhibited an improvement upon taking part in the aerobic exercises. The correlation analysis indicated that aerobic exercises significantly decreased anxiety in HIV positive clients on ART. These results, both descriptive and inferential, imply that aerobic exercises have a positive contribution in alleviating phobia in HIV positive clients.

According to Broman et al. (2004), aerobic exercise has been demonstrated to lessen generalized anxiety and may also lessen anxiety sensitivity by exposing people to physiological sensations they are afraid of. These results support their findings. According to Seid et al. (2020), the most prevalent psychological indicators among HIV-positive clients on antiretroviral therapy (ART) were anxiety, depression, neuroticism, paranoid ideation, and interpersonal sensitivity.

The results of this study that aerobic exercises reduce phobia are important in PLHIV going by the assertion by Radcliffe et al. (2007) that, both agoraphobia and social phobia are in such patients and that to be effectively treated, the patients require a comprehensive assessment of the presenting symptoms, life stresses and coping style, which can be coupled with exercising.

According to Banyan Mental Health (2021), anxiety disorders can coexist with panic disorder and lead to substance abuse as a coping mechanism. While agoraphobia and social anxiety disorder can both cause avoidance of specific situations, this may be to varying degrees. The other main categories of anxiety disorders include obsessive compulsive disorder (OCD), post-traumatic stress disorder (PTSD), generalized anxiety disorder (GAD), panic disorder and agoraphobia, social phobia and other phobias, acute stress disorder, and anxiety disorder brought on by a general medical condition, according to Andriote (2012). Therefore, aerobic exercises may help lower most of these.

4.5 Summary Hypotheses Testing Results

Table 4.38 shows the summary of the results on testing the three study hypotheses.

Table 4.38: Summary Results of Hypotheses Testing

SN	Hypothesis		*p*-Value	Verdict
1.	**Ho_1** There is no significant effect of aerobic exercises on immunological measures of HIV positive clients on ART.	• CD4 Count	0.001	Rejected
2.	**Ho_2** There is no significant effect of aerobic exercise on the functional work capacity of HIV positive clients on ART.	• Borg RPE Scale • Duke Activity Status Index (DASI)	<0.001 <0.001	Rejected Rejected
3.	**Ho_3** Aerobic exercises have no significant effects on psychological markers of HIV positive clients on ART.	• Paranoid ideation • Depression • Neuroticism • Anxiety • Phobia	<0.001 <0.001 <0.001 <0.001 <0.001	Rejected Rejected Rejected Rejected Rejected

Source: Primary Data (2023)

The results above show that all the three study hypotheses were rejected implying that aerobic exercises according to this study were very useful in HIV positive clients on ARVs. In summary, therefore, (i) aerobic exercises significantly improves the immunological measures of HIV positive clients on ART in terms of increased CD4 cell count; (ii) aerobic exercise significantly improves the functional work capacity of HIV positive clients on ART; and finally (iii) Aerobic exercises significantly reduces the psychological markers, namely paranoid ideation, depression, neuroticism, anxiety, and phobia in HIV positive clients on ART these were all affected the same way with a *p*-value of <0.001.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents summary, conclusion and recommendations in chapter four. The discussions start with the pre-study results on physical activity readiness assessment followed by the presentation of discussions in line with the study objectives which are about, (i) assessing the effect of aerobic exercise on immunological measures of HIV positive clients' (ii) measuring the effect of aerobic exercise on functional work capacity of HIV positive clients; and (iii) determining the contribution of aerobic exercise on psychological markers of HIV positive clients.

5.2 Effect of aerobic exercises on immunological measures of HIV+ clients on ART

The results on the CD4 cell count-test show that on average there was an increase of the mean CD4 count of the experimental group while that of the control group seems to have slightly dropped. The experimental group recorded an increase in the CD4 count upon the participants participating in the aerobic exercises while the control group which was not subjected to the aerobic exercises reported a slight decline implying that the control group actually had a negligible change in the CD4 count. In this study aerobic exercises had a positive effect on the immunity of the participants. Additionally, compared to the control group, the experimental group's results indicate a substantial difference in the mean of the post-test to the pre-test. Additionally, it was determined that the experimental group's t-test was statistically significant, whereas the control group's t-test was not.

These results imply that organised and supervised aerobic exercises play a role in the improvement of clinical outcomes of HIV positive client who is on ARVs since they are able to raise the CD4 cell count. This is useful to the patient in that the raised CD4 cell count aids in cushioning the client from opportunistic infections.

5.3 Effect of aerobic exercise on functional work capacity of HIV+ Clients on ART

The results show that before the physical exercises, the rate of perceived exertion was the same across the two groups. However, the experimental group participants rated the exertion to be much lighter than before taking part in aerobic exercise sessions. According to the experimental group's results, the mean of the post-test and the pre-test differs significantly from the control group’s. In contrast to the control group, the experimental group's t-test was shown to be statistically significant, demonstrating that clients living with HIV on ART had an enhanced functional work capacity after 12 weeks of moderate intensity aerobic exercise.

Going by these results, it follows that the functional work capacity of HIV positive patients can indeed benefit from well organised, timed, and moderated aerobic exercises. This is significant in that such patients may be enjoying themselves while keeping physically fit and at the same time improving their functional work capacity. This would mean that they can be in a position to be self-dependent in any chores as opposed to them feeling “week” and incapable of being active without undue fatigue.

The study established an improvement in the VO_2 max for participants in the experimental group compared to the control group. As oxygen is the fuel of the body it can be concluded that the functional work capacity of the participants improved after the aerobic exercise intervention.

It was also found out that the clients in the experimental group had their heart rate lower when exposed to the same exercise intensity as in the pre-test. This is true because as one exercises the heart becomes stronger and it is able to pump sufficient blood and therefore no need of pumping many times. This therefore means the blood supply the muscles can be adequate hence improved functional work capacity.

5.4 Effects of aerobic exercise on psychological markers of HIV+ clients on ART

The psychological markers considered in this study included paranoid ideation, depression, neuroticism, anxiety and phobia. The findings on each of them and the corresponding discussions are as presented in the following sub-sections.

5.4.1 Effects of aerobic exercise on paranoid ideation

According to the results, there was a general improvement as the participants reported less of the paranoid ideation problems they experienced prior to the aerobic exercises for the experimental groups. The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution to the psychological status of HIV positive clients on ART. Additionally, compared to the control group, the experimental group's results indicate a significant difference in the mean of the post-test to the pre-test; additionally, the experimental group's t-test was found to be statistically significant, suggesting that aerobic exercise has a significant impact on the paranoid ideation of HIV-positive clients on ART. These results imply that there are benefits to be drawn by HIV positive clients engaging in aerobic exercises.

5.4.2 Effects of aerobic exercise on depression

The results show that there was a general improvement in the relief of the symptoms of depression upon the participants participating in the aerobic exercises. These results imply that there was a significant improvement among the experimental subject upon engaging in the aerobic exercises. Additionally, the data indicate that the experimental group's post-test mean differs significantly from the pre-test mean when compared to the control group. While at the same time the t-test established a statistically significant relationship between aerobic exercises and alleviation of depression in HIV positive clients on ART.

5.4.3 Effects of aerobic exercise on neuroticism

The findings indicate that the participants of the experimental investigation reported feeling less neurotic overall. These findings imply that the participants benefited from the aerobic exercise

by experiencing relief from the emotions they had previously expressed. The experimental group's mean difference from the pre-test to the post-test is significantly higher than the control groups, according to the results. This demonstrates a notable improvement in the experimental group's customers, suggesting that aerobic exercise has a major impact on the neuroticism of HIV positive clients receiving antiretroviral therapy.

They define neuroticism as “a broad personality trait dimension representing the degree to which a person experiences the world as distressing, threatening, and unsafe” (Weed and Kwon 2007). They go on to say that everyone can be found somewhere along this personality dimension, ranging from extremely chaotic to absolutely stable emotions. They claim that people with high levels of neuroticism are often unstable, tense, labile, and reclusive, whereas people with low levels of neuroticism are typically stable, self-assured, and under less stress. Being neurotic is linked to distress and a lack of happiness with oneself and life, even to the point of describing minor health issues as serious ones. They are also more prone to anxiety, depression, anger, and guilt.

5.4.4 Effects of aerobic exercise on anxiety

According to the results, there was general improvement in the relief of anxiety upon participating in the aerobic exercises. The fact that there was more significant improvement among the experimental subject implies that the aerobic exercises have a positive contribution. In comparison to the experimental group, the control group's results likewise demonstrate a substantial difference in the mean of the post-test to the pre-test. This implies that aerobic exercise significantly affects anxiety in HIV-positive people on ART.

5.4.5 Effects of aerobic exercise on phobia

The results show that there was a general improvement as more experimental participants reported not experiencing any phobia after participating in the aerobic exercises implying that aerobic exercises have a positive contribution. Additionally, the experimental group's t-test was

found to be statistically significant, confirming the findings that aerobic exercises significantly reduce the fear experienced by HIV-positive individuals receiving antiretroviral therapy.

5.5 Conclusions

This section presents the conclusions drawn from the results and the discussions of these results.

It has been made clear that well-structured supervised 12 weeks moderate intensity aerobic exercises at a tempo of 120-150 beats per minute improved CD4 cell in the body of HIV positive clients on ART and well-structured and supervised aerobic exercise is very important to improve the clinical outcomes of PLHIV on ART. HIV positive clients on ART had a significant improvement after an exercise intervention. Given aerobic exercise clients will be more productive and continue doing their work without undue fatigue like their HIV negative counterparts. Since exercise reduced depression syndrome as one of the psychological markers under study its assumed that the clients will have an improvement in other clinical outcomes as found-out by: Seid et al, (2020) where he examined the health effects of chronic depression in people living with HIV when ART began to be available. Clients with chronic depressive symptoms for example were about two times more likely to have poor treatment outcomes and hence die from AIDS than those who never experienced depression. Therefore, aerobic exercise is likely to reduce mortality rates in HIV positive clients on ART.

5.6 Recommendations

Arising from the results presented in chapter four, and the associated discussions and conclusions, believing that specific actions are needed by different stake holder to improve the quality of lives for PLHIV, the following recommendations were made:

- MoH should authorise the use of aerobic exercise as a means for improving immunological measure of HIV+ positive clients. It has been made clear that organised and supervised aerobic exercises play a role in the improvement of clinical outcomes of HIV positive client

who is on ARVs since they are able to raise the CD4 cell count. This is useful to the patient in that the raised CD4 cell count aids in cushioning the client from opportunistic infections.

- The MoH together with health practitioners should encourage HIV clients to participate in aerobic exercise or even make arrangements for aerobic exercises for HIV positive clients. This will help to improve the functioning work capacity of the clients since the results made it clear that aerobic exercise reduces exertion among HIV positive clients.
- The health facilities also need to encourage aerobic exercise so as to help thing in improving the psychological markers considered in this study this study such as paranoid ideation, depression, neuroticism, anxiety and phobia. The aerobic exercise proved that it improves paranoid ideation and reduces depression, neuroticism, anxiety and phobia among the HIV positive clients. The aerobic exercises can improve on the living conditions HIV positive clients.

5.7 Areas for Further Research

Considering that this study was limited in terms of time, content and geographical scopes, there is need for further research to expound the understanding of the study on the fits of exercising even in cases of clients with chronic diseases such as HIV/AIDS in this case. This study makes suggestions on the following areas of further research:

i. To determine the effect of aerobic exercise on other clinical outcome like viral load, body composition and adherence to drugs.

ii. To establish the correlation between demographic characteristics and the CD4 parameters in ART clients undertaking aerobic physical exercises

iii. To establish the best diet-physical exercise mix for the optimisation of immunity in clients on ARVs.

iv. To Establish the effect of exercise of viral load of HIV positive patients on ART care

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APPENDICES

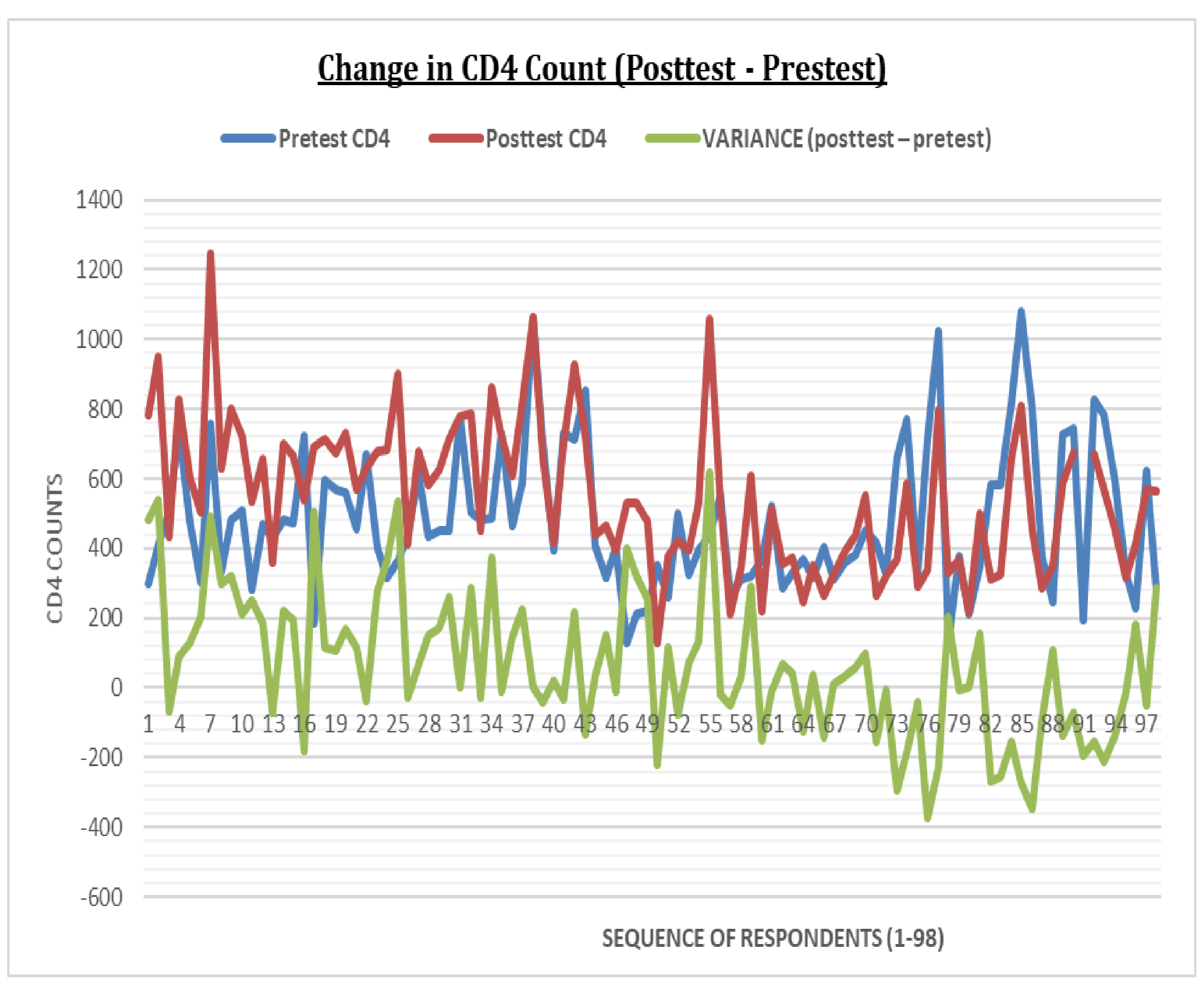
Appendix I: Immunological Markers (CD4) Statistical Results

SN	Age	sex	Pretest CD4	Posttest CD4	VARIANCE (posttest – pretest)	Percentage increase	Day a attend	Pretest Borg	Posttest Borg	VARIANCE (pretest – posttest)	percentage decrease
1	44	M	300	781	481	160.3	60	7	2	5	71.4
2	45	M	410	950	540	131.7	60	7	4	3	42.9
3	46	M	504	436	-68	-13.5	58	7	2	5	71.4
4	38	F	738	828	90	12.2	38	6	3	3	50.0
5	35	F	478	606	128	26.8	54	5	2	3	60.0
6	46	M	303	504	201	66.3	50	7	2	5	71.4
7	44	M	755	1244	489	64.8	45	5	2	3	60.0
8	47	M	334	631	297	88.9	43	6	2	4	66.7
9	43	F	481	800	319	66.3	60	6	2	4	66.7
10	37	F	510	720	210	41.2	60	7	1	6	85.7
11	25	F	280	533	253	90.4	36	6	1	5	83.3
12	26	F	470	657	187	39.8	40	6	1	5	83.3
13	43	M	429	358	-71	-16.6	38	7	2	5	71.4
14	41	M	480	701	221	46.0	58	7	4	3	42.9
15	43	M	472	667	195	41.3	58	7	2	5	71.4
16	49	M	721	538	-183	-25.4	37	7	5	2	28.6
17	39	F	187	690	503	269.0	55	7	2	5	71.4
18	34	F	596	712	116	19.5	53	6	2	4	66.7
19	25	M	569	675	106	18.6	38	5	3	2	40.0
20	27	M	560	729	169	30.2	36	6	5	1	16.7
21	34	F	456	571	115	25.2	36	7	4	3	42.9
22	29	F	670	631	-39	-5.8	31	6	2	4	66.7
23	34	M	404	679	275	68.1	46	7	3	4	57.1
24	43	M	317	683	366	115.5	48	6	3	3	50.0
25	24	M	363	899	536	147.7	55	7	2	5	71.4
26	39	M	439	412	-27	-6.2	58	6	3	3	50.0
27	41	M	612	679	67	10.9	43	7	2	5	71.4
28	43	M	435	584	149	34.3	60	5	3	2	40.0
29	39	F	452	625	173	38.3	38	5	2	3	60.0
30	41	M	452	712	260	57.5	40	5	3	2	40.0
31	34	F	775	778	3	0.4	43	7	2	5	71.4
32	34	F	504	789	285	56.5	39	6	2	4	66.7
33	43	M	481	452	-29	-6.0	41	6	2	4	66.7
34	39	M	488	861	373	76.4	52	6	2	4	66.7
35	38	M	732	720	-12	-1.6	51	7	3	4	57.1
36	39	M	463	607	144	31.1	49	6	4	2	33.3
37	47	M	588	814	226	38.4	58	4	2	2	50.0
38	47	M	1064	1064	0	0.0	60	3	1	2	66.7
39	37	M	703	663	-40	-5.7	36	3	3	0	0.0
40	47	M	396	415	19	4.8	41	4	2	2	50.0
41	38	M	732	700	-32	-4.4	52	3	4	-1	-33.3
42	46	F	714	929	215	30.1	55	6	3	3	50.0
43	46	M	855	721	-134	-15.7	38	3	2	1	33.3
44	44	M	406	437	31	7.6	30	4	3	1	25.0
45	43	F	317	466	149	47.0	38	3	3	0	0.0
46	46	M	405	393	-12	-3.0	28	5		5	100.0
47	45	M	129	530	401	310.9	38	3		3	100.0
48	43	F	213	532	319	149.8	41	3		3	100.0
49	36	M	219	476	257	117.4	49	2		2	100.0
50	45	M	351	129	-222	-63.2		7	6	1	14.3
51	45	M	261	378	117	44.8		4	6	-2	-50.0
52	40	F	499	423	-76	-15.2		3	7	-4	-133.3
53	43	M	323	393	70	21.7		4	6	-2	-50.0
54	44	M	395	530	135	34.2		6	6	0	0.0
55	48	M	440	1056	616	140.0		7	7	0	0.0
56	42	M	551	532	-19	-3.4		3	7	-4	-133.3
57	46	F	262	213	-49	-18.7		6	7	-1	-16.7
58	42	F	312	345	33	10.6		7	6	1	14.3
59	35	F	322	610	288	89.4		7	6	1	14.3
60	36	M	370	219	-151	-40.8		6	7	-1	-16.7
61	48	M	522	511	-11	-2.1		7	7	0	0.0
62	42	F	286	354	68	23.8		7	6	1	14.3
63	36	M	331	371	40	12.1		6	5	1	16.7
64	34	M	370	245	-125	-33.8		7	4	3	42.9
65	44	M	317	353	36	11.4		7	3	4	57.1
66	47	M	405	265	-140	-34.6		5	6	-1	-20.0

67	40	M	312	324	12	**3.8**	6	6	0	**0.0**
68	38	**F**	358	391	33	**9.2**	7	7	0	**0.0**
69	37	M	383	440	57	**14.9**	7	6	1	**14.3**
70	38	M	452	551	99	**21.9**	6	6	0	**0.0**
71	40	M	415	262	-153	**-36.9**	7	7	0	**0.0**
72	37	**F**	327	322	-5	**-1.5**	5	7	-2	**-40.0**
73	48	M	663	370	-293	**-44.2**	4	6	-2	**-50.0**
74	30	M	770	586	-184	**-23.9**	3	5	-2	**-66.7**
75	36	M	328	288	-40	**-12.2**	3	4	-1	**-33.3**
76	37	M	712	340	-372	**-52.2**	4	3	1	**25.0**
77	48	M	1023	796	-227	**-22.2**	5	2	3	**60.0**
78	30	**F**	129	331	202	**156.6**	6	2	4	**66.7**
79	36	M	378	370	-8	**-2.1**	6	7	-1	**-16.7**
80	38	M	213	216	3	**1.4**	5	6	-1	**-20.0**
81	49	M	345	501	156	**45.2**	6	5	1	**16.7**
82	49	M	582	312	-270	**-46.4**	7	4	3	**42.9**
83	39	**F**	582	327	-255	**-43.8**	7	3	4	**57.1**
84	45	M	820	663	-157	**-19.1**	6	2	4	**66.7**
85	35	**F**	1082	811	-271	**-25.0**	4	4	0	**0.0**
86	43	M	802	456	-346	**-43.1**	3	5	-2	**-66.7**
87	49	M	377	284	-93	**-24.7**	6	6	0	**0.0**
88	44	M	245	351	106	**43.3**	4	7	-3	**-75.0**
89	39	M	726	587	-139	**-19.1**	7	6	1	**14.3**
90	45	**F**	745	675	-70	**-9.4**	2	5	-3	**-150.0**
91	35	**F**	196		-196	**-100.0**	2	6	-4	**-200.0**
92	43	M	826	671	-155	**-18.8**	3	6	-3	**-100.0**
93	49	M	781	570	-211	**-27.0**	3	6	-3	**-100.0**
94	44	M	594	456	-138	**-23.2**	4	7	-3	**-75.0**
95	38	M	331	317	-14	**-4.2**	5	5	0	**0.0**
96	29	**F**	229	412	183	**79.9**	7	6	1	**14.3**
97	27	**F**	621	569	-52	**-8.4**	6		6	**100.0**
98	30	M	281	565	284	**101.1**	7		7	**100.0**

Source: Primary Data

Appendix II: CD4 Variance



Appendix III: RPE – Conversion from 0-10 to 6-20 scale and estimating the Heart Rate by multiplying by 10

SN	Sex	Pretest Borg RPE on scale of 0-10	Pretest Borg RPE on scale of 6-20	Approx. Heart Rate (=Borg*10)	Approx. Heart Rate (=Borg*10)	Post-test Borg	Post test Borg RPE on scale of 6-20	Approx. Heart Rate (=Borg*10)	Approx. Heart Rate (=Borg*10)	Post - Pre
1	1	7	15/16	150-160	155	2	8/9	80-90	85	70
2	1	7	15/16	150-160	155	4	11	110	110	45
3	1	7	15/16	150-160	155	2	8/9	80-90	85	70
4	2	6	14	140	140	3	10	100	100	40
5	2	5	12/13	120-130	125	2	8/9	80-90	85	40
6	1	7	15/16	150-160	125	2	8/9	80-90	85	40
7	1	5	12/13	120-130	125	2	8/9	80-90	85	40
8	1	6	14	140	140	2	8/9	80-90	85	55
9	2	6	14	140	140	2	8/9	80-90	85	55
10	2	7	15/16	150-160	155	1	7	70	70	85
11	2	6	14	140	140	1	7	70	70	70
12	2	6	14	140	140	1	7	70	70	70
13	1	7	15/16	150-160	155	2	8/9	80-90	85	70
14	1	7	15/16	150-160	155	4	11	110	110	45
15	1	7	15/16	150-160	155	2	8/9	80-90	85	70
16	1	7	15/16	150-160	155	5	12/13	120-130	125	30
17	2	7	15/16	150-160	155	2	8/9	80-90	85	70
18	2	6	14	140	140	2	8/9	80-90	85	55
19	1	5	12/13	120-130	125	3	10	100	100	25
20	1	6	14	140	140	5	12/13	120-130	125	15
21	2	7	15/16	150-160	155	4	11	110	110	45
22	2	6	14	140	140	2	8/9	80-90	85	55
23	1	7	15/16	150-160	155	3	10	100	100	55
24	1	6	14	140	140	3	10	100	100	40
25	1	7	15/16	150-160	155	2	8/9	80-90	85	70
26	1	6	14	140	140	3	10	100	100	40
27	1	7	15/16	150-160	155	2	8/9	80-90	85	70
28	1	5	12/13	120-130	125	3	10	100	100	25
29	2	5	12/13	120-130	125	2	8/9	80-90	85	40
30	1	5	12/13	120-130	125	3	10	100	100	25
31	2	7	15/16	150-160	155	2	8/9	80-90	85	70
32	2	6	14	140	140	2	8/9	80-90	85	55
33	1	6	14	140	140	2	8/9	80-90	85	55
34	1	6	14	140	140	2	8/9	80-90	85	55
35	1	7	15/16	150-160	155	3	10	100	100	55
36	1	6	14	140	140	4	11	110	110	30
37	1	4	11	110	110	2	8/9	80-90	85	25
38	1	3	10	100	100	1	7	70	70	30
39	1	3	10	100	100	3	10	100	100	0
40	1	4	11	110	110	2	8/9	80-90	85	25
41	1	3	10	100	100	4	11	110	110	-10
42	2	6	14	140	140	3	10	100	100	40
43	1	3	10	100	100	2	8/9	80-90	85	15

44	1	4	11	110	110	3	10	100	100	10
45	2	3	10	100	100	3	10	100	100	0
46	1	5	12/13	120-130	125			0	0	125
47	1	3	10	100	100			0	0	100
48	2	3	10	100	100			0	0	100
49	1	2	8/9	80-90	85			0	0	85
1	1	7	15/16	150-160	155	6	14	140	140	15
2	1	4	11	110	110	6	14	140	140	-30
3	2	3	10	100	100	7	15/16	150-160	155	-55
4	1	4	11	110	110	6	14	140	140	-30
5	1	6	14	140	140	6	14	140	140	0
6	1	7	15/16	150-160	155	7	15/16	150-160	155	0
7	1	3	10	100	100	7	15/16	150-160	155	-55
8	2	6	14	140	140	7	15/16	150-160	155	-15
9	2	7	15/16	150-160	155	6	14	140	140	15
10	2	7	15/16	150-160	155	6	14	140	140	15
11	1	6	14	140	140	7	15/16	150-160	155	-15
12	1	7	15/16	150-160	155	7	15/16	150-160	155	0
13	2	7	15/16	150-160	155	6	14	140	140	15
14	1	6	14	140	140	5	12/13	120-130	125	15
15	1	7	15/16	150-160	155	4	11	110	110	45
16	1	7	15/16	150-160	155	3	10	100	100	55
17	1	5	12/13	120-130	125	6	14	140	140	-15
18	1	6	14	140	140	6	14	140	140	0
19	2	7	15/16	150-160	155	7	15/16	150-160	155	0
20	1	7	15/16	150-160	155	6	14	140	140	15
21	1	6	14	140	140	6	14	140	140	0
22	1	7	15/16	150-160	155	7	15/16	150-160	155	0
23	2	5	12/13	120-130	125	7	15/16	150-160	155	-30
24	1	4	11	110	110	6	14	140	140	-30
25	1	3	10	100	100	5	12/13	120-130	125	-25
26	1	3	10	100	100	4	11	110	110	-10
27	1	4	11	110	100	3	10	100	100	0
28	1	5	12/13	120-130	125	2	8/9	80-90	85	40
29	2	6	14	140	140	2	8/9	80-90	85	55
30	1	6	14	140	140	7	15/16	150-160	155	-15
31	1	5	12/13	120-130	125	6	14	140	140	-15
32	1	6	14	140	140	5	12/13	120-130	125	15
33	1	7	15/16	150-160	155	4	11	110	110	45
34	2	7	15/16	150-160	155	3	10	100	100	55
35	1	6	14	140	140	2	8/9	80-90	85	55
36	2	4	11	110	110	4	11	110	110	0
37	1	3	10	100	100	5	12/13	120-130	125	-25
38	1	6	14	140	140	6	14	140	140	0
39	1	4	11	110	110	7	15/16	150-160	155	-45
40	1	7	15/16	150-160	155	6	14	140	140	15
41	2	2	8/9	80-90	85	5	12/13	120-130	125	-40
42	2	2	8/9	80-90	85	6	14	140	140	-55
43	1	3	10	100	100	6	14	140	140	-40

44	1	3	10	100	100	6	14	140	140	-40
45	1	4	11	110	110	7	15/16	150-160	155	-45
46	1	5	12/13	120-130	125	5	12/13	120-130	125	0
47	2	7	15/16	150-160	155	6	14	140	140	15
48	2	6	14	140	140			0	0	140
49	1	7	15/16	150-160	155			0	0	155

Appendix IV: Exercise Protocol

Aerobic Exercise Plan for PLHIV in Uganda

5 Phases of Aerobics Class

Prescribed aerobic sessions are separated into different levels of intensity and levels of difficulty and will have five stages: warm-up (5-10 minutes), cardiovascular conditioning (25-30 minutes), muscular strength and conditioning (10-15), then lastly a cool-down (5-10 minutes) and stretching and flexibility (5-8 minutes) the time was allocated like this to cater for progressive progression the final week the maximum time was considered.

Tempo: Start at about 120 BPM (beats per minute) and build to 150 BPM this was achieved by setting music beats at that temple.

With the use of Highly Active Antiretroviral Therapy (HAART), medical advancements have transformed HIV infection into a chronic illness that is associated with diminished exercise capacity, disability, impairment in everyday activities, and seral comorbidities come along with that, (Eggleton and Nagali, 2020). The mortality and morbidity of HIV-infected clients have significantly decreased in the HAART era leading to increased life expectancy. Although HAART has significantly decreased the incidence of immunosuppression and wasting syndrome in HIV patients, it is linked to anthropometric and metabolic disorders such as insulin resistance, dyslipidaemia, and an irregular distribution of body fat, (Nsagha et al., 2015). One important management technique used by rehabilitation health professionals to promote health and improve the quality of life for clients with HIV is aerobic exercise. It may be able to reduce a number of HIV-related adverse effects in addition to the morphological and cardiometabolic issues (such as inflammation, oxidative stress, and mitochondrial dysfunction) that can arise with HAART, (Grace et al,. 2015). Exercise clearly helps people with HIV infection improve their quality of life, increase their aerobic capacity, increase their functional ability, decrease insulin resistance, improve their oxidative stress, muscular strength, lipid profile, and lower their risk of cardiovascular disease (Cannata et al., 2020). Importantly, aerobic exercise is thought to be safe, and there is no proof that regular, moderate-intensity exercise may impair immune function in HIV/AIDS patients who are asymptomatic or symptomatic (Jaggers and Hand, 2016). When combined with progressive resistive exercise (CARE), aerobic exercise (AE) improves a number of health indices in HIV-positive clients more effectively than when either is used alone (O'Brien, et al. 2010). The American College of Sports Medicine has lately recommended and used CARE (Nweke et al., 2022)

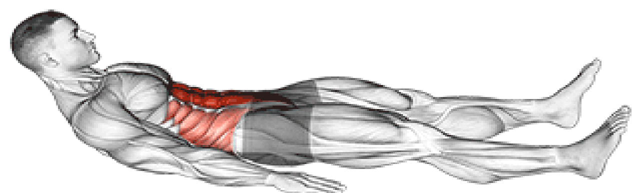
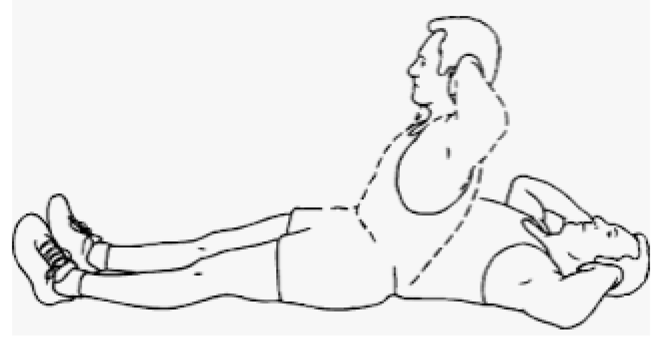
In a study to assess the implication of aerobic exercise on clinical outcomes of PLHIV the following exercise protocol was used that showed significant improvement of the clients that participated in clinical outcomes like: Immunological measures using CD4 cell count, functional work capacity and psychological markers in Uganda.

The Logic model, which links short- and long-term outcomes with programmatic activities, inputs, processes, outcomes, and theoretical assumptions and principles, was used to develop the exercise protocol in order to archive its purpose. Logic model is a visual representation of the elements and sequence of events required to obtain meaningful program results.(Das, Petruzzello and Ryan 2014). Using logic model, it created a feeling of community belonging among study staff, participants, and the researcher by depicting the connections between resources, activities, inputs, outputs, and outcomes. It was realised that exercise without equipment would be more feasible in this case since equipment's were more costly.

Mondays

S/NO	Activity	Procedure	Duration
1	**Warm-up** Play tag	Use labels to teach participants on the right arm as you look for one to tag you also hide your arm not to be tagged	5-10 minutes
	Walk on the spot	Walk on spot with arm action for 1 minute	
	Jog	Jog on spot with arm action for 1 minute	
	Side step	Side step with arm action Side step raising the arms up and down	
	Invisible	Skip an imaginary rope	

	rope skipping		
	Stretching	Do a dynamic stretch from the feet to the head	
	Standing quadriceps stretch	Bring your heel closer to your buttocks, bend your right knee while standing. Using one or both hands, grasp your ankle. Don't pull your knees out to the side; instead, keep them in line with one another as you pull your feet towards balms. Stay in that position for about 30 seconds. Do the same on the other side. Repeat the same for 2 to 3 times.	
2	**Workout**		**20-25 minutes**
	Jog on the spot	Jog on the spot while keeping your core tight with different forms of arm movement.	
	High knee	Move with high knee while raising the hand up ensure the core is tight as you lift the knees change forms of hand movement	
	High knee waist twist side by side	Simple jumps with a waist twist as you move your elbow towards your knee alternately	
	Jump rope (invisible rope)	Jump/skip an invisible rope while keeping the knees soft	
	Trunk jump	Using your core to lift the body with knees bent, trunk jump	
	Slow jogging on the sport	Jog on the sport with different arm movement	
	Jab switch - jump	Do 8 jabs jump while changing side and 8 jabs again as you bend as low as you can while keeping core tight.	

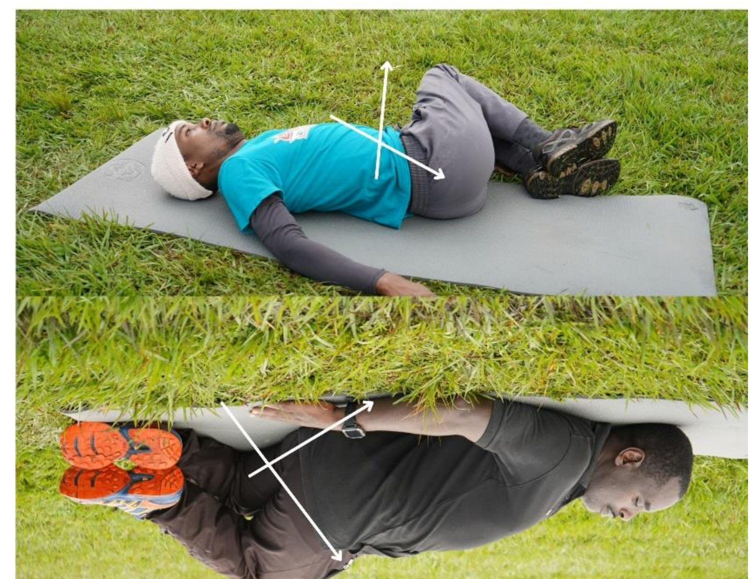
	squats		
	Raise legs while lying on your back	With your legs straight and together, lie on your back. Holding your legs straight, raise them to the ceiling until your butt lifts off the ground. Return your legs to a slightly elevated position by lowering them gradually. Hold on a second. Repeat the same as you raise the legs . 	
	Quarter sit-up	 Raise your feet straight up in the air at a 70-degree angle after placing your hands behind your head. bringing your left knee up to your right elbow. Don't only move your elbows; make sure your rib cage is moving as well. To finish one rep, turn sides and perform the identical motion on the opposite side. 	
	Air twisting crunch	While holding your ears with elbows straight, move the elbow towards the knee alternately	
	Front	Maintain a push-up position while elbows are on the ground	

	plunks		
3	**Cool down** Jog on the spot High knee while raising the hand up Hip flexor burners Stretch Arm reach	Jog on the spot while keeping your core tight While raising the hand up ensure the core is tight as you lift the knees alternatingly With elbows raised, raise the knee up to the chest level while tapping on the ground and hold it up without tapping down and then extend the leg to make it straight Start by placing your feet wider than hip-width apart while standing. Swing your right arm across your chest while pivoting on your right foot. In the same direction, twist your upper body and torso.	**5 minutes**

Tuesdays

S/NO	Activity	Procedure	Duration

1	**Warm-up** Slow jog on the spot Side step Arm reach Side reach Hip rotations Knees lift	Jog slowly on sport for 1 to 2 minutes Side step with different arm action Place your feet wider than hip-width apart while standing. Swing your right arm across your chest while pivoting on your right foot. In the same direction, twist your upper body and torso. Repeat with the opposite arm right away. **Continue for 1minute** Place your feet wider than hip-width apart while standing. Bend your right knee slightly and tilt your body to the right. At the same moment, extend your left arm diagonally, parallel to the rest of your body, to the sky. Lengthen your left leg. Repeat on the other side. Continue for 1-2 minutes. Place your feet wider than hip-width apart and begin while standing. Put your hands behind your head and bend your arms. As you raise one leg, bend your knee. Move that leg in a circle over your body, up to your chest, and back down to the beginning. **Continue for 1 to 2 minutes** Place your feet wider than hip-width apart and begin standing. Put your hands behind your head and bend your arms. As you raise one leg towards your torso, bend your knee as though you were attempting to use it to touch your rip cage. **Continue for 1 to 2 minutes.**	**5-10 minutes**
2	**Workout** On sport jogging Shoulder burners in plié 4 x4 hopes Jab switch jump	Jog on sport with different arm movement Perform shoulder burners in plié starting with wide leg lift and hands straight and then flap them up and down with knees bent and feet facing sides, swing the arms backwards and forward then take them up and down while ensuring they stop at the shoulder level and swing them while writing letter 'O' with the fingers Perform 4 x4 hopes, with one leg raised, do 4 hopes each side while first is raised to the shoulder level and repeat Perform 8 jabs jumps while changing sides and 8 jabs again while bent as low as you can keeping your core	**20-25 minutes**

	squats Hip flexor burners Low plunk position Switch heel kicks Lying bent knee oblique Shoulder taps Spiderman planks	tight. Perform hip flexor burners, with elbow raised raise and the knee up to the chest level while tapping on the ground hold it up without tapping down then extend the leg to make it straight. In a low plunk position with elbows on ground and body straight, alternate knees as you plunk. While keeping low and high in trunk position, squiz the stomach forward while keeping core tight to perform Pulse tucks While switch heel kicks, step on heel and keep knees soft to perform heel kicks,  stance your shoulders above your wrists in a high-plank stance on your mat. Raise your right hand off the floor and contact your left shoulder while using your core to keep your body stable. Using your left hand, repeat while maintaining a firm hip position.	

	Laying back extension	 With your feet hip-width apart, your elbows bent and beneath your shoulders, and your torso in a straight line, begin in the low plank position. Your right knee should be brought to your right elbow. Extend your right leg back and return to the starting position. Do the same on both sides of the legs To begin, place your hands by your head, elbows wide, and lie face down on the floor. To support your lower back, keep your feet flat and use your core and glutes. Then, raise your shoulders, head, and chest off the ground by using your back muscles throughout your spine, and maintain this position for the necessary amount of time. Using your upper back muscles, try to push your shoulder blades together on your back. Additionally, keep your chin slightly tucked in and stare down at the floor directly in front of you rather than raising it to look forward.	

3	**Cool down** Cool down dance Children pose Marching arm circles	 Slow-motion dance for 30 seconds, then rest. Repeat until cool. Lean back to sit on your heels from a tabletop position, extending your arms in front of you or beside you. Breathe deeply while letting your chest drop heavily into your thighs. Put your forehead down on the ground. Stay in the same position for one to three minutes. With your arms shoulder-level and out to the sides, march in place. Rotate your arms forward for eight to ten times. Rotate your arms backwards for eight to ten times.	**5 minutes**

Wednesdays

S/NO	Activity	Procedure	Duration
1	**Warm-up** Red light, green light:	When Coach shouts out a traffic light colour, pretend to be automobiles. Everyone at the starting line should be ready, Move to the finish line when you hear green light, When red Light' is said everyone must halt instantly. When all cross the finish line or when the majority do so, a new round begins.	**5-10 minutes**

	Obstacle course: Touch toes: Flap your wings: Dance party: Dynamic stretch	Construct a basic obstacle course. Among the concepts are hopping over imaginary lines, zigzagging between cones, etc. do the same for about 2minutes Extend your arms to the sides. Touch your right hand to your left foot while bending at the waist. Touch your left hand to your right foot after standing up maintain a flat back. Continue until you are warm. For 30 seconds, flap your arms like a bird. Now jog for 30 seconds while flapping your arms in place. Continue until you are warm. Play music and stay still for 30 seconds. Put an end to the music. Take a break, then restart the song and repeat until you are warm. Stretch all the major muscles	
2	**Workout** Imaginary rope jump Jumping jacks Jog and jump Arm circles Tuck jumps High jumps	Make ten double counts by acting like you are skipping a rope. While performing jumping jacks, spell out "Marathon Kids." At a musical pace After 30 seconds of stationary jogging, 30 seconds of stationary jumping. Repeat after resting until heated up. Make large forward motions with your arms, then backward motions. Perform ten tuck jumps. Leap up and bring your knees to your chest. Bend your knees as you land. Count ten times rest then repeat for three sets. With legs together jump high with hands raised To perform moving plunks, make 4 steps	**20-25 minutes**

	Moving plunks Jog High knee 8 elbows/4 suicide drills Mummy kicks Side shuffles	each side while keeping shoulders elbows and wrists in line. While keeping your core tight, jog on spot Perform alternate high knee raises while raising the hand up and ensure the core is tight as you lift the knees Perform 8 elbows/4 suicide drills. Elbow 8 times and one step sideways as you touch the ground Perform mummy kicks with alternate hand twist while keeping the core tight With the hands raised to shoulder level, trot side by side three steps on each side and then tap the ground and move the opposite side keeping your core tight. In a plunk position take the knees towards the elbow while alternating them and keep your core tight to perform high plunk. High plunk alternate knees fast (do as the but at faster pace)	

	High plunk High plunk alternate knees fast Windmill Isometric hold		
3	Cool down Stretching with squats Copy cat Touch down	Stand up, bend your knee, and use your right hand to grasp your left ankle. Practise your balance. Hold for 20 seconds. Change legs. Repeat three times. As the group duplicates, participants alternately show off their preferred stretch. Do not forget to stretch slowly and softly. Do for each participant once. Maintain a shoulder-width distance between your feet. For 20 seconds, touch the ground. For 20 seconds, touch your right foot. Change legs. Continue for 30 seconds. Shake your right arm gently, then your left, and finally both arms simultaneously.	**5 minutes**

	Shaking the body	Shake your right leg first, followed by your left. Then shake your entire body, including your head and hips. Give every bodily part a shake. for 1 minute. Add some general body stretch	

Thursdays

S/NO	**Activity**	**Procedure**	**Duration**
1	**Warm-up** Walk on the spot Jog Side step Invisible rope skipping Stretching Standing quadriceps stretch	Use stickers to tageach participant on the right arm as you look for one to tag you also hide your arm not to be tagged Walk on spot with arm action for 1 minute Jog on spot with arm action for 1 minute Side step with arm action Side step raising the arms up and down Skip an imaginary rope Do a dynamic stretch from the feet to the head To bring your heel closer to your buttocks, bend your right knee when standing. Hold your foot towards your buttocks with both hands. Do not pull your knees out to the side; instead, keep them in line with one another. Hold this position for 30 seconds. Do it for the other leg. Repeat for two to three times.	**5-10 minutes**
2	**Workout** Jump rope s-s	While keeping feet together, skip a rope	**20-25 minutes**

		and land softly side by side	
	Jog on spot	Jog on the spot while keeping your core tight	
	High knee	While alternating your knees and hand up ensuring tight core, lift the knees high to perform high knee raises.	
	Switch kicks	Switch kicks with elbows raised at the shoulder level	
	Level drill	Level drill (raise hands go down do 4 push-ups and 4 bicycle rides continuously.	
	Heisman	Alternate high knee raise with wide legs keeping core tight	
	8 switch kicks/8 hop squats	To perform 8 switch kicks/8 hop squats, kick alternately in air and hold the body tight as you jump squat	
	Hold centre	Hold centre (hands held together on the chest level bend back a little…	
	Single leg raise	Perform Single leg raise bending as you raise up and then stretch as you take it down	
	Both legs raise	Raise both legs while bending and stretch as you lower your legs	
	Pike push-up		

3	**Cool down** Bending forward while standing Share on Pinterest Stretching the shoulder Legs-up-the-wall pose	Bend forward from a standing position, slowly hinge at the hips. While maintaining a small bend in your knees, lengthen your spine and let your head drop heavily towards the floor. interlace your hands behind your back, place your hands on the floor, or hold opposing elbows in front of or behind your thighs. Be in this position for 1munute. Adjust this stretch if your hands can not reach the floor. Instead of placing hands on the floor, place them on a block or other solid object. The advantages will remain the same. Place your hand close to your neck or spine and raise your right elbow from a standing or sitting position. Gently press your right hand farther down your spine, place your left hand on your right elbow. Bring your left arm up beside your torso and clasp your right hand with your left hand to extend the stretch. extend your reach, grasp an imaginary towel or resistance band. Stay in that position for 30 seconds. Repeat on the opposite side. Place your right side against a wall and take a seat. Lying on your back, swing your legs up along the wall. Put your hips a few inches from the wall or against it.	**5 minutes**

	Corpse pose	Position your arms overhead, on your stomach, or next to your body. Put your hips a few inches from the wall or against it. Be in that position for about five minutes.	
	Spinal twist	With your feet slightly wider than your hips and your toes spread out to the sides, lie on your back with your arms at your sides, palms facing up. Release any stress or tightness in your body by relaxing. Breathe deeply and let your body drop heavily to the floor. Be in that position for five minutes or longer. With your left leg bent or outstretched, lie on your back. Pull the right knee up to the chest. Place the left hand on the outside of the right knee and extend the right arm to the side. Turn to the left with gentleness. For 30 seconds, hold the twist. On the other side, repeat. Do general body stretch from head to toe	

Fridays

S/NO	**Activity**	**Procedure**	**Duration**
1	**Warm-up** Do what the leader does: Move in form of figure 8 Bicycles	Select a participant to serve as the "leader." Ask the "leader" to select their favourite movement-inducing warm-up exercises that the others will imitate. Engage in play 2 minutes. Run or walk in different-sized figure eights. Make sure you walk quickly and feel the stretch in your hips and back. Place your legs and feet in the air while lying on the back. Legs	**5-10 minutes**

		should be moved like a bicycle pedal. For 30 seconds each, pedal slowly, mediumly, and quickly. Between each pedalling pace, take a break.	
	Skipping high	For a certain distance, skip as high as possible. To jump even higher when you skip, make sure to extend your lifted arm high.	
	Walk like a robot:	Raise one leg straight up and bend the waist so that the hand touches the toes. Touch your toes alternately with each gradual stride until they are warm.	
	Walk like a crab:	For a predetermined distance, walk backwards like a crab on hands and feet. Continue until you're warm.	
2	**Workout**		**20-25 minutes**
	Start with a high knee lift	Spend 20 seconds doing high knees. Bring the knees as high as they will go while you jog in place. Repeat after resting for three sets.	
	Jogging	Jog on the spot while keeping your core tight	
	High knee with hand raising up	High knee while raising the hand up ensure the core is tight as you lift the knees	
	Sideways squat	Sideways squat	
	Rotational squats	Rotational squats	

	Jump squats High knee waist twist side by side Jump rope (invisible rope) Trunk jump Wide trunk jump 8 fast feet/8 hooks Moving ski hopes Hit the floor C-sits Twist with knee lift side by side A-frame	Feet shoulder width apart then you jump as you spring from your toes make the core tight Jump rope/invisible rope while keeping the knees soft Use the core to lift the body with knees bent to do trunk jumps. Wide trunk jump (land softly while the knees are bent) While fast running on spot do 8 fast feet/8 hooks keeping the core tight Perform moving skip hopes starting with leg together hope side by side make four kicks and land softly Touch the floor in the middle of your legs with the rear leg slightly bent and raise the hands up as you turn and touch the floor alternately to perform hit the floor exercise. C-sits with hands below the	

		knees Twist with knee lift side by side Keeping hands together lift the hands side by side and then lift the knees alternately to perform A-Frame	
3	**Cool down** Light jogging or walking Do the upper body stretches Seated forward bend Push your knees to chest and pose	Do three to five minutes of easy or brisk walking after three to five minutes of mild jogging. Press palms up towards the ceiling while interlacing fingers, either standing or sitting. Keeping spine straight, draw hands as far back and up as you can. After that, position your left arm in front of your right and extend hands back and forth while facing each other with your palms facing each other. Repeat on the opposite side. Legs should be out in front of you as you sit. Raise your arms. You can fold forward by hinging at your hips. Put your hands on the floor or on your legs. Be in this position for one minute. With your left leg bent or outstretched, lie on your back. Interlace your fingers around the front of your shin and pull your right knee in towards your chest. Maintain this posture for a maximum of one minute. On the other side, repeat. Perform each side two or three times.	**5 minutes**

	Reclining butterfly pose Cat Stretch	With your knees out to the sides and the soles of your feet together, lie on your back. Arms can be placed overhead or next to your body. Maintain this posture for a maximum of five minutes. With a flat back, begin on your hands and knees. Inhale deeply, then arch your back so that your shoulders move back and your belly moves downward towards the earth, allowing the "cats" to gaze upward. As the "cats" stretch their backs, release the breath and turn the back curve around.	

Saturdays

S/NO	Activity	Procedure	Duration
1	**Warm-up** DO climbers of a mountain Do star jumps Crawl like a bear Balance on one leg	Take a push-up position to begin. For 20 seconds, legs "climb the mountain," much like while running. Hands remain on the floor. Repeat after resting for three sets. Perform 10-star leaps. While in the air, leap with your arms and legs out like a star. Repeat after resting for three sets. From one predetermined position to another, crawl like a bear on your hands and feet. Count ten rest then repeat for three sets. At the same time, make 30 circles with both arms. Next, raise one straight leg off the ground and perform ten circles. Change legs. Continue for ten revolutions.	**5-10 minutes**

2	**Workout**		**20-25 minutes**
	Jogging on the spot	Jog on the spot while keeping your core tight	
	High knee with raised hands	High knee while raising the hand up ensuring tight core as you lift the knees	
	Walk as you stretch with alternate hands	Walk as you stretch while alternating the hands	
	One leg squat		
	Forward and reverse lunge		
	Jump over the log	Jog and jump over an imaginary log side by side landing softly	
	8 high knee/8 power jacks	Alternate high knee and power jack by bending down	
	8 alternate high knees	Keep your feet hip-width apart and your arms by your sides. As you start this exercise, stand erect and position your thighs perpendicular to the floor, being careful not to Lift one knee at a time, slowly. Lift and lower your legs at the same steady pace as you alternate between each knee one at a time. Raise your left hand. Keep your pace slow and start swinging your arms. From your shoulder, swing your arms.	

	High knee waist twist side by side Jump rope (invisible rope) Trunk jump Wide trunk jump	Jump an invisible rope while keeping the knees soft Perform trunk jump while using the core to lift the body with knees bent. Perform wide trunk jump and land softly while the knees are bent.	
3	**Cool down** Quad Stretch Copy Cat Ground Down Body shakes	Stand up, bend your knee, and use your right hand to grasp your left ankle. Practise your balance. Hold for 20 seconds. Change legs. Continue for three sets. As the group duplicates, children alternately show off their preferred stretch. Don't forget to stretch slowly and softly. Continue for three sets. Maintain a shoulder-width distance between your feet. For 20 seconds, touch the ground. For 20 seconds, touch your right foot. Change legs. Repeat for three sets. Shake your right arm gently, then your left, and finally both arms simultaneously.	**5 minutes**

		Shake your right leg first, followed by your left. Then shake your entire body, including your head and hips. Give every bodily part a 30-seconds shake. A general body stretch	

Sundays

Rest day

Source for images: (https://www.google.com/search?q=%E2%80%A2+How+to+do+%E2%80%A2%09%E2%80%A2%09High+knee+waist+twist+side+by+side&hl=en-GB&sxsrf=ALiCzsal82gmOYBsSkerVWEfcugDWLgYtg:1664967025747&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjFiofB9cj6AhVrXfEDHficChsQ_AUoAnoECAEQBA&biw=1366&bih=657&dpr=1#imgrc=8MoRg71wb6EymM, 14:00 05/10/2021)

Appendix V: Psychological makers – Results

Question	Not at all (0)	Half a day (1)	More than half a days (2)	Nearly every day (3)	total
Paranoid Ideation					
1. Perpetual/continuous feelings of being bored and/or empty	2	48	40	0	90
2. Intense love-hate relationships with others	0	40	50	0	90
3. Extreme efforts to avoid real or perceived rejection or abandonment by others	1	37	52	0	90
4. A feeling of disconnection with your body and/or your mind and paranoid/suspicious thoughts that are made worse by any stress.	2	44	43	0	89
5. Anger issues, such as becoming extremely angry in inappropriate situations, exploding in rage/temper, or being unable to control your anger, followed by feeling guilty or ashamed.	7	47	36	0	90
Depression					
1. Persistent sadness or low mood; and/or marked loss of interests or pleasure	8	51	31	0	90
2. Decreased or increased appetite and/or weight	11	42	35	1	89
3. Poor concentration or indecisiveness	16	31	41	2	90
4. Feelings of worthlessness or excessive or inappropriate guilt	56	13	21	0	90
5. Worry or slowing of movements	61	15	13	0	89
Neuroticism					
1. Often feel vulnerable or insecure	6	69	15	0	90
2. Get stressed easily	4	13	72	0	89
3. Struggle with difficult situations	7	62	21	0	90
4. Have mood swings	2	17	71	0	90
Anxiety					
1. Do you experience intense anxiety or worry and find it difficult to control?	10	53	27	0	90
2. Does worry or anxiety make you feel fatigued or irritable?	2	43	44	1	90
3. Does worry or anxiety interfere with your sleep or ability to concentrate?	9	29	51	0	89
4. Do you experience repetitive and persistent thoughts that are upsetting and unwanted?	3	46	40	0	89
5. Do you ever avoid places or social situations for fear of your status?	7	45	38	0	90
Phobia					
1. Feeling overwhelming anxiety or fear	5	42	41	0	88
2. Knowing that your fear is irrational, but feeling powerless to overcome it	11	33	45	0	89
3. Fear of losing control of the situation	14	34	37	0	85
4. Feeling an intense need to escape	58	16	16	0	90
5. Chest pain or tightness	67	12	11	0	90
Column total		______	+______		+______

Source: Primary Data

Appendix VI: PAR-Q

Physical Activity Readiness Questionnaire ………………………ID Number

I kindly request you to spare some few minutes of your time to answer the following questions as honestly as possible.

The questionnaire is seeking information about your physical activity readiness and find-out if there are any restrictions that would stop you from participating in physical exercise

This information is for education purpose only and will be treated with utmost confidentiality. Any cooperation in this matter will be highly appreciated.

SECTION A: BACKGROUND INFORMATION OF THE PARTICIPANTS

	SECTION A: BACKGROUND INFORMATION	
	Date _______/_________ /_______	
A1	Sex of participants	1. Male 2. Female
A2	Age of the participants (in completed years)	…………….(years)
A3	What is your occupation?	1. Soldier 2. Housewife 3. Shop keeper 4. Others (specify)………
A4	Marital status	1. Married 2. Single 3. Divorced 4. Others (specify)
A5	Education	1. Primary 2. Secondary 3. Tertiary 4. Others (specify)
	ENGAGEMENT IN PHYSICAL EXERCISE	
E1	Are you currently engaged in any regular physical activity?	3. Yes 4. No
E2	If yes, state them	4 Aerobic 5 …… 6 ……… 7 ………… 8 Others (specify
E3	If yes, how many times a week? ………………….. and for how long per day?? ………………..	……………(times) a week …………..(hours) a day
E4	If No, when did you last participate in a physical activity?	1. A month ago 2. …………… 3. ………….. 4. Over a year ago

E5	Do you dig for more than 3 times a week?	2 Yes 3 No
E6	Do you fetch water daily in more than 1km?	3. Yes 4. No
E7	Do you Jog, play football or netball for more than 3 days a week	4. Yes 5. No
E8	Have you been given any restrictions regarding exercise?	1. Yes 2. No
E9	If yes, what kind of restrictions	1. ………. 2. ……………. 3. ………….. 4. Others specify
AR1	When exercising, including climbing stairs, do you ever experience any of the following?	1. Shortness of breath 2. Fatigue 3. Chest pain 4. Pressure over the heart 5. Others (specify)……….
AR2	What are your personal exercise programme goals?	1. Weight loss 2. Cardiovascular endurance 3. Staying in shape 4. Increasing strength 5. Others (specify)…..
AR3	Which days and times are best for you? (Select at least 3 days)	1 Mondays 2 Tuesdays 3 … 4 …. 5 … 6 ….. 7 Sundays
AR4	Would you prefer a Male or Female Trainer? (tick both if no preference)	1. Male 2. Female 3. Both
AR5	Where do you want to train?	1. Town 2. At hospital 3. Gym 4. Playing field 5. Anywhere accessible

Thank you

Appendix VII: CD4 Cell Results Template

CD 4 Results					
Pre-Test CD4 Cell count				Post-test CD4 Cell count	
Client ID NO	Age	Sex	Pre-Test	Post-test	Total No of days Attended

Appendix VIII: The Borg RPE Scale for Rating Perceived Exertion

Functional Work Capacity			
1 – 15 scale		**0 – 11 sale**	**6 – 20 scale**
1.			
2.	Very, Very light		
3.			
4.	Very Light		
5.			
6.	Fairly light		
7.			
8.	Somewhat hard		
9.			
10.	Hard		
11.			
12.	Very Hard		
13.			
14.	Very, Very Hard		
15.			

Appendix IX: Duke Activity Status Index (DASI Questionnaire)

SN	Activities	Extremely Difficult or unable to perform activities	Quite a bit difficulty	Moderate difficulty	A little a bit of difficulty	No difficulty at all
	Score	**0**	**1**	**2**	**3**	**4**
1	Take care of yourself easily, that is, eating, dressing, bathing or using the toilet?					
2	Walk indoors, such as around your house with ease?					
3	Are you able to walk around or climb stairs with ease?					
4	Can you run a short distance with ease?					
5	Can you do light work around the house like mopping, washing dishes and slashing around?					
6	Are you able to do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?					
7	Can you easily do yard work like raking leaves, weeding, or pushing a power mower?					
8	Are you able to have sexual relations with un due fatigue?					
9	Participate in moderate recreational activities like soccer, jogging, dancing, swimming, or throwing a baseball or football?					
10	Have sexual relations					
11	Perform recreational activities (e.g. bowling)					
12	Perform strenuous sports (e.g. swimming)					
DASI scoring: Positive responses are multiplied by the weight and summed to get a total score, which ranges from 0 to 4 Higher scores indicate higher functional capacity						

Modified from Hlatky, et. al., (1989) Higginbotham MB et al. A brief self-administered questionnaire to determine functional capacity (The Duke Activity Status Index).

Appendix X: Psychosocial Assessment Tool

Psychosocial Assessment Tool

Over the last two weeks, how often have you been bothered by any of the following problems? *(Use "✓" to indicate your answer)*				
Question	Not at all (0)	Half a day (1)	More than half a days (2)	Nearly every day (3)
Paranoid Ideation				
1. Perpetual/continuous feelings of being bored and/or empty				
2. Intense love-hate relationships with others				
3. Extreme efforts to avoid real or perceived rejection or abandonment by others				
4. A feeling of disconnection with your body and/or your mind and paranoid/suspicious thoughts that are made worse by any stress.				
5. Anger issues, such as becoming extremely angry in inappropriate situations, exploding in rage/temper, or being unable to control your anger, followed by feeling guilty or ashamed.				
Depression				
6. Persistent sadness or low mood; and/or marked loss of interests or pleasure				
7. Decreased or increased appetite and/or weight				
8. Poor concentration or indecisiveness				
9. Feelings of worthlessness or excessive or inappropriate guilt				
10. Worry or slowing of movements				
Neuroticism				
6. Often feel vulnerable or insecure				
7. Get stressed easily				
8. Struggle with difficult situations				
9. Have mood swings				

Anxiety				
6. Do you experience intense anxiety or worry and find it difficult to control?				
7. Does worry or anxiety make you feel fatigued or irritable?				
8. Does worry or anxiety interfere with your sleep or ability to concentrate?				
9. Do you experience repetitive and persistent thoughts that are upsetting and unwanted?				
10. Do you ever avoid places or social situations for fear of your status?				
Phobia				
1. Feeling overwhelming anxiety or fear				
2. Knowing that your fear is irrational, but feeling powerless to overcome it				
3. Fear of losing control of the situation				
4. Feeling an intense need to escape				
5.Chest pain or tightness				
Column total		_____	+______	+______

☐ If you checked off any problems above, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all   Somewhat difficult   Very difficult   Extremely difficult

Adopted from Client Health Questionnaire with modification by Spitzer, Kroenke et. al., (2001).

Appendix XI: Informed Consent Form

KYAMBOGO UNIVEISITY

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH STUDY TITLED:

Implications of Aerobic Exercise on Clinical Outcomes of HIV Positive Clients in Uganda; A Case of General Military Hospital-Bombo

1. Introduction

You are being asked to volunteer for a research study. This study is being conducted at General Military Hospital Bombo. The Principal Investigator for this study is Mwebaze Nicholas. The Sponsor of the study is the Student.

2. Purpose of This Research Study

The purpose of this research study is to design and establish the implications of aerobic exercise on clinical outcomes of HIV positive clients on ART in Uganda a case of General Military Hospital-Bombo.

3. Length of Your Participation

Your participation in the study will last a maximum of 14 weeks. You will take part in aerobic exercise for about 12 weeks at least 5 days a week and be followed up for after the exercise sessions. You will need to visit the doctor’s office anytime you feel any changes in your body.

4. Where the Study is being done and Number of People Participating

This study is taking place in General Military Hospital Bombo, and about 98 people are expected to take part.

5. Study Procedures

Before you take part in this research study, the study must be explained to you and you must be given the chance to ask questions. You must read and sign this informed consent form. You will be given a copy of this consent form to take home with you.

6. What Will Happen When You Complete the Study?

When your participation in the study ends, you will no longer have access to the exercise instructor unless you make special arrangements.

7. Procedures that are Not Standard Care for Your Condition or are Experimental

The exercise prescribed will be only done for research purposes unless prescribed.

8. Possible Risks or Side Effects of Taking Part in this Study

Participation in the study may cause the following side effects:

Muscle sores at the start of the activity

Physical injury

Increased appetite

9. Important Information for Women

The effect of the study article on a baby's development is not known. Therefore, pregnant and breast-feeding women may not take part in this study. Women who have a chance of becoming pregnant must have a negative pregnancy test at study entry and use birth control during the study. Acceptable methods include birth control pills, Depo-Provera, diaphragm, intrauterine device (IUD), cervical cap, and condom with sponge or foam. If you become pregnant during this study, you must stop taking the study drug and call your doctor immediately.

10. Costs for Taking Part in this Study

Participation will be free of charge.

11. Token of appreciation for Taking Part in this Study

There will be no any monetary appreciation to any participant for those who will attend 100% of the sessions will be awarded certificates of appreciation.

12. Possible Benefits to You for Taking Part in the Study

There are no direct benefits to you for participating in this study. However, your participation in this study may add to the knowledge about exercise and raise your fitness levels.

13. Other Treatments Available

No any other medications will be provided apart from the routine therapy

14. About Participating in this Study

Your participation in this study is voluntary. You may stop participating in this study at any time. Your decision not to take part in this study or to stop your participation will not affect your medical care or any benefits to which you are entitled. If you decide to stop taking part in this study, you should tell the Investigator.

Your doctor, the Investigator may stop your participation in the study at any time if they decide that it is in your best interest. They may also do this if you do not follow instructions. If you have other medical problems or side effects, the doctor and/or nurse will decide if you may continue in the research study.

15. Compensation for Injury

By signing this consent form, you will not waive any of your legal rights or release the parties involved in this study from liability for negligence.

16. Confidentiality of Study Records and Medical Records

Information collected for this study is confidential. However, Uganda National Council for Science and Technology (UNCST) may review copies of the study records. Members of the Lacor Hospital Institutional Research Committee (LHIREC) may also review parts of your medical records related

to this study. Data collected and entered into the Case Report
Forms are the property of Kyambogo University. In the event of any publication regarding this study, your identity will not be disclosed.

17. Names of Contacts for Questions about the Study

If you have any questions about taking part in this study or if you think you may have been injured because of the study, call Mebaze Nicholas at _0772924070. If you have any questions about your rights as a research subject, you can call the Chair of the Lacor Hospital Institutional Research and Ethics
Committee (LHIREC) at +256 783 449 244

VOLUNTEER'S STATEMENT

I have been given a chance to ask questions about this research study. These questions have been answered to my satisfaction. I have been informed that if later I have any questions about taking part in this study or research-related injury, I may contact Mwebaze Nicholas _ <*Principal Investigator*> at _+256 772 924 070

I understand that my participation in this research project is voluntary. I know that I may quit the study at any time without harming my future medical care or losing any benefits to which I might be otherwise entitled. I also understand that the Investigator in charge of this study may decide at any time that I should no longer participate in this study.

If I have any questions about my rights as a research subject in this study, I may contact the chairperson of the: St. Mary’s Hospital Lacor Institutional Research Committee, Dr. Ogwang David Martin, Email: ogwang.martin@lacorhospital.org Telephone number: +256-471-432310/+256794-593901 P.O. Box 180, Gulu, Uganda. Or Administrator LHIREC Mr. Odongkara Moses on 0783449244 Email. mozodongkara@gmail.com

By signing this consent form, I have not waived any of my legal rights or released the parties involved in this study from liability for negligence.

I have read and understand the above information. I agree to participate in this study. I have informed that I will be given a signed copy of this form for my own records.

_________________	__________________	__/__/____
Name of participant	Signature of participant	Date
_________________________	__________________	__/__/____
Name of person obtaining consent	Signature of person obtaining consent	Date
__________________________	_______________________	___/___/______
Witness	Signature	Date

Appendix XII: Informed Consent Kiswahili Version

MAAFIKIANO

CHUO KIKUU CHA KYAMBOGO

MAAFIKIANO YA KUSHIRIKI KATIKA UTAFITI WENYE MADA: **Athari za mazoezi ya Kimwili kwa Matibabu ya Waathiriwa wa Virusi vya UKIMWI nchini Uganda ikiwakilishwa na Hospitali kuu ya kijeshi ya Bombo.**

1. **Utangulizi**

Unaombwa kushiriki katika utafiti. Utafiti huu utafanyika katika Hospitali kuu ya kijeshi ya Bombo. Mtafiti mkuu wa utafiti huu ni Mwebaze Nicholus.

Mfadhili wa utafiti huu ni mwanafunzi.

2. **Lengo la utafiti**

Lengo la utafiti huu ni kutambua athari za mazoezi ya kimwili kwa waathiriwa wa virusi vya Ukimwi ambao wanatumia dawa zavirusi vya Ukimwi nchini Uganda ikiwakilishwa na Hospitali kuu ya kijeshi ya Bombo.

3. **Muda wa kushiriki**

Kushiriki kwako kutadumu kipindi kisichozidi wiki kumi na nne. Utashiriki katika vipindi vya mazoezi ya kimwili kwa muda wa kama wiki kumi na mbili afadhali siku tano katika kila wiki na utafuatiliwa baada ya kila kipindi cha mazoezi. Itakubidi kuitembelea afisi ya daktari wakati wowote iwapo utahisi mabadiliko yoyote mwilini mwako.

4. **Eneo la utafiti na idadi ya washiriki**

Utafiti huu utafanyika katika Hospitali kuu ya kijeshi ya Bombo na takribani watu wapatao tisini na nane wanatarajiwa kushiriki.

5. **Utaratibu wa utafiti**

Kabla ushiriki katika utafiti huu, wapaswa kupata maelezo tosha kisha yakulazimu pia upewe nafasi ya kuuliza maswali. Inakulazimu usome na kusaini karatasi ya Maafikiano. Utapewa nakala ya karatasi ya maafikiano uliyosaini uihifadhi nyumbani kwako.

6. **Matokeo ya baada ya kushiriki**

Mwishoni mwa kushiriki kwako , hutaruhusiwa tena kumuona mwalimu wa mazoezi ila kwa mipango maalumu naye.

7. **Utaratibu usioafiki hali ya maisha yako au yasiojaribishwa**

Mazoezi yatakayofanywa tu ni ya kiutafiti isipokuwa yale ambayo yatashauriwa.

8. **Madhara au athari ziwezazo kutokea ukishiriki**.

Ukishiriki utafiti huu unaweza kupata;

Madhara hasi kama vile;

Kuvimba kwa misuli mwanzoni mwa mazoezi

Majereha kwenye mwili

Kuzidi kwa hamu yako ya mlo

9. Habari nyeti kwa Wanawake

Madhara kuhusu ukuaji wa mtoto haujathibitika kitaluuma. Kwa hiyo, wanawake waja wazito na wanaowanyonyesha watoto waweza kutoshiriki katika utafiti huu. Wanawake wenye uwezo wa kushika mimba inawalazimu kupata jaribio la kutokua na mimba waingiapo katika utafiti na pia watumie mbinu zakujikinga mimba wakati wa utafiti, mbinu zinazokubaliwa ni pamoja na kumeza vijidonge, Depo-Provera, Diaphragm, intrauterine Device(IUD), Cervical cap, na mipira ya Kondomu ya sifongo au povu. Ikiwa umeshika mimba wakati huu, unalazimika kuacha dawa ya utafiti au umuite haraka daktari.

10. Ada ya kushiriki

Kushriki ni kwa bure

11. Malipo kama kiunua mgongo cha utafiti

Hakuna malipo yoyote ya kifedha kwa mshriki yeyote. Watakaoshiriki kwa asilimia 100 ya vipindi vyote watatunikiwa vyeti vya shukurani.

12. Manufaa ya kushriki kwako katika utafiti

Hakuna manufaa ya moja kwa moja ukishiriki katika utafiti ila kushiriki kwako kutakuongezea maarifa kuhusu mazoezi ya kimwili na kuinua kiwango chako cha afya nzuri.

13. Matibabu mengine yaliyoko

Hakuna matibabu mengine yatakayokupewa isipokuwa ushauri-tiba wa kila mara.

14. Kuhusu kushiriki katika utafiti

Kushriki kwako katika utafiti ni kwa kujitakia. Waweza kuacha kushiriki katika utafiti huu wakati wowote. Hiari yako ya kushiriki au kuacha haitaathiri huduma zako za kiafya au manufaa yoyote unayostahili kupata. Ikiwa umeamua kuacha kushiriki utafiti huu, unapaswa kumjulisha mtafiti. Daktari yako; Mtafiti yaweza kukomesha kushriki kwako katika utafiti huu wakati wowote ikiwa wameamua kuwa ni maslahi yako. Wanaweza kufanya hili pia ikiwa hufuati maagizo. Ikiwa una matatizo mengine ya kiafya au athari hasi, daktari na/au nesi ataamua ikiwa waweza kuendelea katika utafiti.

15. Fidia kwa kujeruhiwa

Unaposaini karatasi ya maafikiano huwa hujajipunguzia haki zako kisheria au kuachilia washriki wa utafiti kutotuhumiwa kwa kutojali/ulegevu.

16. **Siri za kumbukumbu za utafiti na rikodi za matatibu**.

Habari itakayokusanywa kuhusu utafiti huu ni ya siri. Hata hivyo, Taasisi ya kitaifa ya Sayansi na Teknolojia(UNCST) inaweza kupitia pitia nakala za kumbukumbu za utafiti huu. Wanachama wa kamati ya Chuo Cha Utafiti katika Hospitali ya Lacor (LHIREC) wanaweza pia kupitia pitia sehemu za rikodi za matibabu yako kuhusu utafiti huu. Data itakusanywa na kuingizwa katika ripoti mahususi.

Makala ya ripoti yote ni mali ya Chuo Kikuu cha Kyambogo. Iwapo kuna kuchapishwa kwa aina yoyote kuhusu utafiti huu, Wewe hutatambulika.

17. Majina ya wanaohusika kwa maswali kuhusu utafiti huu.

Ikiwa una maswali yoyote kuhusu utafiti huu au ikiwa unafikiri kuwa huenda ulidhurika kutokana na utafiti huu, mpigie simu Mwebaze Nicholus kwa : 077294070. Ikiwa una maswali kuhusu haki zako kama mtafitiwa lengwa, mpigie Mwenyekiti wa Kamati ya Kitivo cha Utafiti na Nidhamu wa Hospitali ya Lacor(LHIREC) kwa +256783449244.

KAULI YA MSHIRKI

Nimepewa nafasi ya kuuliza maswali kuhusu utafiti huu. Mwaswali haya yamejibiwa na kuniridhisha. Nimejulishwa kuwa iwapo baadaye nina maswali mengine kuhusu kushiriki katika utafiti huu au yanayohusu kudhurika, naweza kupata Mwebaze Nicholus-<Mtafiti Mkuu> kwa +256772409270.s

Nafahamu vyema kuwa kushiriki kwangu katika mradi huu wa utafiti ni kwa kujitakia bure. Najua kwamba ninaweza kujiondoa wakati wowote bila kudhuru huduma za tiba yangu wakati ujao au kupoteza manufaa yangu ambayo huenda ni haki yangu. Pia nafahamu vyema kwamba mtafiti anayehusika na utafiti huu yaweza kuamua wakati wowote nisishiriki tena katika utafiti huu. Ikiwa nina maswali yoyote kuhusu haki zangu kama mtafitiwa lengwa katika utafiti huu naweza kumpata Mwenyekiti wa Kamati; St. Mary's Lacor insititutional Research Committee Dkt. Ogwang David Martin kwa Barua pepe: ogwang.martin@lacorhospital.org kwa simu +256471-432310/+256794-593901, S.l.p 180, Gulu, Uganda au Bw. Odongkara Moses kwa 0783449244, barua pepe: mozodongkara@gmail.com

Kwa kusaini karatasi ya maafikiano, sijajiondolea haki zangu zozote au kuachia wahusika wa utafiti huu kutotuhumiwa kwa ulegevu/kutojali.

Nimesoma na kufahamu habari yote. Ninakubali kushiriki katika utafiti huu. Nimefahamishwa kwamba nitapewa nakala ya karatasi ya maafikiano niliyosaini kwa hifadhi yangu nyumabni.

1. Jina la Mshiriki   Saini ya Mshirki   Tarehe.
2. Jina la anayepokea saini ya aliyesaini maafikiano   Tarehe
3. Shahidi   Saini   Tarehe

Appendix XIII: Kyambogo University Letter of Introduction

KYAMBOGO UNIVERSITY

P. O. BOX 1 KYAMBOGO

Tel: 041 - 4286792 Fax: 256-41-220464

Website: www.kyu.ac.ug

Office of the Dean, Graduate School

1st February, 2021

To Whom It May Concern

RE: LETTER OF INTRODUCTION

Dear Sir/Madam,

This is to introduce **Mr Mwebaze Nicholas** Registration Number **18/U/GDSS/19468/PD** who is a student of Kyambogo University pursuing a PhD.

He intends to carry out research on **"Implications of Aerobic Exercise on Clinical Outcomes of HIV Positive Clients in Uganda": A case of General Military Hospital - Bombo** as partial fulfillment of the requirements for the award of PhD in Sports Science of Kyambogo University.

We therefore kindly request you to grant him permission to carry out this study in your institution.

Any assistance accorded to him will be highly appreciated.

Yours sincerely,

KYAMBOGO UNIVERSITY OFFICE OF THE DEAN GRADUATE SCHOOL

Assoc. Prof. Muhamud N. Wambede

DEAN, GRADUATE SCHOOL

Appendix XIV: Research and Ethical Committee Clearance

ST. MARY'S HOSPITAL LACOR

P.O. Box 180,GULU - UGANDA
Tel: +256 - 471- 432310, Fax: +256 - 471-432665
Email: info@lacorhospital.org Website: www.lacorhospital.org

11th February 2021

To **Mwebaze Nicholas**
Kyambogo University
Contact: 0772924070
Email: nicmwebazeru@yahoo.com

LHIREC NO: 0183/07/2020 STUDY TITLE: **Implications of Aerobic Exercise on Clinical Outcomes of HIV Positive Clients in Uganda; A Case of General Military Hospital-Bombo**

Type: [√] **Initial Review**
[ ] Protocol Amendment
[ ] Letter of Amendment (LOA)
[ ] Continuing Review
[ ] Material Transfer Agreement
[ ] Other, Specify: _______________

I am pleased to inform you that at the LHIREC has approve the above referenced application. Approval of the research is for the period of **10th February 2021** to **11th February 2022**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to LHIREC for re-review and approval **prior** to the activation of the changes. The REC application number assigned to the research should be cited in any correspondence.
3. Reports of unanticipated problems involving risks to participants or other must be submitted to the LHIREC. New information that becomes available which could change the risk: benefit ratio must be submitted promptly for LHIREC review.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by subjects and/or witnesses should be retained on file. The LHIREC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Regulations require review of an approved study not less than once per 12-month period. **Therefore, a continuing review application must be submitted to the LHIREC eight weeks prior to the above expiration date of 11th February 2022 in order to continue**

1 | Page

Abilongo 11/2/2021

the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study, at which point new participants may not be enrolled and currently enrolled participants must be taken off the study.

6. You are **required** to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by LHIREC.

No	Document Title	Language	Version	Version date
1.	Proposal	English	2.0	February 2021
2.	Consent	English/Swahili	1.0	February 2021
3.	Questionnaire	English	1.0	February 2021
4.	Psychosocial assessment tool	English	1.0	February 2021
5.	The Borg RPE Scale for Rating Perceived Exertion	English	1.0	February 2021
6.	Cd4 Cell Results	English	1.0	February 2021
7.	Duke activity status index	English	1.0	February 2021

Thanks

ST. MARY'S HOSPITAL LACOR
P. O. Box 180, Gulu - Uganda
LACOR
Odongo 16/2/2021
Date:
Institutional Research and Ethics Committee

Prof. Odongo Emmanuel I. Aginya
Vice Chairman LHIREC

Appendix XV: Research and Ethical Committee Clearance Extension

ST. MARY'S HOSPITAL LACOR

P.O. Box 180,GULU - UGANDA
Tel: +256 - 471- 432310, Fax: +256 - 471-432665
Email: info@lacorhospital.org Website: www.lacorhospital.org

24th February 2022

To **Mwebaze Nicholas**
Kyambogo University
Contact: 0772924070
Email: nicmwebazeru@yahoo.com

LHIREC NO: 0183/07/2020 STUDY TITLE: **Implications of Aerobic Exercise on Clinical Outcomes of HIV Positive Clients in Uganda; A Case of General Military Hospital-Bombo**

Type: [√] Initial Review
[ ] Protocol Amendment
[ ] Letter of Amendment (LOA)
[√] Continuing Review
[ ] Material Transfer Agreement
[ ] Other, Specify: ______________

This is to inform you that the Lacor Hospital Institutional Research Committee (LHIREC) has reviewed *renewal LHIREC*: **0183/07/2020**, for the above captioned study and approved it.

The approval period for the study ends on **23rd February 2023**. Any additional modifications in the research protocol, study site/ personnel, or consent form during this time period must first be reviewed and approved by the LHIREC.

Yours

PP.

Dr. Martin David Ogwang
LHIREC Chairperson

ST. MARY'S HOSPITAL LACOR
P. O. Box 180 Gulu - Uganda
LACOR
Date: 24/02/22
Institutional Research and Ethics Committee

Logistic Office Kampala: Tel. +256 - 414 - 223014, Fax: +256 - 414 - 223013

Appendix XVI: Administrative Clearance

UPDF/MED/A2

WOI NICHOLAS MWEBAZE

20 Oct 21

AUTHORITY TO CONDUCT RESEARCH

Ref:
A. UPDF/JCOS/A2 Dated 04 Oct 21

1. Pursuant to ref A above, be informed that authority has been granted for conducting of your research titled **"IMPLICATIONS OF AEROBIC EXERCISE ON CLINICAL OUTCOMES ON HIV POSITIVE CLIENTS IN UGANDA: A CASE OF GMH-BOMBO"**

2. You are therefore informed to go ahead with the research process.

3. Forwarded for action.

PATRICK OCEN *psc*(U)
Brig
Chairman REC-CMS

Copy;
CMS
D/GMH
D/HIV

/GANDA PEOPLES' DEFENCE FORCES

OFFICE OF JOINT CHIEF OF STAFF
MINISTRY OF DEFENCE HQS-MBUYA HILL
P.O. BOX 3798 KAMPALA
OFFICE TEL: +256 414 - 565146/144
FAX: +256 414 - 223056
EMAIL: jcos@updf.go.ug

Our Ref: UPDF/JCOS/A2

Your Ref:

The **CMS**
LF HQs
BOMBO

04 Oct 21

RECOMMENDATION FOR WOI NICHOLAS MWEBAZE TO CONDUCT RESEARCH IN GMH

II Director Mental Health
This is to forward this dev't to you so that you may comm to the CVCD.
19/10/21

References:

A. Ltr UPDF/MED/A2 dated 28Sep 21.
B. Ltr UPDF/MED/A2 dated 27 Sept 21.
C. Minutes of the Committee dated 17 May 21.

1. Refs A – C sought for clearance for aforementioned Warrant Officer who is pursuing a Health implicated PhD program at Kyambogo University to conduct research in GMH.

2. Authority is granted for the Warrant Officer to conduct research at GMH.

3. Forwarded.

LEOPOLD E KYANDA *'psc'(K),'ndc'(I),M.Phil*
Maj Gen
JCOS

JOINT CHIEF OF STAFF
UGANDA PEOPLES' DEFENCE FORCES

I D/Comdt
Let this WOI go ahead, authority has been granted
18/10/21

SEEN STAMP - GENERAL MIL HOSP.		
		DATE
Director		
Admin Office		
Chief Clerk		19/10/21
Filing Clerk	WG	19/10/21

RESTRICTED

www.updf.go.ug

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Appendix XVII: National Council of Science Technology Clearance

Uganda National Council for Science and Technology

(Established by Act of Parliament of the Republic of Uganda)

Our Ref: HS1276ES **15 December 2021**

Mwebaze Nicholas
No organization Supporting me please
Kampala

Re: Research Approval: **IMPLICATIONS OF AEROBIC EXERCISE ON CLINICAL OUTCOMES OF HIV POSITIVE CLIENTS IN UGANDA; A CASE OF GENERAL MILITARY HOSPITAL-BOMBO**

I am pleased to inform you that on **15/12/2021**, the Uganda National Council for Science and Technology (UNCST) approved the above referenced research project. The Approval of the research project is for the period of **15/12/2021** to **15/12/2022**.

Your research registration number with the UNCST is **HS1276ES**. Please, cite this number in all your future correspondences with UNCST in respect of the above research project. As the Principal Investigator of the research project, you are responsible for fulfilling the following requirements of approval:

1. Keeping all co-investigators informed of the status of the research.
2. Submitting all changes, amendments, and addenda to the research protocol or the consent form (where applicable) to the designated Research Ethics Committee (REC) or Lead Agency for re-review and approval **prior** to the activation of the changes. UNCST must be notified of the approved changes within five working days.
3. For clinical trials, all serious adverse events must be reported promptly to the designated local REC for review with copies to the National Drug Authority and a notification to the UNCST.
4. Unanticipated problems involving risks to research participants or other must be reported promptly to the UNCST. New information that becomes available which could change the risk/benefit ratio must be submitted promptly for UNCST notification after review by the REC.
5. Only approved study procedures are to be implemented. The UNCST may conduct impromptu audits of all study records.
6. An annual progress report and approval letter of continuation from the REC must be submitted electronically to UNCST. Failure to do so may result in termination of the research project.

Please note that this approval includes all study related tools submitted as part of the application as shown below:

No.	Document Title	Language	Version Number	Version Date
	Project Proposal	English	RESEARCH PROPOSAL	
1	Approval Letter	English		
2	Administrative Clearance	English		
2				
3	Risk Mitigation			13 December 2021

Yours sincerely,

Hellen Opolot
For: Executive Secretary
UGANDA NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

LOCATION/CORRESPONDENCE

Plot 6 Kimera Road, Ntinda
P.O. Box 6884
KAMPALA, UGANDA

COMMUNICATION

TEL: (256) 414 705500
FAX: (256) 414-234579
EMAIL: info@uncst.go.ug
WEBSITE: http://www.uncst.go.ug

Appendix XVIII: Study Risk Mitigation Plan Nov 2021 to Jan 2022

IMPLICATIONS OF AEROBIC EXERCISE ON CLINICAL OUTCOMES OF HIV POSITIVE CLIENTS IN UGANDA; A CASE OF GENERAL MILITARY HOSPITAL-BOMBO

Access to Covid-19 specific knowledge: All research assistants and trainers will be trained on the needed knowledge of Covid-19, they will be made aware of how to respond if they, or someone in their surroundings, has signs and symptoms Covid-19. All assistants and trainers, will be informed clearly that 'if feeling sick or present with symptoms of Covid-19' they will be required to self-isolate and report symptoms and any contact with other field research assistants and trainers or participants in the last 7 days to the line manager.

Implementation of infection control measures: Infection prevention and control campaigns will be implemented like: hand washing, respiratory etiquette, hygiene practices.

Avoid physical contact: Minimize any physical contact with other people. These include, no greetings such as handshakes, no kissing, hugs, sharing of pens and phones will also be minimized. Ensure items are not shared among team members by providing pens for each individual research assistants and trainers' member, provide zip-locked bags to place enumerator phones/devices.

Disinfecting all equipment; all equipment will be disinfected every after use

Use of sanitizers: Sanitize all data collection items prior to each activity (pens, phone, tablets, notebooks, ID cards, microphones, mats etc.).

Short questionnaires; Try to ensure questionnaires are no longer than 15 minutes in order to avoid prolonged contact with participants which would increase likelihood of potential infection transmission. As much as possible, use research assistants and trainers that are familiar with mobile data collection to avoid having to be in close proximity to them while training on the tool (research

assistants and trainers with more experience will require less support from facilitators meaning, less close interactions are required).

Ensure social distance; Maintain the recommended distance (at least one metre) when approaching participants, and two meters during exercise sessions.

Avoid physical contact; (handshaking, hugging, etc.) to all trainers and participants.

Measures to be taken after data collection; ensure all research assistants thoroughly wash their hands with sanitizer (at least for 20 seconds).

Appendix XIX: Five A's Bardonian Model

The five A's involves the following:

Assess: assessed the participants' beliefs behaviour and knowledge of exercise and given information where it was needed.

Advise: advised on specific information about aerobic exercise focussing on frequency, intensity, time and type (FITT factors)

Agree: agreed collaboratively set goals based on the participants' interest and confidence in their ability to change behaviour we agreed on the timings for each individual to schedule their suitable time however all were to be trained in the afternoon

Assist: assisted to identify personal barriers strategies, problem solving techniques and social environmental support needed during the time of training.

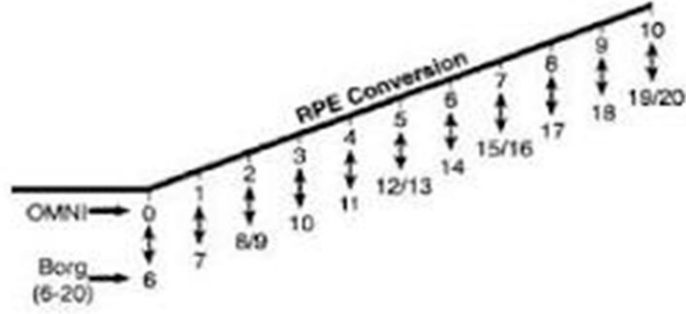
Arrange: arrangements were made with specific plans to follow and grouped the experimental participants those with similar preferences together mainly the days selected.

This helped the study to come up with personal action plans for the participants this may have contributed to ensuring adherence to exercise. The study listed specific goals in behavioural terms listed barriers and came up with strategies to address barriers. Follow-up specific plans were made including formation of whatsApp groups for each exercise day. Shared plans with the practice teams and all the research assistants.

Appendix XX: Rate of Perceived Exertion (RPE) Guidelines

The seven-point Borg RPE Scale ranges from "very, very light; very light; fairly light, somewhat hard; hard; very hard; to very, very hard"; while the Holz RPE scale is classified into 1, 2-3, 4-6, 7-8, 9, and 10 on a scale of 1-10. The details of the Holz RPE scale are that, level 1 is the lowest and it is labelled as 'very light activity' and this is where the subject report there being hardly any exertion, but more than sleeping, watching TV and the like. Level 2-3 is labelled, 'light activity' and this is where the subject feels like he can maintain for hours with easy to breathe and be able to carry on a conversation. Level 4-6 is the 'moderate activity' level where there is heavy breathing and subject can only handle a short conversation although still somewhat comfortable, but becoming noticeably more challenging. Level 7-8 is the 'vigorous activity' level and is about being on the 'borderline uncomfortable' and having short of breath but can speak a sentence. Level 9 is termed the 'very hard activity' level. Here it is very difficult for the subject to maintain exercise intensity and can barely breathe and speak only a few words. Finally, level 10 is termed as the 'maximum effort activity'. The subject feels almost impossible to keep going. At the stage, the subject is completely out of breath, unable to talk.

In merging the two, the following scale is derived at*: very, very light = 0; very light = 1; fairly light = 2-3, somewhat hard = 4-6; hard = 7-8; very hard = 9; and very, very hard = 10*. This is important so that more meaning could be given to help differentiate for instance, between say 'somewhat hard' and 'very hard'.



The results of RPE were converted into Heart rate according to the above scale.