AEROBIC-TRAINING EFFECTS ON HEALTH CHARACTERISTICS OF HIV-POSITIVE ADULTS UNDER BONEPWA, GABORONE.

MASTERS IN SPORTS SCIENCE

BY

THABO MUSWERE

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A MASTERS DISSERTATION SUBMITTED TO THE DEPARTMENT OF SPORTS SCIENCE IN PARTIAL FULFILLMENT OF THE MASTER'S DEGREE IN SPORTS SCIENCE.

SUPERVISED BY PROF I.U ONYEWADUME

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CERTIFICATION

I Ms Thabo Muswere carried out this dissertation entitled “Aerobic-training effects on health characteristics of HIV-positive adults under BONEPWA, Gaborone”, in partial fulfillment of the Master’s Degree in Sports Science**.**

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Ms Thabo Muswere

I certify that this work was carried out by Ms Thabo Muswere in the Department of Sports Science University of Botswana.

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Prof I.U Onyewadume

DEDICATION

This study is dedicated to my mother who raised me, stood by me all the time and motivated me throughout my studies, Ms Difedile Mmamphotshane Muswere Siako. I appreciate the support I got from my siblings, especially Thato Tsitsi Muswere and Rumbidzai Kgalalelo Muswere. I will always appreciate those people who encouraged me throughout my project and had time to proof read my work. I am grateful to all the people who volunteered to take part in this study. I also dedicate this dissertation to my daughter Thabo Neem Muswere. Just thinking of her was motivation enough to complete my studies.

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ACRONYMS

ACHAP: African Comprehensive HIV/AIDS Partnership.

AIDS: Acquired Immune Deficiency Syndrome.

BONEPWA: Botswana Network of People Living with HIV/AIDS.

BIA: Bioelectrical Impedance Analyzer.

BRP: Borgs Rating of Perceived Exertion scale.

HAART: Highly Active Antiretroviral Therapy.

HDL: High density lipoprotein.

HIV: Human Immunodeficiency Virus.

IDCC: Infectious Disease Care Clinic.

LDL: Low density lipoprotein.

NACA: National AIDS Coordinating Agency.

NCDs: Non Communicable diseases.

PAR-Q: Physical Activity Readiness Questionnaire.

SF-12 Health Survey: Short-Form (SF-12) Health Survey.

TC: Total cholesterol.

TG: Triglycerides.

UNAIDS: United Nations Program on HIV/AIDS.

UNDP: United Nations Development Program.

USPEPFAR: United State President's Emergency Plan for AIDS Relief.

WHO: World Health Organisation.

ABSTRACT

The purpose of the study was to compare the pre and post 12 weeks of aerobic training effects on lipid profile, CD4 count, body composition and aerobic capacity of adult HIV-positive individuals on highly active antiretroviral therapy (HAART) under Botswana Network of People Living with HIV/AIDS (BONEPWA). All participants were subjected to 12 weeks of moderate intensity aerobic training, three times a week for 60 minutes per session at the University of Botswana gymnasium. The quasi-experimental multimethod design was used. After individuals from BONEPWA volunteered for the study, purposive sampling through inclusion and exclusion criteria was used to select participants into the study. There were 28 participants who met the inclusion criteria (23 females and 5 males). After 6 weeks one female dropped out of the study. They were of age 18 to 45 years. The significant differences between variables (CD4 count, lipid profile, body composition and VO_2 max) at baseline and 12^{th} week in the participants were compared using the paired student t-test. The significant differences between health related quality of life (HRQoL) variables (Physical- Health Composite Scores (PCS) and Mental-Health Composite Score (MCS) measures) at baseline, after 8 weeks and post 12 weeks in the participants were compared using the repeated ANOVA and using the paired *t*-test for baseline and week 12. All analysis was done using statistical package for the social sciences (SPSS) version 24.0 software. The alpha value was set at $p<0.05$ level of significance. Statistically significant ($p< 0.05$) improvements were found in body mass index, visceral fat, VO_2 max and MCS measures after intervention when using paired *t* test. There were no statistically significant ($p>0.05$) improvements in, body fat percentage (BF%), body muscle percentage (BM%), CD4 count, total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL), triglycerides (T) and PCS measures after intervention.

A repeated measure ANOVA using the Sphericity Assumed determined mean value of MCS was not statistically significant between assessment stages (pre-test, week 8 and post-test) (F (1.33, 33.64) =2.67, p = .079). Post hoc test using the Bonferroni correction revealed a slight increase in the value of MCS at all assessment stages (78.88 ± 14.33, 83.22 ± 13.81, and 85.03 ± 10.53). A repeated measure ANOVA with the Huynh- Feldt correction determined the mean value of PCS was not statistically significant between assessment stages (pre-test, week 8 and post-test) (F (2, 52) =1.81, *P* =.18). *Post hoc* test using the Bonferroni correction revealed a slight increase in the value of PCS at all assessment stages (77.33 ± 14.02, 80.78 ± 15.03 and 83.19 ± 12.35). HIV positive individuals can be advised to engage in regular aerobic training 3 times a week for 60 minutes for significant improvements in VO_2 max and BMI especially when on HAART. Overall the research is relatively preliminary therefore there could be replication of the study by other researchers.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

There are many infections that pose challenges to the health and fitness of people. Human immunodeficiency virus (HIV) infection is one of the public health problems in many countries including Botswana which is one of the hardest hit countries in the world (United States Presidential Emergency Plan for AIDS Relief [USPEPFAR], 2020). Even in the past United Nations Program on HIV/AIDS [UNAIDS] (2014) showed that Botswana had the third highest HIV prevalence in the world, after Lesotho and Swaziland. In 2017 Botswana had a projected 378 184 people living with HIV and 13 797 new infections (USPEPFAR, 2018). When comparing the year 2017 and 2018 there was an increase in AIDS related deaths from 4 062 to 4 923 in Botswana (USPEPFAR, 2019). The infection is largely concentrated in Greater Gaborone and Greater Francistown and highest among older population aged 25 years and above (USPEPFAR, 2019 & 2020). Often, adult HIV-positive patients experience muscle pain, loss of lean body mass and fatigue which lead to reduced aerobic capacity, limiting their work participation and activities of daily living (Chisati & Vasseljen, 2015). Some individuals end up living a sedentary lifestyle that affects other aspects of their health. With the highly active antiretroviral therapy (HAART) given to all HIV positive individuals in Botswana (UNAIDS, 2019), an additional investigation on the benefits of aerobic exercise to HIV positive adults could be explored.

Aerobic capacity is the maximum rate of oxygen consumption as measured during incremental exercise and is called VO_2 max (Bute, Shete & Khan, 2014). Maximum Oxygen Uptake is known to reflect an individual's physical fitness. It is also the best indicator of cardio-

respiratory endurance (Bute et al., 2014). HIV-positive individuals with a higher functional capacity are less prone to long-term disability, institutionalization, and are more likely to have better quality of life (Ortiz, 2014).Various aerobic exercises, when done properly, can reduce depression, improve lean body mass and reduce fat. Exercise can improve strength, endurance and cardiovascular health (Mocumbi, 2015). Exercise has an effect on the CD4 count and viral load of HIV-positive adults (Ezema et al., 2014). The present study is initiated to assess aerobic training effects on lipid profile, CD4 count, body composition, aerobic capacity and health-related quality of life (HRQoL) of HIV positive adults who are on HAART and under Botswana Network of People Living with HIV/AIDS (BONEPWA).

The effects of aerobic training in HIV-positive adults in various health characteristics are still not well described in the scientific literature (Gomes-Neto, Conceicao, Carvalho & Brites, 2015). Aerobic training is vital as it improves aerobic capacity which indicates work capacity of everyday living. Useh (2013) reviewed studies on HIV/AIDS and its physiotherapy on sub-Saharan African countries and found out that in out-patients physiotherapy, exercise prescription in cardiopulmonary therapy was seldom utilized in the care of people with HIV. The emphasis of care was found to be more on routine chest physiotherapy which included occasional suctioning, counseling and health education. According to Remme et al. (2016), cardiovascular risk is usually overlooked among HIV infected individuals in Sub-Saharan Africa.

In developed countries, there has been lots of emphasis on aerobic training ever since the inception of highly active antiretroviral therapy with an increase in the survival and improvement in the quality of life of HIV-positive individuals (Lopez et al., 2015; Mocumbi, 2015). Additional common diseases in HIV infected individuals, such as cardiovascular and side effects related to HAART like lipodystrophy, and other opportunistic infections have become a new focus of attention (Yen et al., 2019). For this reason, physical activity has been recommended to

HIV-positive individuals to induce favorable metabolic changes and reduce the risk of cardiovascular disease (Anandh, Dsa, & Alagesan, 2014).

Exercise for HIV infected individuals, either aerobic exercise or a combination of aerobic and resistance progressive exercises may be beneficial to HIV-positive adults (Ortiz, 2014).Various exercise regimens could be helpful in terms of psychological status, quality of life, anthropometric, metabolic, cardiopulmonary and immune functions. Physiotherapy for adult HIV-positive individuals should be based on evidence including medical, physical and psychosocial benefits (Useh, 2013). Therefore, exercise prescription for all HIV-infected individuals'should be made on an individual basis due to individual differences with appropriate initial screening, and should emphasize both cardio-respiratory and musculoskeletal training components to help improve people's quality of life (Anandh et al., 2014).

Maintaining the physical and functional fitness of HIV-positive individuals has become one of the most important therapeutic targets (Mocumbi, 2015; Ortiz, 2014). Improvements in this area could help the immune system as well. Lopez et al. (2015) suggest that aerobic exercise may produce beneficial physiological changes in HIV-infected population such as improved body composition, increases in both strength and endurance. Physical activity has long been established as a supplemental therapy for treating chronic illnesses. Aerobic training programs may help alleviate the unfavorable metabolic complications associated with HIV and HAART by altering body composition and body fat distribution as well as normalizing lipid profiles (Anandh et al., 2014; Mocumbi, 2015).

Aerobic training contributes to improvements in physiological and functional parameters. Here, the gains are specific to the type of training performed. For example, in a systematic review of the effects of different types of therapeutic exercises on physiological and functional measurements in patients with HIV/ AIDS by Gomes-Neto et al. (2015)**,** resistance exercise

training improved outcomes related to body composition and muscle strength, but with little impact to quality of life, while aerobic exercise training improved body composition and aerobic capacity. In another study combined aerobic and resistance exercise training reduced trunk adiposity in HIV-infected patients receiving highly active antiretroviral therapy (Gomes-Neto, Conceicao, Ogalha, & Brites, 2016).

In a review by Leach, Bassett, Smithdorf, Andrews and Travill (2015) aerobic exercise was found to contribute to improved body composition and when applied safely, appeared to be beneficial for adults living with HIV/AIDS. Therefore, the current use of HAART has provided an increment in life expectancy of adults HIV patients (Gomes- Neto et al., 2016). Nowadays, HIV-positive individuals can be enrolled in HAART and be encouraged to use non-pharmacological approaches such as physical exercises which maintain functionality and quality of life for several years (Anandh et al. 2014).

Brugnaro et al. (2015) state that, some individuals infected with HIV experience numerous comorbidities caused by the disease progression and medications, inability to perform physical activity, malnutrition, or a combination of these. Exercise has been shown to help greatly in reducing metabolic syndromes in HIV infected people; hence, it should be prescribed together with medication (Yar'zever, Abubarkar, Toriola & Igbokwe, 2013). The current research, therefore, intends to assess aerobic training effects on lipid profile, CD4 count, body composition, aerobic capacity and HRQoL of adult HIV-positive individuals who are on HAART and under BONEPWA.

1.2 Statement of the problem

In the late 1980's many people in Botswana died due to HIV (Kandala, Campbell, Madi-Segwagwe & Fako, 2012). Later on intervention against HIV intensified especially through medication; since HIV was so quick to advance to acquired immune deficiency syndrome

(AIDS). However, recently HAART has been used in stabilizing the virus. The therapy cannot rid HIV but because of its success it has changed what was once a fatal diagnosis into a chronic manageable disease (Stanely et al., 2017). Now, patient management focus is to individualize therapy to avoid long-term side effects (Lopez et al., 2015). With aerobic training in the general population known to be beneficial, it is expected that adult HIV-positive individuals can reap some of the benefits of aerobic training too (Mangona et al., 2015). Therefore, studies investigating the efficiency and effectiveness of different exercise training regimen for HIV positive individuals are needed (Lopez et al., 2015). Botswana faces the double burden of urbanization linked to rapid adoption of unhealthy lifestyles, as well as increased non-communicable diseases (NCDs) risk introduced for those living with HIV infection (Ministry of Health of the Republic of Botswana, 2018). The present study therefore, intends to identify the effects of aerobic training on lipid profile, CD4 count, body composition, aerobic capacity and HRQoL of adult HIV-positive individuals on HAART.

HAART has improved the quality of life and life expectancy of HIV positive individuals (Gomes-Neto et al., 2016). Though helpful, HAART has a number of side effects depending on individual body type, level of infection, nutrition and health condition (Ortiz, 2014). The use of HAART affects the physical function (Gomes-Neto et al., 2016), quality of life of HIV-positive individuals including metabolic, somatic and psychological disorders (Lopez et al., 2015; Mangona et al., 2015). The changes have been associated with decrease in exercise capacity and HIV positive individuals' daily activities (Gomes-Neto et al., 2016). Their life expectancy has been increased. Some of the comorbidities and chronic illnesses are due to aging. They are unrelated to HIV or HAART (German Advisory Committee Blood (Arbeitskreis Blut), Subgroup 'Assessment of Pathogens Transmissible by Blood', 2016; Munawwar & Singh, 2016).

However, while accessibility to HIV treatment in Sub-Sahara Africa is improving, the NCDs are now the leading cause of death globaly and also reflected in Botswana (Ministry of Health of the Republic of Botswana, 2018). As HAART becomes more accessible in Sub-Saharan Africa, metabolic syndromes, body fat metabolism and cardiovascular diseases may increase (Mocumbi, 2015). The HIV therapy also contributes to some metabolic disorders (Nansseu & Bigna, 2017). The physiological changes of adult HIV-positive individuals and their interaction with HAART represent a new need for aerobic training research because some of the NCDs increase also with sedentary lifestyle.

Chronic diseases, globally, are now the leading causes of death (Reubi et al., 2016). Angkurawaranon et al. (2016) express that there is evidence of an increasing burden of non-communicable diseases (NCDs) occurring in Sub-Saharan Africa resulting in a double burden of non-communicable and communicable diseases in a region with the least financial and human resources to deal with all these issues effectively. To help deal with the prevalence of chronic illnesses related or unrelated to HAART, but affecting adult HIV-positive individuals, the effects of aerobic training on various health variables should be explored.

In June 2016, Botswana recommended a "Treat All" strategy (UNAIDS, 2019). Now HAART is recommended to all HIV-patients regardless of CD4 cell count and the therapy has to be continued indefinitely (UNAIDS, 2016a). The cost of HIV treatment and its outcomes on the body is high (Remme et al., 2016; UNAIDS, 2016a) and exercise could be a useful additional therapy, it is of low or no cost. The government spends a lot of money towards fighting HIV. Remme et al. (2016) estimated that South Africa, Nigeria, Kenya, Mozambique, Uganda, Tanzania, Zimbabwe, Malawi, Zambia, Ethiopia, Lesotho, Botswana, Namibia and Swaziland have US$ 3.04 billion expenditure on HIV.

Sub-Saharan Africa, is more than 35 years into HIV epidemic yet research on HIV and how to to help in relation to various exercise protocols and outcomes on various health variables remains unacceptably low (Ezema et al., 2014; Stanely et al., 2016). Already Botswana is undergoing a major health transition with people suffering dual disease burden of HIV and non-communicable disease (Ministry of Health of the Republic of Botswana, 2018; Keetile, Navaneethan & Letamo, 2015). Mongona et al. (2015) also say research investigations on exercise of HIV-positive individual are limited. Taking advantage of the 'Treat-All 'strategy and the fact that HAART clinics in Botswana comply with the national and international guidelines (UNAIDS, 2016a), aerobic exercise should be explored. In Botswana HIV-positive individuals initiate HAART at a higher CD4 count which reduces the risk of opportunistic diseases; they also have the advantage of the 'Treat-All' strategy. HIV-positive individuals who initiate HAART at lower CD4 count remain at risk of opportunistic infections than individuals starting the therapy at higher CD4 count (German Advisory Committee Blood (Arbeitskreis Blut), Subgroup 'Assessment of Pathogens Transmissible by Blood', 2016; Munawwar & Singh, 2016).

There are some studies done in Africa on HIV and exercise like that of Chisati and Vasseljen (2015). However, such studies did not include HIV-positive individuals on HAART. Some studies had a population of people with low CD4 count, since some HIV-positive individuals in Sub-Sahara are initiated into HAART at low CD4 count (German Advisory Committee Blood (Arbeitskreis Blut), Subgroup 'Assessment of Pathogens Transmissible by Blood', 2016). However, over the years, HAART guidelines have changed, therefore, further research is needed to match changes taking place since research evolves with time. Raso et al. (2013) add that, studies are required to reinforce the recommendations of aerobic training as an important non-pharmacological treatment in HIV-infected people.

1.3 Rationale for the study

Aerobic training can improve, and maintain, cardiopulmonary fitness in HIV-infected people (Anandh et al., 2014; Gomes- Neto, Conceiacao, Carvalho & Brites, 2013; Ushe, 2013). In spite of the well-known benefits of improved aerobic capacity, scientific studies in relation to exercise training of HIV-positive individuals have not been extensive (Vancampfort, Stubbs & Mugisha, 2018). Lopez et al. (2015), add that, exercise programs have not been extensively utilized as viable therapeutic treatment options for HIV positive population. Also a considerate proportion of HIV positive individuals are insufficiently physically active (Vacampfort et al., 2016). Therefore, knowing the possible effects of aerobic training on selected health characteristics of adult HIV-positive individuals could be important to better recommend exercise programs, hence the need for this study.

Aerobic capacity of an individual is affected by physical activity habits, body composition, gender, age and genetic factors as well as geographic living area (Chisati & Vasseljen, 2015). Differences in exercise uptake and accommodation in health and disease is affected by heredity, genetics, ethnicity and interracial difference (Ezema et al., 2014). A lot of evidence about lipid profile, CD4 count, viral load, body composition and aerobic capacity among adult HIV-positive individuals is based mostly on western populations which have different genetics and physical activity habits from Sub-Saharan African populations (Chisati & Vasseljen, 2015). In developed, countries routine care of adult HIV-positive individuals has now expanded to include screening for cardiovascular risk factors and diseases (Mocumbi, 2015). In contrast, Munawwar and Singh (2016) reported that the opportunistic infections are more prevalent in developing countries. The progression of HIV to AIDS is assisted by various opportunistic infections.

Health characteristics including lipid profile, CD4 count, viral load, body composition and aerobic capacity may also be affected by HAART in addition to the daily living activities (Chisati & Vasseljen, 2015). Da Silva et al. (2015) emphasize that various exercise programs should be part of HIV therapy. Ortiz (2014) advocated for aerobic and strength exercise as an effective orientation to reduce the impact of physical impairment related to HIV infection and secondary effect of HAART that affects the quality of life and participation in the society.

Given the rising prevalence, and the cost, of care for lipodystrophy and metabolic consequences of highly active antiretroviral therapy and HIV itself, additional investigations on aerobic training are justified (Tiozzo et al., 2013). There are long term adverse physiological consequences of HAART application. There is poor muscle strength observed in some HIV-positive individuals associated with lower anaerobic power and peak oxygen uptake (Raso et al., 2013). Maintaining the physical and functional fitness of people living with HIV/AIDS has become one of the most important therapeutic targets (Mocumbi, 2015; Ortiz, 2014).

The present study will investigate adult HIV-positive individuals who are on HAART unlike Chissati and Vasseljen (2015) who did a study on HIV patients who were not on HAART. Aerobic training should be promoted as a non-pharmacological intervention for the care of HIV positive individuals in the intermediate stages of disease (Anandh et al., 2014). Aerobic training of an HIV positive individual could therefore be safe and effective in improving exercise tolerance. In the present study HIV-positive adults were involved in an aerobic training program.

The non-pharmacological strategies like the use of physical activity and cardiovascular fitness can improve many physical and psychological outcomes in the HIV positive population since changes associated with HIV and HAART profoundly affect body image and influence health-related quality of life (Mbada, Onayemi, Ongunmoyole, Johnson & Akosile, 2013). Despite the high prevalence of HIV in Botswana, knowledge about the lipid profiles, body

composition, CD4 count, viral load, aerobic capacity and HRQoL of Batswana living with HIV and taking HAART remains lacking especially when combined with aerobic training. Conducting this study is therefore crucial.

The study will provide information on the use of aerobic training and its effect on outcomes of health variables of interest leading to additional body of knowledge that could help inform further studies. The majority of people who are HIV positive are on highly active antiretroviral therapy with AIDS like symptoms reduced; making HIV a chronic but manageable illness (Birk 2013). Gomes-Neto, Conceicao et al. (2013) state that clinicians should be advised to construct a general exercise program that could fit the individual needs, taking into account the stages of disease progression and adverse effects experienced besides functional ability. Without specific knowledge of the effects of aerobic training on the aerobic capacity, lipid profile, CD4 count, viral load and body composition of HIV infected individuals in Botswana, all the above pose challenges.

1.4 Purpose of the study

The purpose of the study was to compare pre-post 12 weeks aerobic training effects on lipid profile, CD4 count, body composition, aerobic capacity and health-related quality of life among HIV-positive adults on highly active antiretroviral therapy under Botswana Network of People Living with HIV/AIDS in Gaborone and to also to compare their baseline, week 8 and week 12 repeated measures on the health-related quality of life.

1.5 Objectives of the study

The study aimed at comparing the effects of 12 weeks of aerobic training against baseline data of HIV-positive adults' body composition (body mass index, body fat percentage, body muscle mass percentage and visceral fat), lipid profiles (total cholesterol, high density

lipoprotein, density lipoprotein and triglyceride levels), CD4 count, VO_2 max and Health-Related Quality of life (Physical-health Component Summary and Mental-health Component Summary).

The study also aimed at investigating the effects of twelve weeks of aerobic training on repeated measures of Health-Related Quality of life of HIV-positive adults looking at their Physical-health Component Summary and Mental-health Component Summary

1.6 Research Questions

The study was guided by the following research questions:

a) Would twelve weeks of aerobic training lead to a significant difference between baseline and post-test data of selected body composition and lipid profile health variables of HIV-positive adults?
b) Would twelve weeks of aerobic training lead to a significant difference between baseline and post-test data of CD4 count of HIV-positive adults?
c) Would twelve weeks of aerobic training lead to a significant difference between baseline and post-test data of VO_2 max of HIV-positive adults?
d) Would twelve weeks of aerobic training lead to a significant difference between baseline and post-test data of Health-Related Quality of life of HIV-positive adults looking at their Physical-health Component Summary and Mental-health Component Summary?
e) Would twelve weeks of aerobic training lead to a significant difference between repeated measures of Health-Related Quality of life of HIV-positive adults looking at their Physical-health Component Summary and Mental-health Component Summary?

1.7 Hypotheses

The hypotheses below were derived from the research questions and were tested at .05 significance:

a) There will be no significant difference in the selected body composition and lipid profile health variables of HIV-positive adults before and after twelve weeks of aerobic training.
b) There will be no significant difference in CD4 count of HIV-positive adults before and after twelve weeks of aerobic training
c) There will be no significant difference in VO_2 max of HIV-positive adults before and after twelve weeks of aerobic training.
d) There will be no significant difference in Health-Related Quality of life of HIV-positive adults before and after twelve weeks of aerobic training looking at their Physical-health Component Summary and Mental-health Component Summary.
e) There will be no significant difference in Health-Related Quality of life of HIV-positive adults on the twelve weeks of aerobic training looking at the repeated measures of their Physical-health Component Summary and Mental-health Component Summary.

1.8 Assumptions

It was assumed that since BONEPWA has a network of people living openely with HIV, with proper explanation of the purpose, benefits and difficulties of the reaserch to them, they would volunteer for the aerobic training and complete all the twelve weeks of training. Another assumption was that the response of the HIV-positive adults to aerobic exercise training could be different from results of other reviewed studies based on the fact that all HIV-positive adults in Botswana are initiated to HAART regardless of CD4 count levels (UNAIDS, 2016a). Many HIV-positive adults in Botswana are not at risk of opportunistic infection; therefore, exercise intervention could help them. This is because individuals who take HAART at lower CD4 count remain at risk of opportunistic infections (Munawwar & Sigh, 2016). It was assumed that all participants were on HAART unlike Chisati & Vasseljen (2015) who did a study at Malawi but included participants who were not on HAART. It was assumed that the study could have input

on data of HIV positive adults initiated to HAART at high CD4 count, in sub Saharan Africa from a country which strives to meet WHO guidelines for HIV treatment. Another assumption was that all the participants were interested in taking part in the study from the beginning to the end because from the onset the researcher explained everything about the research to them. It was also assumed data collected from participants would be accurate to the precision of the instrument use in testing various health variables. The other assumption was that all persons collecting data were qualified and certified to collect data. The instruments were assumed to be valid, reliable and of international standard. It was also assumed that all participants would give maximum effort especially during exercise testing.

1.9 Significance of the study

The study adds to the scanty existing literature on HIV and aerobic exercise training. Practically, it is obvious that, various health characteristics have a role to play when it comes to daily physical activities of an individual. Developing exercise programs for adult HIV-positive individuals is made difficult by lack of exercise related information on certain health characteristics like their aerobic capacity, lipid profiles, CD4 count, viral load, body composition and HRQoL. This study shows that people should be prescribed or designed exercise activity based on the knowledge of their aerobic capacity, lipid profiles, body composition and HRQoL.

The study is one of the foundational studies on HIV infected individuals in relation to exercise in Botswana and Sub-Saharan African countries. The study shows the value of monitoring of aerobic capacity, lipid profile, CD4 count, body composition and HRQoL in order to monitor individual's aerobic activity progress.

The study could provoke policy debate aimed at informing the government and various agencies on the importance of lipid profiles, body composition, CD4 count, viral load and aerobic capacity monitoring and improvement in adult HIV-positive individuals. Some

governmental and non-governmental organizations, for people living with HIV, could see the value of exercise programs for the HIV positive individuals.

1.10 Limitation of the study

The study includes 18-45 years old male and female volunteers. The study also depended on the participants' willingness to take part in the study, being committed to 12 weeks of exercise program and being able to do exercise testing before and after intervention. There were many female participants (22) in the study and few male participants (5). Male representation in the study was very low but analysis was done as a group outcome. The investigator did not have control of the time for medication and the medication given to participant. However, they were advised to inquire about the medication and their effect in relation to exercise. The participants were advised that within the 12-weeks of the study they should not do any other exercise program apart from the one in this study.

1.11 Delimitation of the study

The study was delimited to adult HIV-positive individuals under the Botswana Network of People Living with HIV/AIDs in Gaborone who were willing and able to provide their informed consent to take part in the study. The participants had to be adults aged 18 years and above, HIV positive and on highly active antiretroviral therapy. The participants were on stable antiretroviral therapy regimen for a year or more. Participants with low CD4 count of below 350 cells/mm^3 were not included in the study. The study was also delimited to Gaborone because that was where the medical laboratory, gym room, and participants were.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HIV and disease progression

HIV belongs to a group of related retroviruses (Bhatt, Shat & Patel, 2013; Hammer & McPhee, 2014). There are two types of HIV which are enveloped RNA viruses that are member of the genus Lentivirus and the family Retroviridae; those are type 1 (HIV-1) and type 2 (HIV-2) (Persing et al., 2016). The predominant type in most parts of the world is HIV-1 and the majority of HIV pandemic is due to HIV-1 even in Botswana (AIDSinfo, 2018; Bhatt et al., 2013). HIV-1 and HIV-2 are transmitted through direct contact with HIV-infected body fluids, such as blood, semen, and vaginal fluids, or from a mother who has HIV to her child during pregnancy, delivery, or breastfeeding (through breast milk) (AIDSinfo, 2018). HIV-2 infection is found mainly in West Africa and generally takes longer to progress to symptomatic HIV/AIDS than HIV-1 (AIDSinfo, 2018)

2.2 Stages of HIV infection

The first stage after HIV infection is acute HIV infection stage (HIV.gov, 2020). Infection with HIV starts without symptoms or ill feeling and is accompanied by slight changes in the immune system (Naif, 2013). As time goes on one may experience a flu-like illness, which may last for a few weeks which is the body's natural response to infection (AIDSinfo, 2018). At this stage the HIV positive individual has a large amount of virus in the blood and is very contagious because there is a widespread dissemination of the virus in his or her boby (Bhatt et al., 2013). People with acute infection are often unaware that they are infected because they may not feel sick right away or at all (HIV.gov, 2020).

The second stage called clinical latency is sometimes called asymptomatic HIV infection or chronic HIV infection (HIV.gov, 2020). According to AIDSinfo (2018) during this stage, HIV is still active but reproduces at very low levels and an individual may not have any symptoms or get sick during this time. Although individuals may look healthy, the virus at this stage is actively replicating in their lymph nodes and blood stream (Ministry of Health, Department of HIV Prevention and Care, Masa, TreatAll, 2016). HIV positive individuals who are not on HAART here can last a decade or longer, but some may progress through this phase faster and those who are taking HAART to treat HIV as prescribed may be in this stage for several decades (AIDSinfo, 2018). HIV positive individuals can still transmit HIV to others during this phase, but as for people who take HAART as prescribed to a point where they stay virally suppressed have effectively no risk of transmitting HIV to their HIV-negative sexual partners (AIDSinfo, 2018; HIV.gov, 2020). At the end of this phase, a person's viral load starts to go up and the CD4 cell count begins to go down. Then one may begin to have symptoms as the virus levels increase in the body, and the person moves into Stage 3 (HIV.gov, 2020).

The third stage is AIDS which result as the direct consequences of the progressive and severe immunologic deficiency induced by HIV (HIV.gov, 2020). People with AIDS have damaged immune systems that they get an increasing number of severe opportunistic illnesses (Hammer & McPhee, 2014). Without treatment, people with AIDS typically survive about 3 years (HIV.gov, 2020). People are diagnosed with AIDS when their CD4 cell count drops below 200 cells/mm or if they develop certain opportunistic illnesses. People with AIDS can have a high viral load and be very infectious. The incidence of infections increases as the CD4 T-lymphocyte number declines (Ministry of Health, Department of HIV Prevention and Care, Masa, TreatAll, 2016).

2.3 The spread of Human Immunodeficiency Virus (HIV)

In the early 1980s, HIV was found in a geographic band stretching from West Africa across the Indian Ocean (Kandala et al., 2012). The countries north of the Sahara and those on the southern core of the continent remained apparently untouched. By the mid 1980's the epidemic began to move explosively to south. According to UNAIDS (2014) and the World Health Organization [WHO] (2013), prevalence estimates by the early to mid-1980 showed that Southern Africa had a high HIV prevalence than any other region in the world. In 2015 South Africa alone had nearly 3.4 million people on HIV treatment which was more than any other country in the world (UNAIDS, 2016b). South Africa in comparison with all African nations was followed by Kenya with nearly 900 000 people on treatment by the end of 2015 (UNAIDS, 2016b). Generally the world's most affected regions are the eastern and southern Africa (UNAIDS, 2017). Two out of three infections are in Sub-Saharan Africa from the estimated 600 new infections that occur globally (Kharsany & Karim, 2016).

The first case of HIV in Botswana was reported in 1985 (Kandla et al, 2012). In 2001 the national prevalence of HIV/AIDS was at 27% (Farahani et al., 2014). In 2002, there were 3 500 HIV positive patients receiving treatment and by November 2012 the number of HIV positive patients increased to 201 822 (Farahani et al., 2014). Botswana has one of the highest documented HIV prevalence rates in the world (United Nations Development Program [UNDP], 2013a). According to UNAIDS (2016a) the estimated HIV prevalence rate for Botswana was 15.7 %. The 2013 population based survey estimated the HIV prevalence at 18.6% which was an increase from 17.6% of the previous national survey conducted in 2008 (USPEPFAR, 2017).Today one in five people in Botswana is infected by HIV (Human People to People [HPP], 2016).

2.4 Efforts towards fighting HIV in Botswana

The battle against HIV in Botswana began in 1987 with various efforts toward HIV education to the general public of Botswana. Then the government adopted the first national policy on AIDS in 1993 (USAIDS, 2016a). National Aids Coordinating Agency (NACA) was formed in 1999 to mobilize and coordinate a multi-sectoral response to the HIV/AIDS epidemic. A program for the prevention of mother-to-child transmission of HIV was initiated in 1999 (Remme et al., 2016; UNAIDS, 2016a).

In 2000, the government of Botswana entered the African Comprehensive HIV/AIDS Partnership (ACHAP), public-private collaboration with the Merck Company Foundation and the Bill and Melinda Gates Foundation, to assist in the launching of an antiretroviral treatment program (Reubi et al., 2016; UNAIDS, 2016a). It was established to support Botswana's national HIV/AIDS programme through a comprehensive approach, care and support. By the time of the formation of an antiretroviral treatment program, Botswana was one of the worst HIV/AIDS affected country in the world (Remme et al., 2016). Botswana Network of People living with HIV/AIDS (BONEPWA) was also formed in 2000. An umbrella network formed by and for the people living with HIV/AIDS (Botswana Network of People living with HIV/AIDS [BONEPWA], 2014).

The government of Botswana provided the antiretroviral therapy to all qualified citizens in 2001, through the national antiretroviral treatment program referred to as "Masa". The first national site for antiretroviral treatment was opened on the 21 January 2002 at Princess Marina Hospital, at the Infectious Disease Care Clinic (IDCC) (UNAIDS, 2014). Infectious Disease Care Clinic is dedicated to the care of adults and pediatric outpatients with HIV/AIDS (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016). Three other main centers were later opened in the same year, namely Francistown, Maun and Serowe, with African

Comprehensive HIV/AIDS Partnership as the key partner. Today, there are many Infectious Disease Care Clinics in Botswana (Farahani et al., 2014). By 2005, voluntary HIV counselling and testing services were available at district health clinics and hospitals, and 16 free standing centers for voluntary HIV counselling and testing were established all over the country to provide such services to clients. The programme helped to improve access of ARV to those in need (Stanely et al., 2017).

When the Infectious Disease Care Clinic opened in 2002, patients with CD4 cell count of 50 cells/ mm^3 and below were given top priority for referral. In April 2012, the national treatment guideline adopted a CD4 cell count cutoff of 350 cells/ mm^3. The 2013 Botswana AIDS Impact Survey (BIAS IV) estimated 18.5 % of the total population to be living with HIV, an increase from 17.6 percent of the previous national survey conducted in 2008 (Stanely, 2017; UNAIDS, 2016b; USPEPFAR, 2017).

The United States and Botswana Partnership through the President's Emergency Plan for AIDS Relief (USPEPFAR) contributed a lot in responding to HIV/AIDS in the country as well as to the global body of knowledge about the epidemic. The President's Emergency Plan for AIDS Relief (PEPFAR) advocated for the government of Botswana to amend the treatment guidelines and change the CD4 count at the initial 350 cells/mm^3 to 500 cells/ mm^3 in 2016 to be consistent with World Health Organisation guidelines (Farahani, 2014). The nation of Botswana took the advice but advanced to 'Treat-All' approach (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016; UNAIDS, 2016a).

The 'Treat-All' approach to HIV management was launched in June 2016 (HPP, 2016). Botswana is one of the first countries in Africa to adopt the 'Treat-All' policy; providing antiretroviral therapy to all Batswana in need of the therapy. Botswana was one of the first countries in Africa to provide free antiretroviral therapy to its citizens during the peak of the

epidemic and has been a world leader in successfully preventing mother to child transmission of HIV (UNAIDS, 2016a). Generally Batswana have come a long way in the fight against the virus. The name of the new policy, 'Treat All', implies that anyone who needs treatment is eligible for treatment.

2.5 Highly Active Antiretroviral Therapy as a Pharmacological Agent against HIV

Antiretroviral therapy (ART) is the therapy for HIV (Mocumbi, 2015). It refers to the use of pharmacologic agents that have specific inhibitory effects on HIV replication. Antiretroviral therapy came into use starting with AZT monotherapy in 1985 (Persing et al., 2016). In 1996 HAART was introduced as a combination of three or more drugs (Bhatt et al., 2013).

The goals of the treatment are to suppress plasma viremia for as long as possible, to delay the selection of drug resistance mutation, and to preserve immune function (Angkurawaranon et al. 2016). Antiretroviral agents belong to six distinct classes of drugs; the nucleoside and nucleotide reverse transcriptase inhibitors, the non-nucleotide reverse transcriptase inhibitors, the protease inhibitors, the fusion inhibitors, the CRRS Co receptor antagonistic and integrase inhibitors (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016). Each of these classes of drugs inhibits HIV replication at different stages in HIV life cycle (Mocumbi, 2015).

The first line HAART regimes may comprise of;1) two nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs) plus a nucleoside reverse transcriptase inhibitor (NNRTI), 2) two nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs) and an integrase strand-transfer inhibitor (InSTI) or 3) two nucleoside/nucleotide reverse transcriptase inhibitors (NRTIs) plus a booster protease inhibitor (PI) (Rekart et al., 2017). Rekart et al. the integrase strand-transfer inhibitor (InSTI) and protease inhibitor (PI) are used as second line and third line alternative reagents. Using HAART resulted in a great improvement in the prognosis of HIV

disease (Mocumbi, 2015). The physician prescribes HAART based on the patient's viral load, the particular strain of the virus, the CD4 cell count and other considerations like disease symptoms (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016). HAART complement each other and are taken together to give an additive effect. HAART must be taken daily for life (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016; Mocumbi, 2015).

The use of highly active antiretroviral drugs is not without some complication. There are adverse effects common in patients receiving HAART (Hima & Naga 2011). Most of classes of antiretroviral drugs lead to abnormal fat distribution in HIV positive individuals. According to Him and Naga (2011) each drug class has side effects. There is now metabolic and complications secondary to the long-term use of HAART (Cabrero, Griffa & Burgos 2010). Medications like nucleoside reverse transcriptase inhibitors (NRTIs) are strongly associated with lipodystrophy, especially lipoatrophy (Cabrero et al., 2010), lactic acidosis, and hyperlipidemia (Hima & Naga, 2011). The non-NRTIs and some protease inhibitors (PIs) are associated with skin rashes (Hima & Naga, 2011). Also some PIs are associated with gastrointestinal intolerance and glucose lipid abnormalities (Reust, 2011). Some comorbidity may include congestive heart failure, coronary artery disease and stroke (Gomes-Neto et al., 2016). The long term use of HAART treatment is associated with substantial toxicities, adherence difficulties and drug resistance (Mocumbi, 2015).

2.6 Regular aerobic training as a non-pharmacological strategy towards HIV

Exercise training is a consistent progression of exercise sessions designed to improve physiological function for better health or sport performance (Aweto, Aijegbusi, Uganabo & Adeyemo, 2016). Gomes-Neto et al. (2016) state that training is a non-pharmacological therapy in adult with chronic diseases; HIV included. Training helps in the development of functional

capacity for various tasks in life. As for sport specific fitness, it focuses on optimizing athletic performance (Singh, 2014). It is vital for everyone to engage in exercise training and know the benefits of training and detraining.

Aerobic training is also called cardiorespiratory exercise because it raises heart rate and breathing rates and makes an individual's heart and lungs stronger (Birk, 2013). Aerobic training uses oxygen to burn fat in an individual's body thus an increase in oxygen uptake. A better understanding of the effects of aerobic exercise could enable people who are HIV-positive and their health care providers to practice effective and appropriate prescription (Gomes-Neto et al., 2016). Improved aerobic capacity through proper aerobic training increases functional stress, improves certain immune function indices, increases lean body weight while decreasing adipose tissue and improving mood in persons with HIV (Birk, 2013). Some examples of aerobic exercises include brisk walking, race walking, jogging, swimming laps, and aerobics.

Generally, regular aerobic training will provide beneficial effects for any age group provided the exercise is specific and appropriate to the level of fitness of individual (Da Silva et al., 2015; Hosiso, Rani & Rekoninne, 2013; Mangona , 2015 & Singh, 2014). Regular aerobic training has been shown to maintain quality of life and decrease the incidence of a number of lifestyle diseases (Singh 2014). Mangona (2015) stated that the recommendations regarding the prescription of exercise for developing and maintaining cardio respiratory fitness with HIV/AIDS differ a little from that stated for the general population. Therefore, more researches on exercise intervention are needed (Ortiz, 2014; Stanely et al., 2017).

Various exercise interventions may be beneficial to HIV patients (Ortiz, 2014). Progressive aerobic exercise correctly performed will increase the level of fitness and improve health. It will also create a sense of wellbeing, produce greater energy and reduce the risk of developing many diseases (Fillipa, Cicuttini, Holland & Cherry, 2013; Hosiso et al., 2013).

Anandh et al., (2014) state that aerobic training can be a useful adjunct to pharmacological therapy for people with HIV. Mocumbi (2015) states that, provided adequate screening is made for detection of common incapacitating conditions, exercise should be recommended to HIV positive individuals as an effective prevention or treatment for metabolic and cardiovascular syndromes associated with HAART exposure and HIV. Again Ortiz noted that, in order to treat functional disabilities, rehabilitators must know how to implement exercise interventions to improve functionality and health-related quality of life in HIV patients.

Through aerobic training one manipulates the intensity, volume, frequency and duration of exercise (Gomes-Neto et al., 2015; Mangona, 2015). For aerobic training of HIV-positive people, Lopez et al. (2015) report that prescription regarding the exercise mode, its intensity and duration must be individualized and in a multidisciplinary manner; considering the progression of the disease and its pathophysiology. Gomes-Neto et al. (2015) shares similar sentiments because the interactions of the above mentioned factors provide the overload stimulus and are effective for producing a training effect. Determining the appropriate mode depends on the patient's preference and safety issue with regard to the stage of the disease or other conditions (Gomes-Neto et al., 2015).

In their review Lopez et al. (2015) suggest that HIV positive individuals can gain significant physical and psychological benefits from aerobic training for a minimum of 6 weeks if performed three times a week or more. Ezema et al. (2014) recommend 8 weeks of aerobic training. Maduagwu et al. (2015), Stanely et al. (2017) and Tiozzo et al. (2013) advocate for twelve weeks aerobic training and expresses that exercise is beneficial to the general health and wellbeing of the HIV population. Anandh et al. (2014) suggest that three months of supervised aerobic training can be beneficial to HIV positive patients.

Aerobic training should last no more than 60 minutes (20-60 minutes of duration) at intensities of 60-75% maximal heart rate (50-60 Vo2 max) and be performed 3-4 sessions a week involving large muscle groups such as walking, running, or cycling (Lopez et al., 2015). Dirajlal-Fargo et al. (2015) found that HIV adults who engage in at least 2.5 hours of moderate intensity exercise per week are likely to experience lower levels of inflammation and subclinical vascular diseases. According to Gomes-Neto, Conceicao et al. (2013) aerobic exercises should be performed at a moderate intensity, from 11 to 14 on the Borg Rating of Perceived Exertion (BRP) scale, at 50% to 85% the VO2 max/peak. Helping practitioners choose moderate intensity exercise may be accomplished with valid scale of rate of perceived exertion (RPE) (Lopez et al., 2015). The number of weekly exercise sessions should be increased until the patient can tolerate three to five sessions weekly (Gomes-Neto, Conceicao et al., 2013). In other words a progressive increase in both intensity and volume of training should be possible depending on the patient's rate of development (Lopez et al., 2015).

2.7 Health-related quality of life of adult HIV-positive individuals in relation to aerobic training

The presence of HIV, the symptoms and complications associated with HIV have a negative effect on the quality of life of HIV patients (Mbada et al., 2013). Health related quality of life refers to the quality of life in a clinical setting that includes those dimensions such as global health perception, symptom status, functional status, biologic and physiologic variables, and individual and environmental characteristics directly affected by overall state of health (Mbada, 2013).

Changes associated with HIV and HAART affects body image and influence health-related quality of life (Gomes- Neto et al., 2015). Gomes-Neto et al., (2016) reported that functional impairment is common among HIV patients; so lifestyle modification should therefore

be a priority in the management of chronic HIV disease. HIV-related disability has been associated with decrease in exercise capacity and patient's daily activities; hence higher risk of mortality (Gomes-Neto et al., 2015; Gomes-Neto et al., 2016). Hima and Naga (2011) explain that the longer time spent receiving HAART and a higher CD4 count at HAART initiation is associated with death from non-AIDS causes. That is if someone is able to keep a low undetectable virus through HAART they could progress slowly through disease stages and or even die without having reached the AIDS stage; which is the the last stage of disease progression.

Most study outcomes on the exercise and the quality of life of adult HIV positive individuals cannot be generalized to all people living with HIV in other clinical stages since clinical stages of HIV/AIDS, as well as progression of the disease, have a negative effect on the self-reported quality of life of people living with HIV (Lopez et al., 2015). Results from a study by Cabrero et al. (2010) demonstrated high prevalence of body physical changes perceived by HIV infected patients as well as their treating physician. Therefore, more researches are needed on HIV and exercise with various clinical stages of HIV/AIDS. Lopez et al. (2015) further noted that more studies are needed that explore exercise interventions before or during antiretroviral therapy regimen.

Tiozzo et al., (2013) reported that twelve-week aerobic and resistance exercise improved both physical and mental quality of life in exercise group of people who were HIV positive but control group had lower scores. The exercise participants reported improvements in performing daily activities such as dressing, bathing, walking climbing stairs and carrying groceries which are captured in the physical quality of life scale (Tiozzo et al., 2013). Scoring higher in the quality of life scale is an indication that the participants improved with aerobic and resistance

exercise training. Anandh et al. (2014) found that aerobic training of HIV patients improved their quality of life.

Fillipa et al. (2013) found that increasing physical activity levels of HIV-positive individuals was associated with improved perceived body image and psychological wellbeing. Anandh et al. (2014) indicated that three months of supervised aerobic training and resistance training improves quality of life. Aerobic training of people who are HIV-positive shows substantial improvements than progressive resistance training in quality of life (Anandh et al., 2014; Gomes-Neto et al., 2016). Reduction in level of activity in HIV positive patients may be a factor associated with the reduction of aerobic capacity.

2.8 The use of highly active antiretroviral therapy as contributing factor to aerobic fitness of adult HIV-positive individuals

Highly active antiretroviral therapy improves HIV-patient's quality of life by reducing HIV related opportunistic infections (Gomes-Neto et al., 2015). Such symptoms and complications include muscle wasting, fatigue, disability and prevalence of opportunistic infections (Mbada et al., 2013). HAART has its own side effects on the health of an individual just like any other medication (Maduagwu et al., 2015). Ezema et al. (2014) state that there is a rising need for an effective intervention to reduce the impact of physical impairments related to HIV infection and secondary effects of HAART that affect their quality of life and participation in society.

People living with HIV can minimize the side effects of antiretroviral therapy by exercising regularly as part of a healthy lifestyle. They could also improve diet, sufficient sleep and avoiding tobacco usage (Lopez et al., 2015). While antiretroviral therapy is currently the only effective treatment for HIV, assessing interventions like exercise training programs is necessary for improving the lives of people living with HIV (Lopez et al., 2015; Mangona et al.,

2015). This could be helpful in managing physical impairments in patients who encounter limitations in their activities of daily living.

There are so many challenges with researches on HIV, its therapy and training. Mangona et al. (2015) noted that it is expected that people with HIV can keep some of the benefits of exercise as the general population. People with HIV can effectively do that when they are on HAART. A study by Chisati and Vasselgen (2015) compared pre ART participants with HIV negative participant and they found a noticeably lower aerobic capacity in the pre ART participants compared to the HIV negative control. Chisati and Vasselgen's results showed that inflammation played a role in the reduced aerobic capacity that was observed in HIV positive participants.

Stanely et al. (2017) and Aweto et al. (2016) reported that research results on the benefit of exercise for individuals with HIV and the secondary effect of antiretroviral therapy are conflicting and inconclusive often in some researches due to the small sample size and a high percentage of dropouts. Lopez et al. (2015) adds that, additional studies investigating the effectiveness and efficiency of different exercise training regimen for people who are HIV-positive and on HAART are needed. To deal with the direct effects of HIV and secondary effects of HAART, Mangona et al. (2015) reported that exercise has been shown to provide many health benefits ranging from increased aerobic capacity to mood improvements.

2.9 CD4 count as contributing factor to aerobic fitness of adult HIV-positive individuals

Late HAART initiation translates into substantially early mortality after initiation of the therapy. Low CD4 count and advanced stages of the disease are the most important predictors of clinical progression and poor survival after antiretroviral initiation (Munawwar & Singh, 2016). Patients who initiate antiretroviral therapy at low CD4 count remain at risk for opportunistic

infections for a substantially longer period than patients starting antiretroviral therapy at higher CD4 count.

The immune system of people living with HIV and several immunological variables including HIV -1 ribonucleic acid viral load and CD4 cell count has been implicated for decreased aerobic capacity in people living with HIV (Tiozzo et al., 2013). Immunological markers do not only give prognostic information on HIV, but they are also linked to HIV-related illnesses and mortality (Tiozzo et al., 2013). Stanley et al. (2013) found that, twelve weeks of aerobic exercise training improved CD4 cell count while Anandh et al. (2014) indicated that three months supervised aerobic training increases CD4 count. Twelve weeks of aerobic training improved CD4 cell count (Maduagwu et al., 2015). On the other hand Ezema et al. (2014) found that moderate intensity aerobic exercise can increase CD4 count and it is an effective complementary therapy in increasing CD4 count in people living with HIV.

Tiozzo et al. (2013) did a study that compared two groups of randomly assigned men and women to exercise. One group was receiving standard medical treatment plus combined aerobic exercise training (CARET) the other group received standard medical treatment only from a predominantly lower socioeconomic status population. Contrary to other findings Tiozzo et al. (2013) found that the exercise group of HIV patients demonstrated a more stable $CD4^+$ T-cell count from base line of -3% while the control group experienced a reduction of -16% after twelve weeks. The exercise group had no significant increase in $CD4^+$ T-cell count but the fact that the group mean level was stable was a positive finding.

Most people from a low socioeconomic status are facing many issues, some of which are economical, others psychological. They need proper diet and need support in many ways. Without support their health deteriorates quickly especially when ill. Without all this the HIV-

positive individuals would probably not take medication accordingly hence a drop in CD4 cell count.

2.10 Aerobic capacity (VO_2 max) of adult HIV patients as a contributing factor to aerobic fitness of adult HIV-positive individuals

People living with HIV are severely deconditioned and face functional aerobic impairment compared to the general population (Fillipa et al., 2013; Mbada et al., 2013). HIV related disability has been associated with decrease in aerobic capacity and patient's daily activities (Gomes-Neto et al., 2015; Gomes-Neto et al., 2016). Mendes et al. (2013) observed that HIV-positive individuals with lipodystrophy presented with lower VO_2 max when compared with HIV positive individuals without lipodystrophy. Gomes-Neto et al. (2016) in their study noted that aerobic capacity values were reduced in HIV infected patients under HAART when compared with predicted values. Reduced aerobic capacity may contribute to further physical impairment and activity limitation placing HIV infected patient at risk of poor health outcomes.

Reduced aerobic capacity can be associated with lower CD4 cell count and faster progression to AIDS. Therefore, improved cardiorespiratory fitness from aerobic training interventions may lead to more stable and favorable health outcomes in HIV-positive adults. Chissati and Vasseljen (2015) stated that aerobic capacity is an important aspect in the physical fitness of HIV positive individuals. Anandh et al. (2014) suggest that, three months of aerobic training of an HIV positive participant improves aerobic capacity than progressive resistance training of the same length. Ezema et al. (2014) did a related study that had a significant positive correlation between change in aerobic capacity (VO_2 max) and change in CD4 count. For Ezema et al. there was a significant increase in VO_2 max in the exercise group compared to the control group from 8 weeks of aerobic training.

Controlled exercise for HIV positive individuals on HAART is safe and beneficial on cardiovascular health, regardless of the type of exercise (Mangona, 2015). The mechanism explaining the relationship between HIV/AIDS and aerobic capacity is somewhat intricate and complex. Mbada et al. (2013) noted that the pathophysiology of decreased aerobic capacity has been associated with the negative effects of HIV on anaerobic metabolism, muscle fatigue and eventually muscle wasting in people with HIV (Mbada et al., 2013).

Abnormalities specific to reduced aerobic capacity in the HIV infected individual include decreased lactate threshold and reduced peripheral muscle oxygen utilization during exercise. In general, studies show that individuals with HIV may increase their VO_2 max with exercise similar to the general population (Tiozzo et al., 2013). Since reduced aerobic capacity can be associated with lower CD4 cell count and faster progression of AIDS, improved aerobic respiration fitness from combined aerobic and resistance training may translate in to more stable, favorable, health outcomes in HIV-positive patients (Tiozzo et al., 2013). In a systemic review (Gomes-Neto, Conceicao et al., 2013) found a significant increase in aerobic capacity of HIV patients.

In comparing people living with HIV and healthy control Mbada et al. (2013) found that VO2 max of people living with HIV was lower than that of the healthy control. It is therefore likely that reduced VO2 max in people living with HIV may be as a result of reduced oxygen uptake and reduced energy expenditure. Physiological deconditioning could be a causative factor of reduced VO_2 max in people living with HIV. Another explanation could be reduced ability of the exercising musculature to extract oxygen (Mbada et al., 2013). Chisati and Vasseljen (2015) who studied pre- antiretroviral therapy participants and negative control expressed that there was a decrease in VO_2 max of 45% in HIV positive individuals. Maximal oxygen consumption (VO_2 max) was 16% lower in females compared to males in HIV-negative individuals while in HIV-

positive individuals, VO2 max was 25% lower in females compared to males (Chisati & Vasseljen, 2015). The intake of antiretroviral drugs probably causes a reduction in VO_2 max in the participants.

For Lopez et al. (2015) aerobic training was associated with significant improvement in aerobic capacity, quality of life and depression in HIV patients. With Tiozzo et al. (2013) the exercise group improved their estimated VO_2 max; an important measure of aerobic capacity related to health and longevity. Reduction in the level of activity may be a factor associated with the reduction of aerobic capacity. In a cross sectional study of ten HIV infected men (predominantly African American) and eight non infected (predominantly Caucasian) older HIV-infected men on HAART had reduced oxidative enzyme activity and increased markers of oxidative stress, all of which are significantly associated with low aerobic capacity (Ortmeyer et al., 2016)

2.11 Muscle strength as a contributing factor to aerobic fitness of adult HIV-positive individuals

Raso et al. (2014) noted that poor muscle strength is observed in some HIV positive individuals. In their study, Tiozzo et al. (2013) observed that, the exercise group, compared to control group, achieved a significant improvement in upper body (15%) and lower body (21%) body strength through training. These increases are associated with improved aerobic capacity, reduced risks of falls and a lower incidence of hip fracture in the elderly who are HIV-positive.

There is a need to perform upper body strength training for HIV-positive patients (Tiozzo et al., 2013) because the limited increments in upper body strength can be attributed to HAART. The nucleotide reverse transcriptase inhibitors (NRTI) medication causes peripheral neuropathy and limited ability to recruit motor nerves in the upper body musculature (Tiozzo et al., 2013).

The physiological limitations associated with the side effects of nucleotide reverse transcriptase inhibitors, show the importance of performing upper body training for HIV-positive adults.

Gomes-Neto et al. (2016) noted that as a result of associated comorbidities and related phenomena such as loss of lean muscle mass and pain due to HIV, individuals often reduce their physical activities which may further decrease tolerance to exercise and quality of life. Improving musculoskeletal strength may have significant implications for better independence later in life (Da Silver et al., 2015). Muscle strengthening is particularly considered an important type of physical activity for HIV-infected people. An increase in lean body mass observed in a study by Mendes et al. (2013) and a reduction in total body fat are good for building muscle.

2.12 Body composition as a contributing factor to aerobic fitness of adult HIV positive individuals

Aerobic training is important because it is associated with cardiovascular fitness. Cardiovascular fitness is associated with improved body composition (Fillipa et al., 2013; Gomes-Neto, Zwirtes et al., 2013).When one improves cardiovascular fitness through aerobic training it may be a useful long term strategy to improving body composition. HIV-positive individuals should be encouraged to improve and maintain cardiovascular fitness. Ley and Prista (2013) reported that while life expectancy of people with HIV is increasing, there is also an increase in the risk factor for cardiac disease in the HIV-positive population. Fillipa et al. (2013) in their study observed that higher level of cardiovascular fitness in HIV patients was associated with better body composition. According to Gomes-Neto, Zwirtes et al. (2013), aerobic exercise training improves outcomes related to body composition, reduce body weight, total body fat and waist hip ratio.

In relation to weight, Tiozzo et al. (2013), in their research, exercise and control groups showed no body weight changes but the exercise group experienced a reduction in waist

circumferences and the control group an increase. Aerobic training increases lean body mass (Mendes, 2013). That could be a marker of decreased risk of metabolic disease associated with abdominal obesity (Tiozzo et al., 2013). Da Silva et al. (2015) suggested that long term aerobic exercise intervention is likely to preserve along the years, the muscle mass through strength and functionality of HIV-positive individuals under highly active antiretroviral therapy.

Bekolo, Nguena, Ewane, Bekoule and Kollo (2014) explain that long term use of HAART in HIV-positive people is associated with disturbances in blood lipids, metabolic and cardiovascular complications which should be monitored. HAART can induce raised levels of total cholesterol (TC), low density lipoprotein-cholesterol (LDLc), triglycerides (TG) and variable effects on high density lipoprotein-cholesterol (HDLc). Ministry of Health Department of HIV Prevention and Care, MASA, Treat all (2016) reports that all classes of antiretroviral therapy cause elevated total cholesterol (TC) and triglycerides (TG), which may lead to a serious long term cardiovascular related morbidity. Regardless of whether they are related to highly active antiretroviral therapy or not, they must be addressed promptly; including modification of cardiovascular risk factors such as stroke, heart attack, peripheral arterial disease, smoking, hypertension, diabetes, body mass index (BMI) of 25 and above as well as elevated waist hip ratio (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016).

Post highly active antiretroviral era lead to a condition known as lipodystrophy which is associated with physiological changes that disrupts the body's functions in producing, utilizing and distributing fats in the body. These changes in body composition impact negatively on the quality of life of HIV infected persons (Angkurawaranon et al., 2016; Ley & Prista 2015). Mendes et al. (2013) state that some HIV positive individuals committed to HAART develop a syndrome of fat redistribution named HIV lipodystrophy syndrome (HIVLDS). This is basically body fat changes (Gomes-Neto et al., 2015). Lipodystrophy is an abnormality in the way the

body produces, uses, and stores fat and there are two kinds of lipodystrophy; namely fat wasting (lipoatrophy) and fat accumulation (hyper-adiposity) (Lopez et al., 2015). The alteration in body composition results to accumulation and reduction of fat in some parts of the body (Maduagwu et al., 2015). According to Hima and Naga (2011) fat wasting leads to body changes characterized by a reduced subcutaneous fat in the face, arms, and buttocks. It can be changes through an increase in visceral fat and fat increase in the back, neck and chest areas which is fat accumulation. Fat accumulation and fat wasting can occur with or without changes in body weight (Lopez et al., 2015 & Ortiz, 2014)

Sedentary conditions add to the issue of lipodystrophy, hyperlipidemia and may contribute to the development of risk of cardiovascular disease (Mendes et al., 2013). Hyperlipidemia is the increase in the amount of fat in the blood (Hima & Naga, 2011). Besides contributing to the reduction in body fat, exercise can help prevent the buildup of body fat in HIV positive individuals. Mendes et al. noted that alteration in the fat compartments in the central region of the body has been associated with insulin resistance, dyslipidemia, hypercholesterolemia and risk of cardiovascular disease. Gomes-Neto et al. (2016) stated that HIV-positive individuals with lipodystrophy end up having reduction in muscle mass and aerobic capacity as compared to those without such fat changes. Fat deposit is a surrogate marker of metabolic unfavorable fat distribution HIV population (Dirajlal-Fargo et al., 2015).

Maduagwu et al. (2015) found significant improvements in lipid profiles of HIV infected persons doing aerobic exercise. Their results indicated a significant reduction of 28.1% total cholesterol, 37.9% triglycerides, 44.4% low density lipoprotein and an increase of 79.7% high-density lipoprotein among HIV infected persons that completed a twelve week moderate intensity treadmill exercise. In another study comparing aerobic capacity of patients with and without lipodystrophy; patients with lipodystrophy exhibited a significant reduction in muscle

mass and aerobic capacity and higher frequency of metabolic syndrome compared to those without such fat changes (Gomes-Neto et al., 2016). For Raso et al. (2013) higher levels of cardiovascular fitness levels were associated with better body composition. Without any intervention to the detrimental effects of HIV and HAART the result becomes of great impact to body composition. Contrary to other findings Yar'zever et al. (2013) found no significant difference in the patient's body weight and body mass index for pre and post-tests respectively after 12 weeks of cycle exercise programme.

2.13 The rise of chronic diseases HIV included

HIV as a chronic condition has been related to disability, decreased exercise capacity and impairment in daily activities (Gomes-Neto et al., 2016; Raso et al., 2013). Ezema et al. (2014) state that decreased physical activity and the cardiovascular risks still pose some problems for health and general well-being. Chronic disease epidemic in the global south is understood to be a serious threat to the sustainability of development through both its negative impact on the productivity of working age population and the burden of disease it places on the health system already overstretched by infections, maternal and perinatal diseases (Reubi et al., 2016). According to Dimala and Blencowe (2017) the increasing HAART coverage in Sub-Saharan Africa has been associated with increasing cardiovascular disease incidence. In Botswana, households are not just grappled by double burden of disease in some cases a triple or even quadruple burden that could include chronic illnesses, injuries and infectious diseases; including HIV.

Reubi et al. (2016) noted that over the past ten years, concerns have been mounting over rapid rise in the prevalence of non-communicable diseases (NCDs) in the global south and the health and economic burdens they present. The World Health Organisation has published a number of reports on non-communicable diseases and adopted a Global Action Plan for the

Prevention and control of Non-communicable Diseases from 2013-2020 (Angkurawaranon et al., 2016; World Health Organisation, 2013). The World Bank and United Nations Development Program (UNDP), two of the leading organizations in international development, have also been active and issued discussion and policy papers about the mounting danger of chronic diseases for emerging economies (UNDP, 2013b). UNDP records that more than 60% of deaths worldwide are related to non-communicable diseases and nearly 80% of these deaths occur in low and middle income countries. Botswana is one of the developing nations (UNDP, 2013b).

The lives of many people in the world are being cut short by chronic diseases such as heart diseases, stroke, cancer, and chronic respiratory diseases. This is no longer happening in high income countries (Mocumbi, 2015). Globally most chronic disease deaths today are in low and middle income countries (Seitz, 2016). People in these countries tend to develop diseases at younger ages, suffer longer often with preventable complications and die sooner than those in high income countries. Munawwar and Singh (2016) reported that the opportunistic infections are more prevalent in developing countries. The developing countries have a burden of HIV which influences some of the chronic diseases. Therefore lifestyle modification should be a priority in the management of chronic HIV disease (Gomes-Neto et al., 2016).

2.14 Social support of adult HIV-positive individuals

Adult HIV positive individuals receive either encouragement or discouragement as social support and this has a lasting influence on HIV positive individuals' training experiences and their perception regarding those experiences (Toledo, McLellan-Lemal, Henderson & Kebaabetswe, 2015). Having a good social support is associated with higher physical activity levels hence social isolation may be a risk factor for inactive HIV-positive individual (Fillipa et al., 2013). Also, emphasis on good nutrition and adherence to antiretroviral therapy by health care providers and or exercise scientists may enhance immune function in the HIV population

(Mendes et al., 2013). Problems related to depression after HIV prognosis result from social isolation and a sedentary lifestyle; a situation favorable to limitation of aerobic capacity.

In their research Tiozzo et al. (2013) found that, social support that was provided to exercise intervention provided better adherence to Highly active antiretroviral therapy and subsequently improved the immunological profile of the exercise group. Anandh et al. (2014) study on aerobic training and progressive resistance of HIV positive individuals showed that they had decreased depression, reduction in anxiety and an increase in quality of life scores which was not found in the control group. There is still a problem of HIV related stigma and discrimination throughout the world. BONEPWA (2014) reported that there is internal and external stigma experienced by people living with HIV from the community members. This stigma becomes an obstacle in the form of discouragement in relation to exercise training progress and perception of people living with HIV.

Lifestyle modification should become a greater priority in management of chronic HIV diseases (Gomes-Neto et al., 2016). Proper nutrition and adherence to antiretroviral therapy may enhance immune function of the HIV population (Maduagwu et al., 2015). All this can be achieved with the presence of positive social support. Botswana has made a significant stride in the fight against HIV/AIDS in terms of prevention, education, treatment, care and support (Skinkamba & Moseki-Lowani, 2016). BONEPWA is one of the organizations that has brought a huge social motivation and support to people living with HIV/AIDS (BONEPWA, 2014)

2.15 Conclusion

HIV epidemic has always been of high prevalence in Sub-Saharan Africa ever since its outbreak in the mid 1980's (UNAIDS, 2016b). Of the new infections that occur worldwide, two out of three are in Sub-Saharan Africa (Kharsany & Karim, 2016). In Botswana a lot has been done ever since 1987 in terms of educating people about the virus, adoption of HIV policies, and

creation of programs and organizations that could help run HIV/AIDS initiatives (Remme et al., 2016; UNAIDS, 2016a). The clinics infectious disease care clinics, voluntary counselling and testing centers are now easily accessible throughout the country of Botswana (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016; UNAIDS, 2016a). Today in Botswana all adult HIV-positive patients are initiated into HAART. Of all initiatives literature searches show none related to monitored aerobic training of HIV-positive adults on HAART.

HAART is the only successful therapy for HIV but it comes with some effects. HAART is associated with comorbidities like lipodystrophy, heart problems (Gomes-Neto, 2016), muscle wasting, fatigue, prevalence of opportunistic infections (Mbada et al., 2013). The presence of HIV and its symptoms negatively affect the quality of HIV patients. Adult HIV positive patients can reduce the effects of HAART by regular exercising, improving diet and avoid the use of drugs apart from the prescribed ones and alcohol usage (Lopez et al., 2015). Regular aerobic training has been proven to provide beneficial effects and reduce the incidence of disease occurrence (Singh, 2014). Aerobic training improves the quality of life of adult HIV positive patients (Anandh et al., 2014). If quality of life is low, activity level may be reduced hence reduction in aerobic capacity. Most study outcomes cannot be generalized to all people living with HIV (Lopez et al., 2015). Therefore more studies are needed in various countries and various clinical settings. This study to be carried in Botswana is justified.

Some countries initiate HAART at low CD4 count (Maherta, 2013) and late HAART initiation leads to early mortality. In Botswana HAART is initiated at a higher CD4 count hence a reduced rate of opportunistic infections (Munawwar & Singh, 2016). With the adoption of "Treat all" there is need for other intervention since now HIV infected individuals are living longer and stronger than ever before. Through exercise, the abnormalities related to HIV infected individuals could be reduced (Tiozzo et al., 2013). In Botswana, the burden of non-

communicable and communicable diseases has increased and a way forward has to be explored (Reubi et al., 2016). Aerobic exercise is an easy, achievable, low cost initiative and it can be explored.

There is evidence that has emerged regarding the benefits of exercise on physical health and quality of life of people living with HIV. However many questions still remain unanswered, as to how to achieve these positive effects in diverse and specific living contexts of people, particularly in Africa, where the main burden of HIV is found, but where few studies have been conducted (Ley & Prista, 2015). Lopez et al. (2015) explains that studies investigating the efficiency and effectiveness of different exercise training regimens for HIV positive individuals, mainly on HAART, are needed. In addition more studies are needed that explore the timing of implementing exercise interventions before or during the course of HAART regimen. This study was carefully planned to involve HIV-positive adults in aerobic exercise training.

CHAPTER THREE

3.0 RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The purpose of the study was to investigate the effect of aerobic training on lipid profile, body composition, aerobic capacity, CD4 count, and Health-Related Quality of Life of Batswana HIV-positive adults who are on HAART and in Botswana Network of people living with HIV/AIDS (BONEPWA).

The study was conducted in two phases; the pilot study phase and the data collection phase. The pilot study was conducted from the 26 January 2019 to the 3 May 2019 and was not financed by any organisation; it was self-sponsored. The report on the outcome of the pilot study is separately reported in Appendix A. The participants of the pilot study were not drawn from the same organisation as the participants in the major study phase. The data collection phase discussed in this chapter was fully funded by the University of Botswana. It was conducted from the 20 May 2019 to 30 August 2019.

3.2 Research Design

The research was a quasi-experimental multimethod design. Combining different methods in the same research can take many different forms such as mixed method and or multimethod (Vogt, Gardner & Haeffele, 2012). Mixed method research applies to researches where one gathers both the quantitative and qualitative data, integrates the two then draws interpretations based on their strengths (Creswell, 2015; Vogt et al., 2012). The multimethod research refers to the research that does not necessarily cross the quantitative-qualitative border (Vogt et al., 2012). According to Creswell (2015) when multiple forms of qualitative data (for example; interviews and observations) or multiple forms of quantitative data (for example;

survey data and experimental data) are collected, the term is multimethod research not mixed method research.

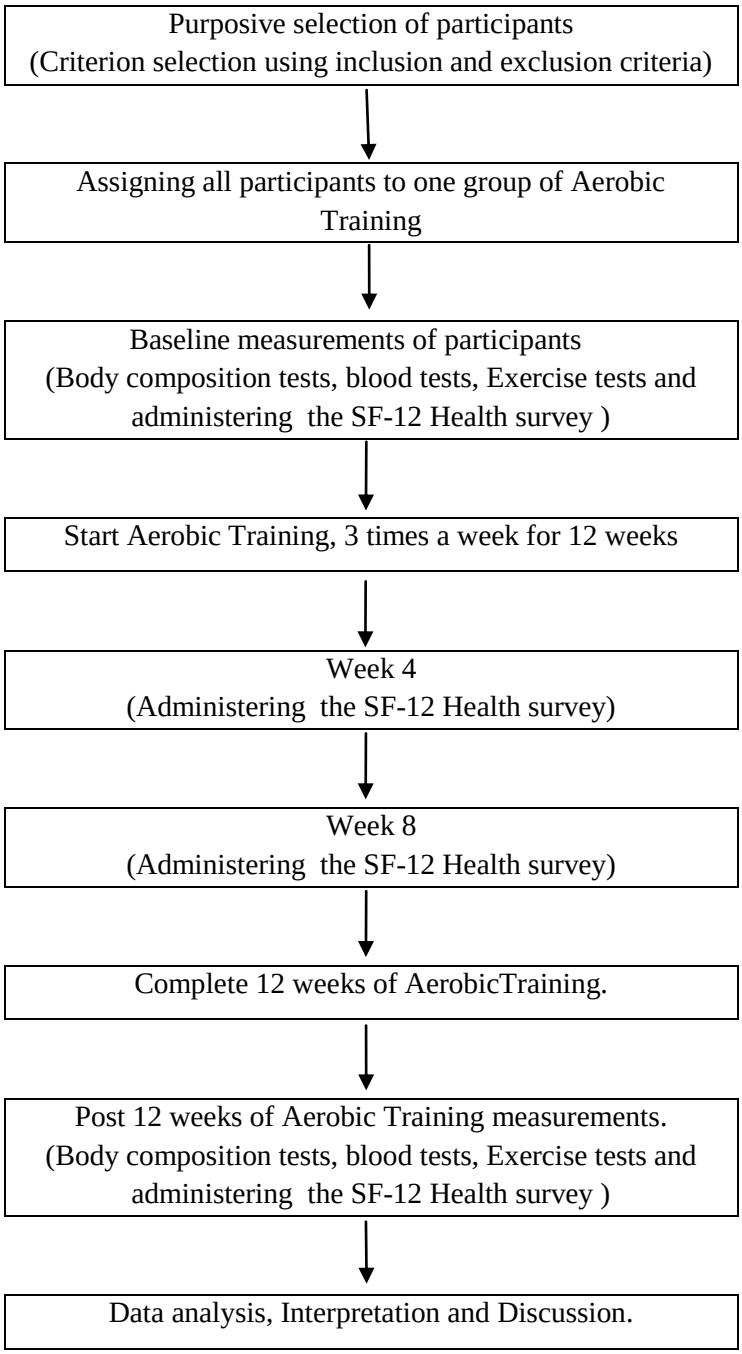
The research was a quasi-experimental multimethod design because there was the collection of multiple forms of quantitative data. There was data collection, analysis and interpretation of the quasi experimental pre-test and post-test test results of the health characteristics of the HIV positive adults and the Short Form-12 Survey (SF-12) results that were useful in assessing the health-related quality of life (HRQoL) of participants. There was no complete random assignment of participants to exercise intervention (Campbell & Krauss, 2012; Edmonds & Kennedy, 2017). The method was also used because it was impossible to control all potentially confounding variables (Purushothama, 2014). The design helped to control many possible threats to validity (Campbell & Krauss, 2012). The design is able to confound individual differences that could affect the result of the study because all treatment groups include the exact same pareticipants.

A short questionnaire was administered to assess and evaluate the participants mental and physical health related quality of life in relation to the study. The Short-Form SF-12 Health Survey (SF-12) was used.The survey also helped to track how the participants were coping with the aerobic training program. With SF-12 health survey one can measure and evaluate physical and health related quality of life of HIV-positive individuals (Gomes-Neto et al., 2016).

After all the pretests were done, the participants were all assigned to aerobic training; a within-subject quasi-experimental design. Therefore, the quasi experimental multimethod design used was one-group with some measurements recorded as pretest-posttest (lipid profile, CD4 count, body composition and aerobic capacity) while the SF-12 health survey was self-reported after every 4 weeks. Stanely et al. (2017), Anandh et al. (2014) and Tiozzo et al. (2013) suggest that three months of aerobic training in the HIV-positive group is safe. Mangona et al. (2015)

noted that modified and controlled exercise for HIV-positive participants on antiretroviral therapy is safe. The quasi experimental multimethod was helpful in monitoring participants and assessing various health characteristics of the participants.

Figure 1



A flow chart showing the research design

3.3 Study site

The research was carried in the gymnasium of the University of Botswana Campus Indoor Sports Center.

3.4 Population

The study targeted male and female volunteer adult HIV-positive individuals.The participants had to be 18 years old and above, under BONEPWA. According to Southern African AIDS Trust (2017) the adolescents, the youth and young adults in Botswana are the most vulnerable groups when it comes to HIV acquisition. Apart from being vulnerable some were born HIV positive and they are now adults because according to Stanely et al. (2017) HIV has been in the sub-Saharan Africa more than 35 years. The age of maturity according to section 49 of the Interpretation Act of Botswana, means when a person has attained the age of 18 years (Southern African AIDS Trust, 2017). Reaching age of maturity means that consent from parents or guardians is not necessary.

3.5 Inclusion and exclusion criteria

The participants were screened for HIV with the results indicating positive and, volunteered to participate in the study; an inclusion criterion adopted from O'Brien et al. (2010). With reference to the last CD4 count checkup they had to be of CD4 count 350cells/mm^3 and above. The participants were taking HAART and volunteered to give blood samples for pre and post measurements of the twelve weeks of aerobic training (Taye, 2016). They were not supposed to be involved in a structured, monitored training program for at least 6 weeks prior to the beginning of the exercise training. A short detraining period of four to six weeks can lead to a complete loss of the benefits of training (Bocalini, Serra, Rica and dos Santos, 2010).

The participants who were HIV-positive but mentally and physically challenged were excluded. If any participant was unable to provide a signed consent form, she or he did not take part. The pregnant HIV positive participants were also excluded (Taye, 2016).

3.6 Sample and sampling procedure

Purposive sampling was used to select participants from BONEPWA. According to Etikan and Bala (2017) purposive sampling is based on the judgement of the researcher as to who will provide the best information to achieve the objectives of the study. BONEPWA is the first and only organisation for people living openly with HIV in Botswana (BONEPWA, 2014). The participants were selected with the help of BONEPWA management because they met the characteristics required for the study. Here the researcher only selected participants who met specific criteria. The most common form of purposive sampling is criterion sampling (Edmonds & Kennedy, 2017).

Some individuals at BONEPWA are living openly with HIV status and do not fear public disclosure and most are youths (BONEPWA, 2014). Management informed the people at BONEPWA about my study and gave my contact details (cell phone number) to them. Then the interested individuals called or sent a message to arrange for a meeting with me. We then met one-on-one to explain the purpose and procedure of the study. They also had to produce evidence that they were HIV-positive. Positive living involves adherence to HAART. BONEPWA has some support groups affiliated to the organisation but people in those support groups are not yet open about their status (BONEPWA, 2014).

There were 37 HIV-positive adults who gave consent to take part in the study, therefoere from BONEPWA only 37 HIV-positive individuals disclosed their status to the researcher. The researcher was advised that BONEPWA is an organisation that has both HIV-negative and HIV-positive individuals and no one should assume that all individuals there were HIV-positive. With

that, the researcher was only restricted to working with a population that had disclosed their status.

The research focused on people who were living in Gaborone. It took a long time to get participants due to schedules of one-on-one face meetings. Out of the 37 people who gave consent to take part in the study by the time data collection began; only 30 were leaving in Gaborone so 7 were excluded from the study on the basis of living outside Gaborone. From the 30 volunteers, one was excluded due to pregnancy and one could not join due to the nature of the job he had; which required night and day shifts.

Only 28 volunteers met the inclusion criteria and showed up from the beginning of training, 23 females and 5 males. After 6 weeks one female dropped out of the study hence 22 females and 5 males leaving the participants at 27. They were aged 18 to 45 years. The invitation was open to people of any nationality but only Batswana volunteered.

3.7 Ethical consideration

When looking at ethical considerations institutional review board (IRB) of certain affected organizations are important. IRB in research does not only help protect human participants in the study but also helps researchers from making mistakes (Bloss, Nebeker, Beitz & Bae, 2016). Prior to data collection and intervention, ethical clearance was obtained from the University of Botswana Review Board, Ref: UBR/RES/IRB/SOC/GRAD/131(Appendix N)**,** another ethical clearance was done by the Ministry of Health of the Republic of Botswana Research Division Review Board, Ref: HPDME: 13/181 (Appendix O). Permission to draw participants for pilot studies from Greater Gaborone clinics was granted by Ministry of Health GGDHMT , Ref: GGDHMT 2/27 V (25) (Appendix P)**.** There was an approval letter to draw participants from BONEPWA (Appendix K) for data collection and an approval to use the University of Botswana Campus Indoor Sports Complex Gymnasiums (Appendix L)**.** Ethically a

researcher has a duty to use appropriate methods, be objective, acknowledge sources, do ones work and avoid plagiarism (Zoizer & Meskens, 2017; Vaughn, 2017).

Informed consent is a basic part of research ethics. The Nuremburg Code of 1947 outlines various principles of ethical conduct in research that include informed consent, voluntary participation, no harm to participants and beneficence (Jarmusik, 2019; Moreno, Schmidt & Joffe, 2017). The principles have become the foundation of contemporary research ethics in most countries around the world (Jarmusik, 2019). Prior to taking part in the training interventions, an informed consent form was filled by every participant who engaged in the study. Informed consent is a voluntary agreement for participation in research; and only competent adults can give legally effective informed consent to participate in research (Nijhawan et al., 2013; Southern African AIDS Trust, 2017). Independent reviews and informed consent are considered to be one of the pillars of the system for protecting the rights and welfare of human subjects in research (Bernheim, Childress, Bonnie & Melnick, 2015). This system is designed to prevent harms, abuses, and exploitation in public health research as well as in clinical research. All procedures were clearly explained to the participants. The participants were assured that all information was to be treated with great confidentiality.

3.8 Informed consent

All participants provided a signed informed consent form. Informed consent is vital in studies that involve human participants (Nijhawan et al., 2013). Participants were informed that all data obtained from them will be kept confidential using numbers for identification instead of their personal details.

There were two versions of informed consent forms (the English and Setswana language versions) provided to the participants. The participants, who could read, understand, and write on their own, signed the consent. The participants who were not able to read and understand on their

own, the researcher had to orally explain the form to them. If they showed sufficient understanding and interest the participants then signed the consent forms at the bottom.

3.9 Physical Activity Readiness Questionnaire (PAR-Q)

Before any participant could be involved in exercise testing and training, the physical activity readiness questionnaire (PAR-Q) was be used to assess their physical activity readiness. The 2002 revised version PAR-Q, was adopted from The Canadian Society for Exercise Physiology (2002). The English and Setswana version of the form was used. The participants, who could read, understand, and write, answered the questionnaire. As for the participants who were not able, the researcher had to orally explain the questionnaire to them. If they showed sufficient understanding, the participants signed the forms at the bottom. If there was any participant who needed medical clearance before participating in the exercise they had to get it from the hospital individually.

3.10 Instruments for data collection

a. Data collection sheet: The data of participants were collected on individual data forms using the data collection sheet which was labeled in numbers.

b. Lab requisition letter: Was used to request for blood tests of participants by the Diagnofirm Medical Laboratory.

c. Physical Activity Readiness Questionnaire (PAR-Q): The physical activity readiness questionnaire (PAR-Q) was adopted from the Canadian Society for Exercise Physiology (2002).

d. The SECA stadiometer: For measuring the participants' height the SECA stadiometer (SECA stadiometer, seca 217 model, Germany) calibrated from 0 cm to 220 cm was used. The participants' height was measured to the nearest 0.1 cm.

e. The SECA digital electronic weighing scale: The SECA digital electronic weighing scale (SECA, Alpha model 770, Germany) was used for measuring the weight of participants. The scale was calibrated from 0 kg to 200 kg.

f. The Automatic Omron Sphygmomanometer: The automated Omron sphygmomanometer (Omron M3W, Omron healthcare, Japan) was used to measure blood pressure.

g. The Tanita multi frequency segmental body composition analyzer: To measure body composition of the participants, their bioelectrical impedance measurements was performed with the Tanita body composition analyzer (Tanita multifrequency segmental body composition analyzer, Tanita MC-780 MA model, Tokyo, Japan).

h. The Polar digital heart rate monitor: The digital heart rate monitor (Polar digital heartrate monitor, Polar Electro oy, Finland) was used to monitor participants' heart rate during exercise test and exercise training.

i. The treadmill: For VO_2 max assessment through exercise test, the treadmill (Track Master, model no. TMX58220, Newton, Kansas USA) was used.

j. Hallo needle: A hallo needle was used to draw blood samples from participants for CD4 count and lipid profile tests.

k. Portable coolers: Were used to store and transport blood samples from UB to Diagnofirm Medical Laboratory.

l. Personal protective equipments: To cover the body when drawing blood such as lab coat, gloves and masks.

m. Architert lipid analyzer: For lipid profile test Abbott Architert (Abbott Architert, Ci8200) analyzer was used.

n. Beckman Coulfer flow cytometer: To test for CD4 count flow cytometry was performed using Beckman Coulfer (Beckman Coulfer, AQUIDS**)**

o. Vacutainer Tubes: Blood samples was collected from participants into the vacutainer tubes (Betcon, Dickinson, Francklin Lakes, NJ, USA) for assessment of lipid profiles and CD4 count.

p. The Short-Form SF-12 Health Survey (SF-12): The SF-12 health survey represents a short yet meaningful measure of health status (Patel et al., 2017).

3.11 Validity and reliability

The usefulness of any test or measurement is determined by its validity and reliability (Wakins, 2018). Validity is the extent to which an instrument measures what it is intended to measure and a valid test must be reliable (Doi & William, 2013). Reliability is the consistency of measurements, simply the stability of a score in repeated measures (Wakins, 2018). The instruments to be used such as the sphygmomanometer, weighing scale, stadiometer, segmental body composition analyzer and treadmill were properly checked for any defects and were calibrated by the qualified and certified Biomachanics laboratory technichian before they could be used for the reaserch. Calibration can help address systematic measurement error (Advanced Instructional Systems & The University of North Carolina, 2011). All the instruments used for data collection were also used during the pilot phase. Therefore they were all piloted for use in the data collection stage.

There were several practice sessions on how to carry out measurements under the supervision of the trained and certified laboratory technician before conducting the pilot study. The pilot study was also conducted to help familiarized the researcher in the proper ways of conducting the tests especially the anthropometric measurements, BIA, exercise test and the survey test. The qualified, experienced phlebotomist from the Diagnofirm Medical Laboratory was responsible for collecting blood samples and the qualified and certified lab technician at the Laboratory carried out the blood tests. The same phlebotomist and lab technician were

responsible for both the pre and post tests. The Diagnofirm Medical laboratory is also certified and accredited to conduct such tests (Appendix J).

Measurement error interferes with the reproducibility of a test or score when the measurement is repeated which compromises reliability and affects the ability to measure change (Edmonds & Kennedy, 2017). There was an SF-12 health survey which could be ambiguous or unclear to some people. To ensure the questionnaires were clear and understandable to all individuals there was a Setswana and English language versions of the tool. Because researcher is qualified in teaching languages, translated the health survey then gave it to other language experts to check if it was translated properly. To ensure that participants were not impatient to a point of getting distracted when filling the survey, a short version of the health survey was selected. There is a long version of the form called SF-36 Health Survey (Huo et al., 2918).They also submitted the forms individually that way the researcher had a chance to check for any unanswered question before parting with the participant. For data analysis the researcher was the only one involved in inputting and cross checking of any missing data.

Training was done at the same gym room, at the same time, 3 times a week, under the same instructors and supervised by the researcher. For training adherence, participants' attendance was monitored through attendance register and praised for their attendance. Communication through mobile telecommunications by a call and or messages was important during the 12 weeks of training for motivational talks to encourage participants to come for training, checking on how participants were doing, or just to inform the researcher when one was unable to come for training. To account for missed sessions an extra day each week was set aside to for a similar training session to the missed one.

Measurements were taken in the same manner in all participants during the pre and post data collection stage. The sequence was to fill in the SF-health survey, then collect their resting

blood pressure, height, use Bioelectrical Impedance Analysis scale for body composition, extract blood samples from participants then conclude by doing exercise testing on a treadmill. As for VO_2 max test, they all had to ensure that they did not touch the handles, or any part of the treadmill while doing the test. This helped control for posture during the test which could be helpful in reducing error of inconsistency in the measurement protocol. All the instruments used were checked the day before the test and two hours before the test procedures to ensure that everything was working properly. The Diagnofirm Medical Laboratory manager and nurse were called to remind them of the day of the test and to confirm attendance at the Biomechanics lab.

Height was measured with a stadiometer through the use of the international standards for anthropometric assessment by Stewart, Marfell-Jones, Olds and de Ridder (2011). These are internationally recognized standardized procedures. Measuring blood pressure with an automated device can be a better indicator of patient's condition because the method is noninvasive, relatively operator independent and has good reproducibility in clinical practice (Climie, Schultz, Nickolic & Ahuja, 2012). Taksande, Jadhav and Vagha (2015) compared the automated and manual and they found out that the automated blood pressure device is reliable and accurate for measuring blood pressure. This helped to reduce human error since it was automatic.

Multi-frequency bioelectrical impedance analysis is an inexpensive and relatively simple method for measuring body composition through the use of electrodes that send a harmless very-low level of electric current through the body (Saladino, 2014). The method is excellent for consistency and repeated measures also it is a hazard free and safe technique (Bera, 2014). Also it is automatic and reduces human error. The device used for BIA is less invasive and may be better accepted where there are policies against the use of skinfold caliper and they can estimate body composition faster than skinfold caliper (Bera, 2014). Multi frequency-bioelectrical impedance analysis and dual-energy x-ray absorptiometry are comparable method for measuring

body composition and can be recommended for groups of different populations (Ramires-velez et al., 2017). According to Ling et al. (2011) the direct segmental multi-frequency bioelectrical impedance analyzer is a valid tool for the assessment of total body and segmental body composition in the general middle age population.

The treadmill has been used for a long time in estimating VO_2 max through Bruce protocol (Loung, Ignaszewski & Taylor, 2016). The modified Bruce protocol is a multistage, well standardized, predictive maximal test (Loung et al., 2016). It has a lower initial intensity and very good for sedentary individuals and HIV participants (Taye, 2016). Researchers like Phillip (2008) and O'Brien et al. (2010) have used it with HIV-positive participants and recommend it.

3.12 Procedure for data collection

The exercise tests were done at the Biomechanics laboratory at the University of Botswana with each participant given 30 minutes for both the tests and drawing of blood. Each participant had an appointment for the test. Most people came on a weekend and those who were unable because of work, social issues or illness the Department ceased the use of the lab and gave the researcher a chance to complete the tests during the week no other personnel either students or lecturers interfered with the data collection or visited the lab during the procedure. The Diagnofirm Medical Laboratory personnel were given an area inside the lab to attend to the participants to draw blood samples from them.

a. Data collection sheet

The demographic data, body composition results, exercise test data and blood test data of participants, date of the test and test time were recorded on the data collection sheet. The form included participant's age, gender, height, body weight, body mass index, multi frequency segmental body composition analysis results and VO_2 max exercise test results. The lipid profile

test results and CD4 count test result forms were received printed from the laboratory results and then the scores of various selected variables were entered into the data sheet. The SF-12 health survey questionnaire was a readymade form for data collection. The results were collected assigning numbers on to each participant's form for identification purpose. Participants' real names were not used in the forms (Beam & Adams, 2011).

b. SF-12 Health Survey

For repeated measures, a short questionnaire for participants at the beginning of the 12 weeks of aerobic training and after every 4 weeks of aerobic training was used to assess and evaluate the participants' mental and physical-health related quality of life in relation to the study (Gomes-Neto et al., 2016; Mbada et al., 2013; Montazeri et al., 2011). The Short-Form SF-12 Health Survey (SF-12) was used.The participants filled the forms while seated. They were each given 3 minutes to complete it before commencement of any other test. That way all participants filled and submitted the forms on time. The Physical-health Component Summary (PCS) and the Mental-health Component Summary (MCS) of the SF-12 was used as a measure of self-reported health-related quality of life (Mbada et al., 2013).The survey also helped track how the participants were coping with the aerobic training program.

The SF-12 is a short version of the Medical Outcome Study Short Form-36 (SF-36). The SF 36 questionnaire has 36 questions grouped into eight domains whose scores range from 0 to 100 and here zero corresponds to the worst general state of health and 100 to the best state. Therefore the higher the total scores the better the perception of quality of life (Gomes-Neto et al., 2016; Montazeri et al., 2011). The SF-12 has 12 items selected from the SF-36, it is brief tool which can be self-reported or administered by interview. In this research it was self-reported as participants filled out forms on their own. The SF-12 also has eight domains similar to that of the SF-36. The 8 domains are; Physical Functioning (PF), Role Limitations due to Physical Health

(RP), Role Limitations due to Emotional Health (RE), Social Functioning (SF), Bodily Pain (BP), General Health Perception (GH), Vitality (VT) and Mental Health (MH). At the end two summary measures of the Physical-health Component Summary (PCS) and the Mental-health Component Summary (MCS) measures aggregate the 8 scales (Gomes-Neto et al., 2016; Huo, Guo, Shenkman & Muller et al., 2018; Mbada et al., 2013).It is essential to assess quality of life to help HIV positive individuals properly when it comes to aerobic training because health related quality of life is related to one's physical and mental status (Gomes-Neto et al., 2016).

c. Blood Pressure measures

The ACSM's guidelines for exercise testing and prescription method were followed for blood pressure assessment. According to Thomson et al. (2010) the participant sits quietly for 5 minutes on a chair with back support then a cuff is wrapped firmly around his or her upper arm at heart level; ensuring to align cuff with brachial artery. The bladder within the cuff had to encircle at least 80% of the upper arm. The automated Omron sphygmomanometer (Omron M3W, Omron healthcare, Japan) was used to measure blood pressure. The researcher pressed the button to quickly inflate the cuff pressure and it automatically stopped when the pressure was appropriate then the systolic blood pressure and diastolic blood pressure readings appeared. For each participant, the stable blood pressure measurements were recorded.

d. Height

Using the international standards for anthropometric assessment (ISAK) by Stewart et al. (2011) height was measured with a stadiometer (SECA stadiometer, seca 217 model, Germany). It took 1 minute to measure and records the participant's height. The free stature method was used (Stewart et al. 2011). The participants were asked to remove their shoes and any heavy outer garments and hair ornaments (Beam & Adams, 2011). Then the participants were asked to stand with their back to the height ruler. Their bodies were upright, with the feet together. The

participants were asked to look straight. Height was recorded on the record paper. Height was measured to the nearest 0.1cm (Stewart et al., 2011).

e. Bioelectrical Impedance Analyzer

To measure body composition, the bioelectrical impedance measurements was performed with the body composition analyzer (Tanita multi frequency segmental body composition analyzer, Tanita MC780 model, Tanita Corporation of America, Inc, America) for body mass index, visceral fat, body muscle percentage and body fat percentage. According to Verney, Schwartz, Amichi, Pereira, Thivel (2015) the multi frequency segmental body composition analyzer, uses the very latest multi-frequency technology to record a comprehensive range of measurements in just 20 seconds, from segmental fat and muscle mass to basal metabolic rate, visceral fat levels, phase angle and intra or extra cellular body water. Verney et al. noted that this advanced technology shows greater accuracy when calculating body composition measurements. Also, bioelectrical impedance analyzer is quick and non-invasive and clinically comparable to dual-energy x-ray absorptiometry and hydrostatic weighing.

The analyzer consists of a stand-alone unit where the participant had to step on barefoot (standard mode). Information concerning the participant such as age, gender and height was then entered into the analyzer. Once the body mass was assessed by the scale, the participant had to take the grips in both hands (alongside his body) during the impedance measure. A full segmental analysis was performed in less than 20 seconds. The information displayed was then recorded on the record sheet for statistical analysis. The scale showed body weight in kilograms (kg), percentage (%) body fat, body fat mass in kilograms (kg), percentage (%) body muscle, body muscle mass in kilogram (kg), visceral fat rating, and body mass index kg/m^2.

f. Blood Tests

The blood samples were collected by a phlebotomist from Diagnofirm Medical Laboratory and sent for analysis of lipid profile and CD4 count. The lipid assays were based on serum and the CD4 flow cytometry was based on whole blood. The phlebotomist collected all the blood collection tools needed on a tray for the procedure and placed them within safe and easy-to-reach table ensuring all items were clear and visible (Maduagwu et al., 2015). The phlebotomist washed her hands with soap and water and dried them with a towel. She then wore a safety gown, mask and well fitting, non-sterile gloves. The phlebotomist introduced herself to each participant and stated her full name and explained the procedure to the participants. She asked the participants of known allergies or phobias and or if they had ever fainted during previous injections or blood draws. Then she labeled the blood collection tubes with the date collected, participants' identity number, and filled any necessary laboratory form (UK Biobank, 2011).

The phlebotomist extended the participant's arm and inspected the ante cubital fossa or forearm to locate the vein of a good size that was visible, straight and clear (UK Biobank, 2011). A firm but gentle pressure was applied starting from the center of the venipuncture site and work downward and outward to cover an area of 2 cm or more with a tourniquet. The located vein site was cleaned with a 70% alcohol swab for 30 seconds and allowed to dry completely. The participant was asked to form a fist so that the veins would appear more prominent. The vein was anchored by holding the participant's arm and placing a thumb below the venipuncture site (Yar'zerver et al., 2013). The vein was entered swiftly at a 30 degree angle or less and the needle introduced along the vein at the easiest angle of entry. Once sufficient blood was collected into the vacutainer tubes (Becton Dickinson, Franklin Lakes, NJ, USA) the participant was asked to open his or her fist then the tourniquet was released before withdrawing the needle. The needle was withdrawn gently and gentle pressure applied to the site with clean gauze. The participant

was asked to hold the gauze in place, with the arm extended and elevated (Maduagwu et al., 2015).

The blood collector tubes were placed in the rack which was later placed in the cooler box for proper transportation from the University of Botswana Biomechanics lab to the Diagnofirm medical laboratory. According to PREDICT One Health Consotium (2013), the insulated coolers can be used for sample transport of less than 48 hours duration with the sample tubes placed in the transport rack or box and secured upright in the transport container. The used needles were placed inside a leak proof and puncture resistant sharps container. The samples were stored at room temperature and were all run within stipulated time frames.

The laboratory has standard operational procedures (SOPs) which guides them and informs that the CD4 samples are stable at room temperature for up to eight hours and at 2-8^{0}c for up to 30 hours and lipids are stable at room temperature for up to 24 hours and at 2-8^{0}c for 7 days. Assoumou (2017) did a study that demonstrated that the reproducibility of CD4+T cells count measurement on stored blood samples at room temperature can be evaluated up to 72 hours after post collection. Assoumou explains that, it is recommended that sample processing for CD4+ T- lymphocytes cell counts should be done on fresh samples but it is not always possible. The stability of samples is also crucial for the analysis of total cholesterol, low density lipoprotein cholesterol, high-density lipoprotein cholesterol, and triglycerides (Franca, Mendes & Ferreira, 2018). Used disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal (UK Biobank, 2011). All waste according to the laboratory management is collected by a contracted registered clinical waste management company.

For assessment of lipid profile; triglyceride, total cholesterol, high density lipoprotein cholesterol and low density lipoproteins cholesterol levels were evaluated using the enzymatic

method (Ortmeyer et al., 2016). All measurements were analyzed using the Abbott Architert (Abbott Architert, C8200) equipped with calibration filters and serum control. The results of the test were entered into the lab sheet. The results were collected from the lab for analysis.

For CD4 count assessment, blood sampled were transferred to tripotassium ethylenediamine tetraacetate (K3-EDTA) bottles for onward analysis of CD4 cell counts by flow cytometry using (Beckman Coulfer, AQUIDS) monoclonal antibody panel technique (O'Brien, 2010; Koyalta et al., 2013; Coetzee & Glencross, 2017). This method is based on adding monoclonal antibodies to a blood sample and running the fluid through a light source, usually a laser beam technique (Coetzee & Glencross, 2017; Koyalta et al., 2013). This analysis was performed at baseline and after 12 weeks of aerobic exercise training at the same laboratory by the same phlebotomist in order to minimize error and ensure reliability. According to Coetzee and Glencross, (2017) Flow Cytometry (FC) is the testing platform of choice for CD4 T-lymphocyte enumeration in HIV infected patients

g. Aerobic capacity (VO_2 max)

The Bruce Protocol is a common method for estimating VO_2 max (Loung, Ignaszewski & Taylor, 2016). The modified Bruce protocol is a multistage, well standardized, predictive maximal test where participants jog to exhaustion on the treadmill (Loung et al., 2016 & O'brien et al., 2010). This protocol was modified to walking and light jogging speeds in order to provide a safe margin of heart rate and intensities for each HIV positive participants. It has a lower initial intensity and very good for sedentary individuals and HIV participants (Taye, 2016). This fitness assessment estimates one's VO_2max using a formula rather than using direct measurements of the volume and oxygen concentration of inhaled and exhaled air. Some researchers like Phillip

(2008) and O'Brien et al. (2010) have successfully used it with HIV-positive participants and recommend it.

The track master tread mill (Track master full version treadmill, Inc, Newton KS) was used. The participant's jogged time (T) to exhaustion was then imputed into the Bruce Protocol formula for estimating VO_2 max (American College of Sports Medicine (ACSM), 2014). The formula used for male participants was; VO_2 max ml/kg/min = 14.8 – (1.379x T) + (0. 451 x T^2) – (0.012 x T^3) and for female participants was; VO_2 max ml/kg/min= (4.38x T) – 3.9 (O'Brien et al., 2010).

The participants were asked to refrain from both strenuous and physical activities and the consumption of any stimulants such as coffee for 24 hours before the exercise test and they did not have to eat at least 2 hours before the start of the test. The test took 25 minutes, where 5 minutes is for warm up 15 minutes for the test and the last 5 minutes for cool down (ACSM, 2014). The test score was the time taken on the test, in minutes. Ideally this should be between 9-15 minutes. Digital heart rate monitor, chest strap (Polar WearLink digital heart rate monitor, coded 31) were used to observe the target exercise test heart rate of each participant. The Borg rating of perceived exertion scale developed by Swedish researcher Gunnar Borg was used during testing to help participants rate their exertion on the scale during the test (William, 2017).

i. Exercise Protocol

All participants were subjected to 12 weeks of moderate intensity aerobic training, three times a week for 60 minutes per session at the University of Botswana gymnasium. The sessions were held in the evening from 1730 hours to 1830 hours. The intention was to aim for moderate intensity exercise to avoid overdoing exercise and reduce any health risks (Gomes-Neto et al., 2015). The 60 minutes exercise session comprised of warm up phase (10 minutes) which include stretching exercises among others, aerobic training phase (40 minutes) and cool down phase (10

minutes). It is vital to choose proper parameters (mode, frequency, duration and intensity) (Mangona et al., 2015 & Stanley, 2017).

Table 1

The Weekly Aerobic Training Program

	Duration	Activities
Warm up	10 minutes	Jogging 2 laps around the indoor track or Jogging on the spot for 5 minutes then stretching and breathing exercises.
Day 1	40 minutes	Body Conditioning Training Day Jogging 5 laps around the track, shuttle runs (x 8 reps), cardio step activities like: V-steps (x 8 reps both legs), Squat (x 8 reps), Single leg dead lift (x 8 reps), Diagonal hand to toe touch(x 8 reps), side plank with touch (x 8 reps), squat and jump(x 8 reps).
Day 2	40 minutes	Moderate Intensity Training Day shuttle runs (x 8 reps), Sit up and reach toes (x 8 reps), Squats (x 8 reps), jog on the spot holding weights on both hands(1kg/2kg) (x 8 reps), pushups with legs on aerobic steps (x 8 reps), Russian twist with medicine ball (x 8 reps), Jog 2 laps around the indoor track.
Day 3	40 minutes	Cardio Variety Training Day Aerobic step exercises with free hands, dumbbells (1kg/2kg), overhead dumbbell press in stepping motion(x 8 both sides), barbell split squat (x 8 reps each leg), Barbell Curl (x 8 reps), dumbbell step up (x 8 reps).
Cool down	10 minutes	Stretching and relaxation activities, walking a lap around the indoor track.

Note. x 8 reps = Eight repetition; cool down and warm up activities were common on daily basis; Day1, Day2, Day 3 = represent common activities done weekly on first day, second day and third day of the week.

Table 2

The Weekly Target Training Heart Rate as Percentage of Maximum Heart Rate and the beats per minute of songs

Week	TTHR	Song b/min
1-3	50-55	50-55
4-6	60-65	60-65
7-9	65-70	65-75
10-12	70-75	70-75

Note. TTHR = Training Target Heart Rate; b/mim = Beats per minute.

For intensity there was the use of a radio that could be manipulated to produce targeted beats per minute to exercise with .Table 2, present summarized weekly beats per minute of songs. From low intensity beats at first week (50-55 b/min), this gradually increased weekly to reduce the effect of the stress of exercise on the HIV-patient; which could predispose the patient to early fatigue. The Karvonen method (Target Heart Rate = ((max HR - Resting HR) x % intensity) + Resting HR) was used to determine the training target heart rate (TTHR) for each participant (Loung et al., 2016). Target heart rate is desired range that is achieved during aerobic exercise. Normal heart rate ranges between 72 -90 beats per minute. Training heart rate helps the heart and the lungs receive maximum benefits from an exercise session. In order to maximize cardiovascular exercise, it is recommended to work in the zone of target heart rate which is considered to be 50-85%. (Gomes-Neto et al., 2015; Loung et al., 2016).

Heart rate monitors were used but they were not enough; there were three from the Department of Sports Science and one participant bought herself a heartrate monitor. Even so when placed on some participants who came on that day, they gave a brief insight to the training progress.

The starting exercise intensity or target training heart rate (TTHR) at 1st week to 3rd week was 50-55% of heart rate reserve (HRR). This was gradually increased to70-75% of HRR at last phase (10th week to 12th week) of the exercise protocol because of the HIV condition. Gomes-Neto et al. (2015) agree that aerobic training should be done at moderate intensity of 50 percent to 85 percent HR max. There is a need for a good well, structured aerobic training program which could be effective for overall health (Ezema et al., 2014).

The training exercise protocol was monitored by the researcher and the gymnasium instructors. An attendance register for participants was used to monitor attendance of participants at the gymnasium.

3.13 Emergency Plan

There was always a first aid kit box filled with first aid materials for any emergency. The trainers were also trained and qualified to give first aid. The researcher carried a cellphone at all times to be able to call for emergency services in case there was a need. Before training started the researcher realised that some participants were professional counsellors, some motivational speakers and others activists; so to have a sense of ownership some volunteered to help counsel any participant in times of need. Their service was anticipated but there was never a need to engage them.

3.14 Data Analyses

Frequency counts, percentages, mean and standard deviations where necessary were used for descriptive statistics to summarise socio-demographics of the participants. The significant differences between variables (CD4 count, lipid profile, body composition, VO_2 max, HRQoL) at baseline and week 12 in the participants were compared using the paired student t-test. The repeated ANOVA test was used for HRQoL repeated measures. The paired student t-test, also called dependent t-test compares two means that are from the same individual (Purushothama,

2014). All analysis was done using IBM statistical package for the social sciences (SPSS) version 24.0 software. The alpha value was set at $p < 0.05$ level of significance.

The mean was used as the measure of central tendency, however the mean does not provide an adequate description of the population so for variability of the data around the mean the standard deviation was used (Carlson & Winquist, 2018; Wassertheil-Smoller & Smoller, 2015).

According to Vinceny and Weir (2012) generally the *t* test is based on the assumptions that; the population to which the samples are drawn is normally distributed, the sample or samples are randomly selected from the population, if the samples are not randomly selected, a generalization from the sample to the population cannot be made, when two samples are drawn, the samples have approximately equal variance and the data must be parametric. The *t* test is robust because it produces reasonably reliable results even if the assumptions are not met totally.

Repeated measures ANOVA permits the researcher to determine the significance of mean differences measured on the same subjects over repeated trials (Vincent & Weir, 2012). It is often used in testing designs in which subjects are measured before, during and after treatment or in which subjects are measured repeatedly over time (Vincent & Weir, 2012). The SF-12 health survey that was used to produce repeated measures of HRQoL for pre-test, week 4, week 8 and post-test, it was then analyzed with one way repeated ANOVA but only for pre-test, week 8 and post-test. There are some researchers who show that individuals can mostly gain significantly from exercise training after 6 weeks (Lopez, 2015) and 8 weeks (Ezema et al, 2014) of training. Repeated measures ANOVA produces an *F* value that can be evaluated to determine whether any significant difference exist among the mean values of the various trials. Like the *t* test the *F* test produces valid results even when the population is not normally distributed for this reason it is

considered to be robust (Singh, Rana & Singhal, 2013). The repeated measures ANOVA should meet the additional assumptions of sphericity (Edmonds & Kennedy, 2017).

For this research where Mauchly's test of Sphericity indicated that the assumption of sphericity had been violated the researcher assessed the situation and proceded using the different correctional adjustment which was the Huynh-Fedlt. When the test has violated sphericity but the values of Greenhouse-Geisser and Huynh-feldt are below .75 one can use the Greehouse-Geisser row but when this values are above .75 one should use the Huynh-feldt row to interprete data (Field 2016; Singh, Rana & Singhal, 2013).

CHAPTER FOUR

4.0 DATA ANALYSIS, INTERPRETATION AND DISCUSSIONS

4.1 Presentation of the results

In this chapter the results of the whole group are presented in tables, analyzed and discussed. There are other tables in the Appendix B**,** table A1 showing the attendance of the exercise compliant group and non-compliant group. Also in Appendix D, tables C1 and C2 Paired t-test analysis of the health characteristics of the two groups. Compliant group refers to the participants who attended 95% and above of training days (n =18) while the non-compliant group being the participants who attended below 95% of the training days (n = 9).

The paired t-test analysis tables shows the, total number of participants , mean, standard deviation, mean difference, t-value, degree of freedom, effect size (Cohen's d) and two-tailed significance level. The repeated ANOVA was used to analyze repeated measures produced by the SF-12 health survey. All the variables are computed by the SPSS except for the effect size of the paired t-test.

Effect size measures the mean difference in terms of the standard deviation. Therefore Cohen's d for paired t-test was computed as sample mean difference divided by sample standard deviation (Edmonds & Kennedy, 2017). There is the criteria for evaluating effect size using Cohen's d; mean difference less than 0.2 = small effect, mean difference around 0.5 = medium effect and mean difference more than 0.8 = large effect. When the effect size is large fewer research participants are needed in order to detect reliable difference and when the effect size is smaller a large respondent sample is required to in order to detect a reliable difference (Edmonds & Kennedy, 2017).

Table 3

Participants' Statistics (n = 27)

	M	SD
Age	37.78	6.84
Height (cm)	162.70	8.32

Note. M = Mean; SD = Standard Deviation.

There were 27 participants, 22 female and 5 male participants who completed all testing. The mean age and standard deviation of participants' age was 37.78 (6.84) years respectively.

Table 4

The Means and Percentages of the Weekly Aerobic Training Attendance up to week 12 (n = 27)

	Attendance			
Week	MP	%	MA	%
1	24.67	91.37	2.33	8.63
2	27	100		
3	25.33	93.81	1.67	6.18
4	20	74.07	7	25.93
5	23.33	86.41	3.67	13.59
6	22	81.48	5	18.56
7	23.67	87.67	3.33	12.33
8	24.33	90.11	2.67	9.89
9	23.33	86.41	3.67	13.59
10	22.33	82.70	4.67	17.30
11	24.67	91.37	2.33	8.63
12	21.67	80.26	5.33	19.74

Note. MP = Mean of those present on a particular week; MA = Mean of those absent on a Particular week; % = percentace of those present or those absent on a particular week.

Table 4 shows that the participants turned up most days for training and at the end of the 12 weeks, they all went through the same tests and those tests were analyzed as a group for paired t-tests not individually. Most participants came for training during the first week, second week third week and eleventh week.

Table 5

Paired t-test Analysis of Selected Health Characteristics of HIV- Positive Participants before and after 12 weeks of Aerobic Training (n=27)

	Mean and Std. Deviation						
	Pre-test	Post-test	Mean diff	*T*	df	d	Sig.
VO2 max (ml/kg/min)	38.43 (8.2)	47.97 (6.64)	-9.54	-10.587	26	-2.04	.000*
Weight (kg)	71.75 (19.73)	70.52 (19.23)	1.23	2.712	26	.52	.012*
BMI (kg/m2)	26.98 (6.75)	26.60 (6.58)	.38	2.200	26	.42	.037*
VF	5.63 (3.59)	5.15 (3.36)	.48	2.380	26	.46	.025*
BMR (kcal)	1456.59 (293.29)	1434.96 (274.53)	21.62	2.011	26	.39	.055
SBP(mmHg)	115.04(14.77)	113.78(12.51)	1.26	.518	26	.10	.609
DBP (mmHg)	74.15 (8.68)	71.89 (8.45)	2.26	1.396	26	.27	.175
Pulse Rate	89.14 (9.51)	87.48(10.96)	1.67	.996	26	.19	.328
BF (%)	34.89 (13.10)	35.06 (14.24)	-.17	-.055	26	-.01	.956
BFM (kg)	25.11 (12.97)	24.36 (12.18)	.76	1.065	26	.21	.296
SF (%)	29.29 (8.69)	28.52 (8.80)	.77	1.376	26	.26	.181
SFLA (%)	36.89 (10.52)	35.85 (10.83)	1.04	1.449	26	.28	.159
SFRA (%)	37.11 (11.83)	35.17 (10.88)	1.95	1.515	26	.29	.142
SFLL (%)	37.91 (8.34)	37.53 (8.25)	.37	.612	26	.12	.546
SFRL (%)	37.85 (8.40)	37.46 (1.59)	.39	.655	26	.13	.518
BM (%)	63.72 (7.85)	63.61 (8.14)	.11	.131	26	.03	.897
BMM (kg)	44.39 (9.32)	44.85 (10.22)	-.45	-.522	26	-.10	.606
SMM (kg)	25.08 (4.50)	24.84 (4.33)	.24	.800	26	.15	.431
SMM LA (kg)	2.20 (.68)	2.21 (.68)	-.01	-.171	26	-.03	.866
SMM RA (kg)	2.16 (.67)	2.17 (.70)	-.01	-.151	26	-.03	.881
SMM LL (kg)	7.15 (1.99)	7.19 (1.64)	-.05	-.235	26	-.45	.816
SMM RL (kg)	8.48 (6.20)	8.32 (5.73)	.16	1.359	26	.26	.186
BW (%)	48.13 (5.86)	46.89 (10.30)	1.24	.779	26	.03	.443
BWM (kg)	35.44 (9.29)	34.71 (9.81)	.73	.917	26	.18	.368
TC (mmol/L)	4.13 (.73)	3.98 (.88)	.15	1.181	26	.23	.248
HDL-C(mmol/L)	1.25 (.35)	1.22 (.35)	.03	.775	26	1.49	.445
T (mmol/L)	.99(.38)	1.13 (.61)	-.13	-1.713	26	-.33	.099
LDL-C(mmol/L)	2.43 (.64)	2.36 (.61)	.08	1.014	26	.20	.320
CHOL/HDL	3.48 (.89)	3.59 (.83)	-.11	-.989	26	-.19	.332
Total T-Cells CD3 (cells/uL)	1670.29 (510.97)	1718.15 (556.30)	-47.85	-.617	26	-.12	.542
CD4 (cells/uL)	763.00 (270.85)	766.30 (266.79)	-3.30	-.113	26	-.02	.911
CD4 % (%)	34.26 (7.23)	33.44 (7.86)	.83	1.057	26	.20	.300
CD8 (cells/uL)	1145.93(1683. 37)	1141.37(1417.18)	4.56	.010	26	.00	.992
CD4:CD8	1.01 (.48)	.98 (.50)	.03	1.082	26	.21	.289

Note. SBP = Systolic Blood pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index; BF(%) = Body Fat Percentage; BFM =Body Fat Mass; SF = Segmental Fat; SFLA = Segmental Fat Left Arm; SFRA = Segmental Fat Right Arm; SFLL = Segmental Fat Left Leg; SFRL = Segmental Fat right Leg; BM % = Body Muscle Percentage; BMM = Body Muscle Mass; SMMLA = Segmental Muscle Mass Left Arm; SMMRA = Segmental Muscle Mass Right Arm; SMMLL Segmental Muscle Mass Left Leg; SMMRL= Segmental Muscle Mass Right Leg; BW = Body Water; BWM = Body Water Mass; VF = Visceral Fat; BMR = Body Metabolic Rate; TC = Total Cholesterol; HDL-C = High Density Lipoprotein Cholesterol; T = triglyceride; LDL =Low Density Lipoprotein Cholesterol; *t* = t-value; df = Degree of freedom; d = Effect size (Cohen's d); Sig.= Significance (*p < .05).

Table 5 shows the details of the paired t-test of selected health characteristics of HIV-positive participants before and after 12 weeks of aerobic training. The mean and standard deviation of VO_2 max before intervention was 38.43 (8.2) and after intervention was 47.97 (1.3), with a p-value less than .05. This shows that there was a statistically significant difference in VO_2 max after the intervention. The effect size was -.73, showing a small effect. The results were not consistent with the hypothesis; therefore we reject the null hypothesis.

The mean and standard deviation of body mass index before intervention was 26.98 (6.75) and after intervention was 26.60 (6.58), with a p-value less than .05, p = .037. This shows that there was a statistically significant difference in body mass index after the intervention. The effect size was 0.42; reflecting a medium effect. The results were not consistent with the hypothesis; therefore we reject the null hypothesis.

The mean and standard deviation of visceral fat before intervention was 5.63 (3.59) and after intervention was 5.15 (3.36), with a p-value less than .05, p = .025. This shows that there was a statistically significant difference in visceral fat after the intervention. The effect size was 0.46, showing a medium effect. The results were not consistent with the hypothesis; therefore we reject the null hypothesis.

From Table 5 the mean and standard deviation of body fat percentage before intervention was 34.89 (13.10) and after intervention was 35.06 (14.25), with a p-value above .05, p = .96. This shows that there was no statistically significant difference in body fat percentage after the intervention. The effect size was .21, showing a small effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

The mean and standard deviation of body muscle percentage before intervention was 63.72 (7.85) and after intervention was 63.61 (8.14), with a p-value more than .05, p = .90. This shows that there was no statistically significant difference in body muscle percentage after the intervention. The effect size was .03, showing a small effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

The mean and standard deviation of total cholesterol before intervention was 4.13 (.73) and after intervention was 3.78 (.88), with a p-value above .05, p = 0.25. This shows that there was no statistically significant difference in total cholesterol after the intervention. The effect size was .23, showing a small effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

The mean and standard deviation of high density lipoprotein before intervention was 1.25 (.35) and after intervention was 1.22 (.35), with a p-value above .05, p = .45. This shows that there was no statistically significant difference in high density lipoprotein after the intervention. The effect size was 1.49, showing a large effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

The mean and standard deviation of triglycerides before intervention was .99 (3.8) and after intervention was 1.13 (.61), with a p-value above .05, p = .10. This shows that there was no statistically significant difference in triglycerides after the intervention. The effect size was .33,

showing a medium effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

The mean and standard deviation of low density lipoprotein before intervention was 2.43 (.64) and after intervention was 2.36 (.61), with a p-value more than .05, p = .32. This shows that there was no statistically significant difference in low density lipoprotein after the intervention. The effect size was .20, showing a small effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

The mean and standard deviation of CD4 count before intervention was 763.00 (270.85) and after intervention was 766.29 (266.79), with a p-value more than .05, p = .911. This shows that there was no statistically significant difference in CD4 count after the intervention. The effect size was -.02, showing a small effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

Table 6

Paired t-test Analysis of the Physical and Mental Component Summary Measures derived from the SF-12 v1 before, after 4 weeks, 8 weeks and after 12 weeks of Aerobic Training (n=27)

	Mean and Std.deviation		Mean diff	t	df	D	Sig.
	Pre-training	Week 4					
MCS	78.89 (14.33)	79.93 (16.90)	-1.04	1.338	26	-.07	.738
PCS	77.33 (14.02)	77.78 (15.11)	-.44	-.127	26	-.02	.900
	Pre-training	Week 8					
MCS	78.89 (14.33)	83.22 (13.82)	-4.33	-1416	26	-.27	.169
PCS	77.33 (14.02)	80.78 (15.03)	-3.44	-.948	26	-.182	.352
	Pre-training	Post-training					
MCS	78.89 (14.33)	85.04 (10.53)	-.615	-2.086	26	-.40	.047*
PCS	77.33 (14.02)	83.19 (12.35)	-5.85	-1.621	26	-.31	.117

Note. MCS = Mental Component Summary; PCS = Physical Component Summary.

Table 6 shows the details of the Paired t-test analysis of the physical and mental health component summary measures of participants derived from the SF-12 v1 before, after 4 weeks, after 8 weeks and after 12 weeks of Aerobic Training. However, the focus was only on the analysis of the pre and post twelve weeks of aerobic training.

The mean and standard deviation of the mental-health component summary before intervention was 78.89 (14.33) and after 12 weeks of intervention was 85.04 (10.53), with a p-value less than .05, p =.047. This shows that there was a statistically significant difference in the mental-health component summary measures after the twelve weeks of aerobic training intervention. The effect size was -.4, showing a small effect. The results were not consistent with the hypothesis; therefore we reject the null hypothesis.

The mean and standard deviation of the physical-health component summary before intervention was 77.33 (14.02) and after 12 weeks of intervention was 83.19 (12.35), with a p-value more than .05, p =.117. This shows that there was no statistically significant difference in the physical-health component summary measures after the twelve weeks of aerobic training intervention. The effect size was -.031, showing a small effect. The results were consistent with the hypothesis; therefore we fail to reject the null hypothesis.

Table 7

Participants' Descriptive Statistics in Relation to MCS and PCS (n=27)

	Time	Mean	Std. Deviation
MCS	Pre-test	78.89	14.33
	Week 8	83.22	13.81
	Post-test	85.03	10.53
PCS	Pre-test	77.33	14.12
	Week 8	80.78	15.03
	Post-test	83.19	12.35

Note. MCS: Mental Component Summary; PCS: Physical Component Summary

Table 7 shows the mean and standard deviation of MCS and PCS at different stages of aerobic training (pre-test, week 8 and post-test). The means and standard deviations of MCS before aerobic training, during aerobic training and after 12 weeks of aerobic exercise training were 78.88 (14.33), 83.22 (13.81), and 85.03 (10.53) respectively.

The means and standard deviations of PCS before aerobic training, during aerobic training and after 12 weeks of aerobic exercise training were 77.33 (14.02), 80.78 (15.03) and 83.19 (12.35) respectively.

Table 8

Mauchly's Test of Sphericity [a] *in Relation to the Repeated Measures ANOVA Results of the Participants'MCS and PCS (n=27)*

					Epsilon [b]		
Within Subjects Effect	Mauchly's W	Approx. Chi-Square	*Df*	*P* value	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
MCS Time	.823	4.857	2	.088	.850	.903	.500
PCS Time	.454	19.724	2	.000	.647	.667	.500

Table 8 shows the Mauchly's Test of Sphericity which indicates that for MCS the assumption of spheriocity was met $\chi^2(2) = 4.86$, $p = .09$; but for PCS the assumption of spheriocity was not met $\chi^2(2) = 19.72$, $p = .00$.

Table 9

The Repeated ANOVA Tests of Within-Subject Effect in Relation to the Participants' MCS and PCS (n=27)

	Source	Type III Sum of Squares	Df	Mean Square	*F*	Sig.	Partial Eta Squared
MCS	Time						
	Sphericity Assumed	538.840	2	269. 420	2.672	.079	.093
	Greenhouse-Geisser	538.840	1.700	326.990	2.672	.088	.093
	Huynh-Feldt	538.840	1.806	298.291	2.672	.085	.093
	Lower-bound	538.840	1.000	538.840	2.672	.114	.093
	Error (time)						
	Sphericity Assumed	5243.827	52	100.843			
	Greenhouse-Geisser	5243.827	44.196	118.648			
	Huynh-Feldt	5243.827	46.967	111.649			
	Lower-bound	5243.827	26.000	201.686			
PCS	Time						
	Sphericity Assumed	467.136	2	233.568	1.805	.175	.065
	Greenhouse-Geisser	467.136	1.294	361.023	1.805	.188	.065
	Huynh-Feldt	467.136	1.333	350.410	1.805	.187	.065
	Lower-bound	467.136	1.000	467.136	1.805	.191	.065
	Error (time)						
	Sphericity Assumed	6728.198	52	129.388			
	Greenhouse-Geisser	6728.198	33.642	199.994			
	Huynh-Feldt	6728.198	34.661	194.115			
	Lower-bound	6728.198	26.000	258.777			

Table 9 present repeated ANOVA tests results of within-subject effect in relation to the rarticipants' MCS and PCS. Using the Sphericity Assumed row for MCS, there was no significant main effect on the MCS after 12 weeks of aerobic training ($F(1.33, 33.64) = 2.67$, $p = .079$, $\eta p2 = .09$).

Since the Greenhouse-Geisser and Huynh- Feldt values of the Mauchly's test of sphericity are above .75 to interprete the within-subject effect of the participants' PCS the Huynh- Feldt row was used. Therefore, using the Huynh- Feldt row for PCS, there was no

significant main effect on the PCS after 12 weeks of aerobic training (F (2, 52) = 1.81, p = .18, ηp2=.07).

Table 10

The Pairwise Comparisons of the Participants' MCS and PCS (n=27)

	(l) Time	(J) Time	Mean Difference (l-J)	Std. Error	*P* value	95% Confidence Interval for Difference [a]	
						Lower Bound	Upper Bound
MCS	Pre-test	Week 8	-4.33	3.061	.506	-12.167	3.500
		Post-test	-6.148	2.947	.141	-13.689	1.392
	Week 8	Pre-test	4.33	3.061	.506	-3.500	12.167
		Post Test	-1.815	2.087	1.000	-7.156	3.526
	Post -test	Pre-test	6.148	2.947	.141	-1.392	13.689
		Week 8	1.815	2.087	1.000	-3.526	7.156
PCS	Pre-test	Week 8	-3.444	3.634	1.000	-12.745	5.856
		Post-test	-5.852	3.611	.352	-15.092	3.388
	Week 8	Pre-test	3.444	3.634	1.000	-5.856	12.745
		Post Test	-2.407	1.583	.421	-6.458	1.643
	Post -test	Pre-test	5.852	3.611	.352	-3.388	15.092
		Week 8	2.407	1.583	.421	-1.643	6.458

Table 10 gives the *post hoc* comparisons which depicts where exactly the differences occurred if an overall significant difference has been achieved. There was no significant difference depicted from any pair in table 10.

4.2 Discussion of results

The paired t-test of selected health characteristics of HIV-positive participants before and after 12 weeks of aerobic training showed that there was statistically significant difference in VO_2 max, BMI and visceral fat. The body fat percentage, body muscle percentage, CD4 count, and lipid profiles before and after intervention showed no significant difference. The Paired t-test analysis of the MCS was statistically significant before and after twelve weeks of aerobic

training intervention, while the PCS showed no statistically significant difference before and after twelve weeks of aerobic training intervention.

A repeated measure ANOVA using the Sphericity Assumed determined mean value of MCS was not statistically significant between assessment stages (pre-test, week 8 and post-test) (F (1.33, 33.64) =2.67, p = .079). Post hoc test using the Bonferroni correction revealed a slight increase in the value of MCS at all assessment stages (78.88 ± 14.33, 83.22 ± 13.81, and 85.03 ± 10.53). A repeated measure ANOVA with the Huynh- Feldt correction determined the mean value of PCS was not statistically significant between assessment stages (pre-test, week 8 and post-test) (F (2, 52) =1.81, *P* =.18). *Post hoc* test using the Bonferroni correction revealed a slight increase in the value of PCS at all assessment stages (77.33 ± 14.02, 80.78 ± 15.03 and 83.19 ± 12.35).

There are so many reports on the importance of exercise to the general population. Recently, several studies emerge proving that exercise is beneficial to the HIV infected population, as for any other human being (Maduagwu et al., 2017; Schlabe et al., 2017). Though several studies emerge mostly from developed nations, there are few studies on physical activity or training that involves people who are HIV positive in Sub-Saharan Africa (Vancambfort et al., 2018). People in different countries are treated in different ways; when it comes to HIV therapy some take long to be initiated in to HAART. In other countries their research sometimes involves people who are not on therapy. Chisati and Vasseljen (2015) did a study involving HIV positive individuals who were not on therapy comparing them to HIV negative people. Botswana is different as everyone is initiated into HAART if HIV positive; hence the need to conduct a study of this nature that is relevant to the nation. The present study supports that there are benefits of aerobic exercise. To the best of my knowledge, this is the first study in Botswana that compare pre-post 12 weeks of aerobic training effects on lipid profile, CD4 count body composition,

aerobic capacity and health-related quality of life of HIV-positive adults on HAART therapy under Botswana Network of People Living with HIV/AIDS.

It was not easy at first. The study had 28 participants. There were 23 female and 5 male participants. One female participant dropped out leaving 27 participants. That is 3.6 % drop-out rate. That was a very low drop-out rate as compared to other studies. There are some studies that involved HIV positive participants in exercise and they experienced a drop out of more than 20%. In their study Bonato et al. (2017) had 29 % dropout rate of participants from the study, Tiozzo et al. (2013) experienced 38 % dropout rate. Schlabe et al. (2017), in their research of 12 months, 21 HIV positive participants were enrolled, 8 did not finish training period while only 13 participants completed training and participated in the marathon. John et al. (2018) conducted a study on effects of 6 weeks of aerobic exercise program on the cardiovascular parameters, body composition, and quality of life of people living with HIV. There were 60 participants but 8 dropped out; 5 from experimental group and 3 from the control. Their study demonstrated a 16% drop-out rate. The study subjects achieved higher completion rate (80 %). Oursler et al. (2018) did a study with 22 HIV positive men in an aerobic exercise for 16 weeks; their attrition rate was 27 %.

The observed dropout rate from the present study may be as a result of the kind of participants I had because they were mature and probably determined to see whether or not exercise could help their cause. Some participants were workers; hence able to come for training most of the time without transport fare problems. Others were well known HIV activists, motivational speakers, and counsellors by profession and from the onset they were prepared to complete the exercise program. There was one-on-one discussion on the importance of the study with the participants. Therefore, from the onset they were well informed about what they were

going to do. Each time someone was running late for training or missed a session I had to call and hear the reason and kept motivating them to come for training. Though they completed, some missed some training days (see Table 4) due to, social issues, personal issues, work related issues and or illness like influenza because the training period was during the cold winter period from May to August. Vancampfort et al. (2018) did a systematic review and found out that in Sub-Saharan Africa, participation in physical activity by HIV-positive individuals is associated with a range of complex factors such as demographic and biological factors.

Participation in a study like this was first time experience for all the participants and the researcher. When someone volunteers for something, there is always that high expectation. Therefore, one has to work really hard to keep up with the demands of daily activities. Be alert to attend to issues that could arise from the participants. Since the participants were from BONEPWA some knew each other and were able to give support and encouragement to each other to come for training.

4.21 Effects of aerobic training on body composition

The findings of this study indicate that aerobic training had an effect on body composition as shown by a statistically significant ($p < .05$) decrease in body mass index of participants after intervention. Therefore 12 weeks of aerobic training can improve body composition. In their review, Vancampfort et al. (2018) expressed that lower levels of of physical activity was associated with higher BMI.

The results of this study are consistent with those of Bonato et al. (2017), Mangona et al. (2015), Perez-Gomes (2013) and John et al. (2018) who found a significant reduction in weigh and body mass index of HIV positive individuals after exercise intervention. In their study, John

et al. showed that even 6 weeks of aerobic exercise intervention which included nutritional guidance in HIV positive participants can lead to improvements (decreases) in the body composition parameters in the experimental group.

The results of this study are not consistent with those of Yar'zever et al. (2013) who investigated the effects of 12 weeks of cycle exercise programme on CD4 count and viral load in HIV sero-positive patients in Kano, Nigeria. They found no significant difference in weight and body mass index of HIV positive individuals' pre and post intervention. The effort people put toward an exercise program and their lifestyle matters because the participants since they volunteered they could just attended but without putting more effort into the cycle exercise program. Yar'zever et al. explained that only 75% of the participants in the experimental group complied with the exercise program, their study had no restrictions on alcohol, smoking and patients' lifestyle.

In this study there was a reduction in visceral fat which was statistically significant ($p < .05$). As for body fat percentages and body muscle percentage, there were no significant differences ($p > .05$) after intervention but they were all stable. The results of this study are consistent with those of Da Silver et al. (2015) who found out that after 1 year of training with regards to muscle mass, there was no significant increase observed in total skeletal muscle mass, appendicular skeletal muscle mass and body fat. The trunk remained stable in both men and women. Bonato et al. (2017) conducted a study for 12-weeks enrolling HIV positive sedentary individuals with metabolic complications. They were all on treatment. Bonato et al. found no significant changes observed by dual-energy x-ray absorptiometry (DEXA) of fat and lean mass or of superficial, visceral or total fat by ultrasonography.

The findings of this study are inconsistent with those of John et al. (2018) who found statistically significant improvement in muscle mass after exercise intervention with HIV positive individuals. In their study Mangona et al. (2015) found out that body fat decreased significantly in all groups after intervention. Perez- Gomes et al. (2013) also found out the 10 weeks of endurance training decreased body fat in young men as well as fat % even fat and percentage of fat at trunk and at the abdominal region. Some researchers found a significant reduction in thorax, waist-hip ratio, body fat (Bonato et al., 2017; Mangona et al., 2015; Mendes et al., 2013).

4.22 Effects of aerobic training on lipid profile

When comparing the mean of total cholesterol (TC) before intervention 4.13 (.73) and after intervention 3.78 (.88), there was a decrease of 1.09% but it was not significant ($p > .05$). High density lipoprotein, Low density lipoprotein and triglycerides were all stable. The findings of this study are consistent with that of Mangona et al. (2015) because high density lipoprotein and triglyceride had no differences found after intervention. Also, Bonato et al. (2017) and Schlabe et al. (2017) found a reduction in total cholesterol after intervention in training groups.

Contrary to my findings Maduagwu et al. (2015) conducted a study on the moderate intensity aerobic exercise on CD4 cell counts, total cholesterol (TChol), triglycerides (TG), high density lipoprotein (HDL) and low density lipoprotein (LDL) of HIV infected persons. The results of their study indicated significant improvement in the variables between pre-test and post-test in the experimental group. Significant difference also existed in the variables between the experimental and the control groups at the end of the study. In the control group, there was a significant improvement and significant increase in TG between pre and post-tests, while TChol, HDL and LDL had no significant difference. Mangona et al. (2015) in their study found that

cholesterol increased after intervention in their participants. Bonato et al. (2017) observed a reduction in low density lipoprotein cholesterol and an increase in high density lipoprotein cholesterol. Perez-Gomes et al. (2013) found that HDL significantly decreased for endurance group. In their review Albarrati et al. (2018) found out that low to moderate aerobic intensity did not reduce LDL except in few studies that had been limited to specific population.

All the participants were on HAART treatment some on statin. HAART, according to Husain and Ahmed (2015), is associated with hypercholesterolemia, increase in LDL-C, hypertriglyceridemia and lowered HDL-C in most people. Therefore, one could end up with lipodystrophy and fat redistribution problems such as lipohypertrophy, lipoatrophy, and or a mixed syndrome (Husain & Ahmed, 2015). The total HDL and LDL cholesterols are each independent strong predictors of CVD. Therefore, elevated LDL is often a target for cholesterol lowering therapy. Most patients who are on HAART because of its known effects are on lipids lowering drugs (statin) which are used to treat patients with dyslipidemia (Wang & Xu, 2017). Moderate aerobic exercise should be recommended for sedentary HIV positive individuals to help fight risks associated with lipodystrophy, fat redistribution and cardio vascular diseases.

4.23 Effects of aerobic training on CD4 count

This study shows that CD4 count mean and standard deviation difference before 763.00 (270.85) and after 766.30 (266.79) intervention was stable hence no significant difference ($p > .05$). Having a stable CD4 count is a positive finding. The norm CD4 count ranged from the lab report was 374-1527 cells/uL so the participants were within the expected ranges pre and post training. They had higher CD4 count scores as compared to other studies (Anandh et al., 2014; Ezema et al., 2014; Mangona et al., 2015; Yar'zever et al., 2013) who had participants with low CD4 counts. This could be the reason why it was even a challenge to increase such to a

significant value. Some studies experience significant improvement in CD4 cell counts in the experimental group which could be attributed somehow to the lower scores observed at baseline which improves significantly after intervention (Maduagwu et al. 2015).

Like my study, Ibeneme et al. (2019) engaged HIV positive individuals in aerobic and resistance exercises and found no significant effects on CD4 cell count. Mangona et al. (2015) engaged Mozambican women in 12 weeks of exercise. They divided them into; formal exercise (aerobic) group, playful exercise group and control group but they found no significant effect on CD4 count after intervention. The exercise participants that took part in the study by Tiozzo et al. (2013) demonstrated a more stable CD4 count from baseline while the control group experienced a significant reduction after 12 weeks of exercise. Schlabe et al. (2017) after engaging HIV positive individuals in a study for a year did not find significant change in CD4 cell count after 3 months but they did find a significant change after 6 and 12 months. They (Schlabe et al.) observed a significant increase in CD4 cell count of 20% in the compliant exercise group while in the non-compliant exercise group a decrease was found. The increase in CD4 counts may be an effect of longer training period compared this study. The training period of their studies was over one year; a very long training period.

In their study, that had aerobic training group and resistance training group, Anandh et al. (2014) proved that there was a statistically significant difference in CD4 counts. Yar'zever et al. (2013) recoded a substantial increase in CD4 count and a decrease in viral load in the exercise group while the control group had a decrease in CD4 count and an increase in viral load. With Yar'zever et al., exercise group trained for 12 weeks while control group joined at 6 weeks up to week 12. This shows that 6 weeks of aerobic training did not affect CD4 count. When CD4 count reduces, the viral load increases because CD4 cells help fight against the HIV.

Maduagwu et al. (2017) did a study that was aimed at investigating the effectiveness of 12 weeks aerobic exercise on the quality of life and CD4 cells of HIV seropositive patients in Nigeria. At the end of their study, there was a significant improvement ($p<0.05$) in CD4 cell counts between pre-tests and post-tests in the experimental group. They also recorded a significant difference ($p < 0.05$) in the control group. In 2015, Maduagwu et al. recorded an improvement that was significant ($p < 0.05$) in the CD4 count of the exercise and control group. Similarly in 2013, Mendes et al. (2013) reported an increase of CD4 count in both the exercise and control groups after 24 weeks of resistance training with aerobic component. When looking at the fact that the control group did not exercise but had an increase in CD4 count then CD4 count increment could be attributed to adherence to HAART. In attending to weekly lectures in Mendes et al. study all participants learnt about the importance of adherence to HAART to which they might have taken their treatment seriously. With proper intake of medication, the immune system becomes strong because HAART slows the progression of HIV to AIDS if an individual takes it seriously. This enables the CD4 count to increase and or become stable. Vancampfort et al. (2018), in their review, found out that lower levels of physical activity were associated with lower levels of CD4 count, a higher viral load and the presence of opportunistic infections. Hence, some moderate levels of aerobic training are good for HIV-infected persons.

4.24 Effects of aerobic training on VO_2 max

From the results of this study, aerobic training had a significant effect ($p < .05$) on VO_2 max after intervention. The VO_2 max scores increased after twelve weeks of training. An improvement in VO_2 max is good as it impacts positively on the HIV infected individual. Our findings are in line with those of other researchers like of Ezema et al. (2014), John et al. (2018) and Mendes et al. (2013) who found out that cardiorespiratory fitness (VO_2 max) improved

significantly after exercise intervention in the experimental group as compared to the control group. Oursler et al. (2018), in their pilot trial, demonstrated that moderate intensity aerobic exercise and a high intensity aerobic exercise in older HIV infected men increase endurance and ambulatory function.

This study shows that aerobic exercise can improve aerobic capacity since VO_2 max is an important measure of aerobic capacity. A decline in aerobic capacity may lead to lower endurance, quicker fatique, and reduced independence during daily life activities (Tiozzo et al., 2013). This could also reflect on the participants as some used to miss training because they felt tired from the previous day's activities or just from their daily life activities. Marzel et al. (2018) explains that, increased physical activity might improve cardiovascular and other health benefits in HIV positive individual.

4.25 Effects of aerobic training on the mental and physical health related quality (HRQoL) of life of participants

The physical and mental-health component summary measures of participants were derived from the SF-12 v1 before aerobic training, after 4 weeks, 8 weeks and after 12 weeks of Aerobic Training. The mean and standard deviation of the mental-health component summary (MCS) measures of participants showed improvement (an increase) throughout the 12 weeks of aerobic training. Before intervention the mean and standard deviation scores of MCS were 78.89 (14.33) respectively; after 4 weeks of intervention the scores increased to 79.93 (16.90). After 8 weeks of intervention, it was 83.22 (13.83). This showed positive improvements though not statistically significant. The statistically significant results were reflected after 12 weeks of intervention. The mean and standard deviation increased also to 85.04 (10.53) respectively. The findings of this study are in line with that of Mbada et al. (2013), who conducted a case control

study on health-related quality of life and physical functioning in people living with HIV/AIDS. The study involved 37 people living with HIV/AIDS (PLWH) and 37 control group who were HIV negative.They all completed a self-report SF-12 questionaire and the SF-12 mental-health component score (MCS) of HIV positive individuals in their study which was higher than that of the control group.

The mean and standard deviation of the physical-health component summary measures also increased. The increase of this component was not statistically significant throughout the twelve weeks of aerobic training. Before intervention, the mean and standard deviation were 77.33 (14.02) respectively and after 4 weeks of intervention, it increased to 77.78 (15.11). After 8 weeks of intervention, there was an improvement also with the mean and standard deviation of 80.78 (15.03) even after 12 weeks of intervention in which an improvement was recorded 83.19 (12.35). Just like my findings, Mbada et al. (2013) found no significant difference in the SF-12 physical-health component score (PCS) of people living with HIV/AIDS and the control group ($p = 0.782$) in their case-control study of HIV positive and negative participants.

Contrary to my findings, Gomes-Neto et al. (2016) in their cross-sectional study used the Short Form-36 (SF-36) to assess the health related quality of life. The SF-12 I used was derived from the SF-36; it was basically the short version of SF-36 (Montazeri et al., 2011). Gomes-Neto et al.'s study objective was to determine if aerobic capacity and health related quality of life was decreased in HIV positive individuals on HAART. They compared patients with and without lipodystrophy. The domains of SF-36 for patients with lipodystrophy that had lower values were pain, vitality, general health and mental health. When comparing patients with and without lipodystrophy only the SF-36 domain of functional capacity was low in the group with

lipodystrophy. The lower values show a reduction in the health-related quality of life. An increase in values shows an improvement in the health-related quality of life.

The current study indicates that aerobic training is good, safe and can positively impact HIV-positive adults. Aerobic exercise can promote improvements in different health domains and wellbeing of HIV positive individuals (Archer, 2016). Aerobic training can delay the progression of HIV to AIDS, improve the quality of life of an individual and improve their aerobic capacity (Grace, Sample & Combrink, 2015; O'Brien et al., 2015). Aerobic exercise is good in lowering blood pressure (Ezema et al., 2014; John et al., 2018; Mendes, 2013) and can be a complementary therapy in lowering blood pressure according to John et al.

Combined aerobic and resistance (strengthening) exercises is an effective way of improving ones quality of life (Gomes-Neto et al., 2015; Ortiz, 2014). Tiozzo et al. (2013) advocated for short term combined exercise training as it improves the health of HIV infected patient. Such intervention can reduce the impact of physical impairments related to HIV infection and the effects of HAART coupled with sedentary lifestyle. Such impairments affect ones quality of life and participation in the society (Ortiz, 2014).

4.26 Reflection on the cited studies in relation to the current study

The cited studies differed in inclusion and exclusion criteria from the current study. For most of the participants in this study it was their first time experience training in a gymnasium and doing a monitored training program. Some studies engaged participants with CD4 count that ranged from 200-500 cells/uL (Yar'zever et al. 2013) or from 200-750 cells/uL (Anandh et al., 2014; Ezema et al., 2014; Mangona et al., 2015). The participants of this study had a mean and standard deviation of CD4 count before and after intervention at 763.00 (270.85) and 766.30

(266.79) respectively. The participants' CD4 count was high. This could also be because in Botswana people are initiated into HAART immediately upon testing positive to HIV; hence improved and stable CD4 count ranges.

There were some studies that were carried without exercise intervention and reported a low VO_2 max in HIV positive individuals on HAART. One example is the study by Gomes Neto et al. (2016) who found out that aerobic capacity values were reduced in HIV-infected patients under HAART when compared to predicted values. This is possible because at baseline, the VO_2 max values are reduced but after intervention the values sometimes increase to show improvement. Other researchers compared HIV-positive individuals who were not on HAART to HIV-negative individuals; Chisati and Vasseljen (2015) hence significantly lower VO_2 max reported on HIV-positive individuals as compared to their control group of HIV-negative individuals. Their findings were not surprising because they compared people with a compromised immune system to the ones with a better immune system. Usually, HIV-positive individual fight for survival unlike the HIV-negative individuals because HIV negatively impact on one's health.

Various cited studies used variety of training programs. There was no single training done to validate training programs by any of the past researchers. The current exercise guidelines in literature are generalized with gaps in knowledge about the exercise mode, duration, intensity and frequency needed to produce beneficial changes in the HIV-positive individuals. The way people train could have a positive or negative impact on the outcome of their performance. Schlabe et al. (2017) noted that, there is a need to have a common program and manipulate its intensity, duration and frequency parameters for the HIV positive individuals.

In this study, the participants trained three times a week, in the evening from 1730 hours to 1830 hours; that is three hours weekly. With shortage of heartrate monitors, the sound system had to be controlled especially the weekly beats per minute of songs (Table 2). From low intensity beats at first week (50-55 b/min), this gradually increased on weekly basis. The target training heart rate also was gradually increased on weekly basis. Aerobic training aimed for 75% TTHR at 12 weeks.

Contrary to our approach, Schlabe et al. (2017) were not afraid to push training a bit higher because for them duration of training was 3-4 hours at first training period. Their participants trained at 60-70% of maximum heart rate in the first 12 weeks. Then Schlabe et al. increased their hours of training to 6 hours per week, intensity to 70-80% of maximum heart rate. After seven months, training moved to 7-10h per week; then 2 weeks before marathon 60-70% of maximum heart rate. They began to report significant improvements in various health variable CD4 counts included.

Anandh et al. (2014) had three groups of aerobic training, progressive resistance training and control group in their study. Aerobic training comprised 10 minutes warm up, 30 minutes aerobic training (walking on a treadmill, arm ergometer, elliptical trainer each 10 minutes daily) and 10 minutes cool down. The intensity was 50% for the first month, 60% for the second month and 70% for the third month while Ezema et al. (2014) did moderate intensity continuous exercise training at 60-79% of maximum heart rate, 45-60 minutes, 3 days a week for 8 weeks. In their systematic review Ibeneme et al. (2019) found out that engaging in moderate intensity aerobic exercise of 55-85% maximum heart rate, for 30-60 min, two to five times a week for 6 - 24 weeks significantly improved role activity limitation due to physical health problems.

There are many tools used by various researchers to assess health-related quality of life while in the current study I used SF-12. In their study Gomes-Neto et al. (2016) used SF-36. There are some reviewed studies which used various tools like Medical Outcome Study-HIV Short Form-36,SF-35, SF-30, SF-12v2, SF-2, Life Index, Sickness Impact Profile, Quality of Life Enjoyment and Satisfaction questionnaire (Q-LESQ) (Bhatta, Liabsuetrakul & McNeil, 2017; Grace, Semple & Conbrink, 2015).

CHAPTER 5

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The purpose of the study was to compare pre-post 12 weeks aerobic training effects on lipid profile, CD4 count, body composition, aerobic capacity and health-related quality of life among HIV-positive adults on HAART treatment under the BONEPWA organisation in Gaborone.

The finding of this study showed that aerobic training was beneficial to the general health and wellbeing of HIV infected individuals. There were significant improvements recorded from body composition (BMI and visceral fat ratings) and mental-health component summary pre-and post-intervention scores. CD4 count levels and physical-health component summary improved but not significantly. It is worth noting that all participants had their CD4 counts within the normal range. There was a significant improvement in VO_2 max scores. The study found no significant improvements in the total cholesterol, high density lipoprotein cholesterol, low density lipoprotein and triglyceride. The study had a small dropout rate with very few participants missing training. When all participants do not train as planned, they end up affecting the outcome of the study negatively.

In the reviewed literature, some studies used HIV-positive participants with different inclusion criteria; some had low CD4 counts. The training method, duration, frequency and intensities varied from one study to the other. Though researchers tackled issues from different point of view they proved that various training methods, especially at moderate intensity, are good for HIV positive individuals. A well supervised training program is more beneficial as it

can monitor various health characteristics and one can receive proper, specific and relevant advice.

5.2 Conclusion

Aerobic training of HIV-positive adults under BONEPWA for 12 weeks resulted statistically significant differences in BMI, visceral fat and VO_2 max. The CD4 count and lipid profiles had no significant difference before and after intervention. The Paired t-test analysis of the mental-health component summary was statistically significant before and after twelve weeks of aerobic training intervention while the physical-health component summary showed no statistically significant difference before and after twelve weeks of aerobic training intervention. When using repeated measure ANOVA, the mean value of MCS and PCS were not statistically significant between assessment stages.

Following the results of the study, it can be concluded that HIV-positive adults on HAART can be advised to take part in aerobic exercise training if they wish to obtain significant improvement in various health variables such as BMI, VO_2 max and MCS. The HIV-positive adults should be advised that aerobic training alone would not significantly increase their CD4 count. As a result, they must always use their HAART medications as prescribed by the medical practitioner while engaged in aerobic training.

5.3 Recommendations

a) HIV positive individuals who are on therapy need to be encouraged to participate in aerobic training, as the study has shown that there are health benefits that can be derived from such training

b) Many studies could be done manipulating various training programs, intensity, duration and frequency with gradual increase in weekly training days.

c) I recommend a study with control group and more male participants

d) A study that has control over the diet of participants could be helpful.

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APPENDIX A

PILOT STUDY

1. Outcomes of the pilot study

This pilot study is the mini data collection version of the major study. A pilot study assist in planning and modification of the main study and it is the first step of the entire research protocol (In, 2017). The pilot study in this research was self-sponsored and it followed the proposed methodology of the major study. Where changes occurred, it was, mainly because of the findings of the pilot study. This section will therefore give feedback on areas that were amended from the proposal and reasons behind their implementation to the research.

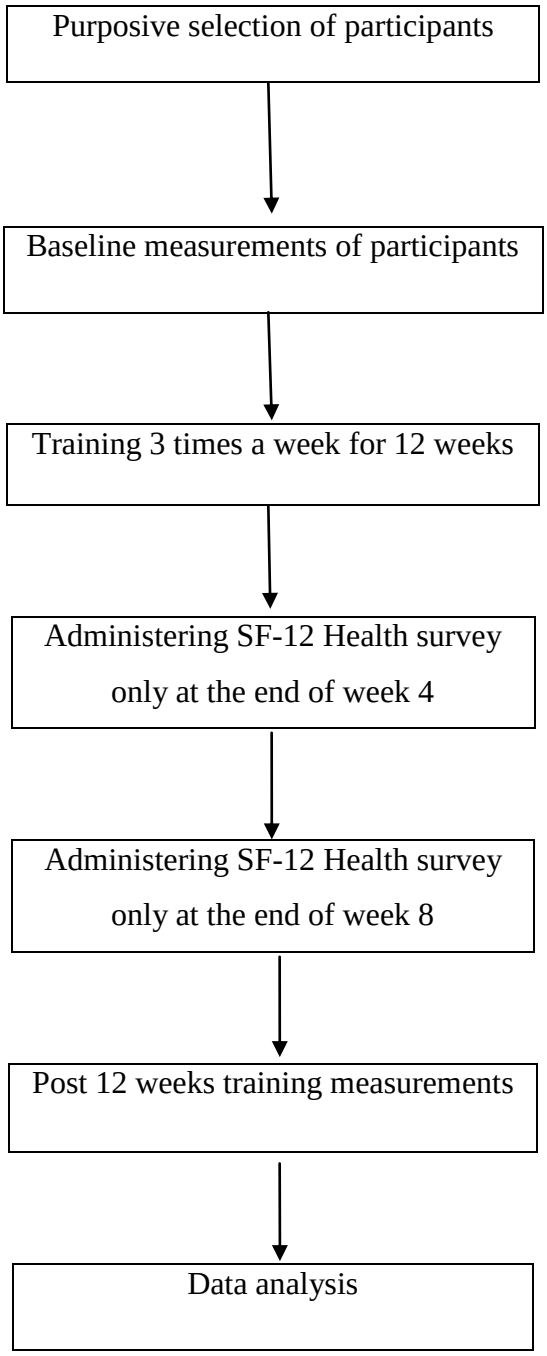
2. The Objective of the pilot study

The objective of the pilot study was to familiarize the researcher with data collection processes, validate instruments for data collection and to assess the feasibility of the study.

3. Research design

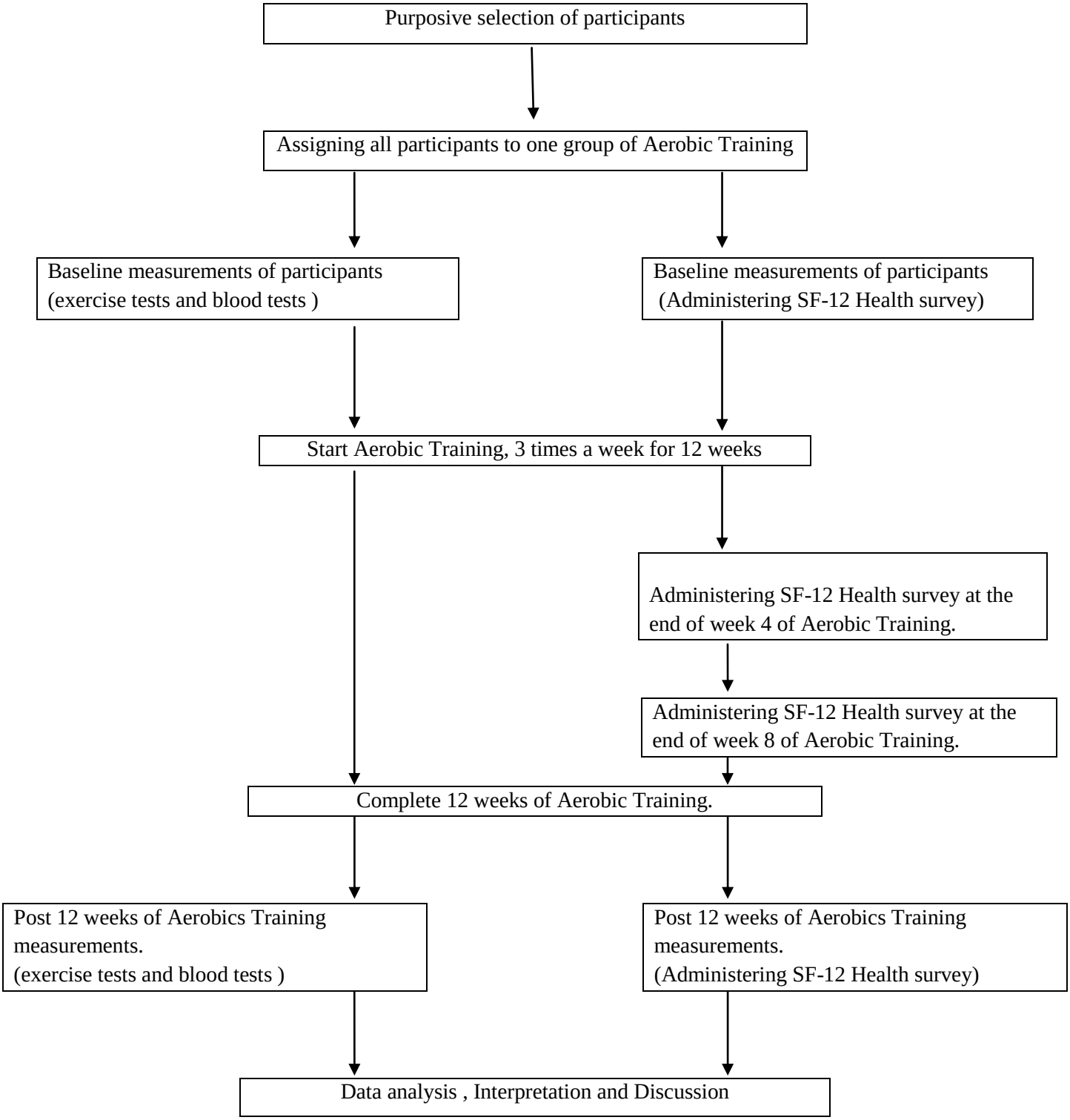
The pilot study followed the research design as it was proposed. After pilot studies the initially proposed flow chart showing the research design (figure 2) was amended to the one on figure 3 but with further advices from the supervisor it was finalized to the one on figure 1. It was amended form the proposed one, figure 2, because it did not clearly represent or reflect all data collection stages well. The flow chart on figure 3 was also amended because it was presented as if there were two groups of participants.

Figure 2



A flow chart showing the research design

Figure 3



A flow chart showing the research design

4. Population of the study

The pilot study targeted male and female HIV-positive adults who were 18 to 35 years. The participants were volunteers from patients who attended the Greater Gaborone clinics. The clinics that were approached were the government clinics in Gaborone close to the University of Botswana proximity. The clinics were located in Broadhurst, Tsogang, Block 8, Main Mall, Village and Bontleng, in Gaborone. Based on location of the clinics it was hoped that the volunteers would be living in Gaborone, close to the University. That way they would spend less or nothing on transport to reach the University of Botswana gym room. It proved difficult to find many participants of age range 18 to 35 years as people above 35 years were showing interested at a higher rate than the proposed age. The researcher then adjusted age to a maximum 45 years. This was in anticipation that even for the data collection phase one could struggle to find participants if age restriction was at 35.

6.5 Sample and Sampling Procedure

The researcher submitted request letters with attached ethical clearance from the University of Botswana and Ministry of health IRB to the selected clinics as a way of requesting for a permission to place flyers (figure 4) on selected Infectious Disease Care Clinic (IDCC) side only. With advice from the nurses in charge of the clinics, the researcher secured permit from the Greater Gaborone District Management Team (GGDHMT) (Appendix P) that also allowed the researcher to gain access to clinics. The IDCC area in clinics is where most HIV positive patients do their routine visits (Ministry of Health Department of HIV Prevention and Care, MASA, Treat all, 2016).Placing flyers there was the best way to reach out to those who could participate. The researcher was only reaching out to HIV positive adults who could voluntarily open to her about their HIV status. Placing the flyers there gave HIV-positive adults access and a voluntary

choice to read the flyer and reach out to the researcher on the cell phone number that was provided on the flyer for clarity, explanation, face-to-face meeting and or for volunteering to join. A flyer is a form of paper advertisement intended for wide distribution and usually posted or distributed in public places (Kramer, 2019).

Nineteen people called me in response to the advert, fifteen made it to the scheduled face-to-face meetings for explanation about the pilot study. One volunteer lived outside Gaborone so he was rejected on the basis of location. All the fourteen volunteers met the inclusion criteria and joined the pilot phase. Purposive sampling was used only after HIV positive adults volunteered for the study through the same inclusion and exclusion criteria. The participants were also told that they were taking part in the pilot study.

Figure 4

Information flyer

6. Ethical consideration

The IRB of the University of Botswana and the Ministry of Health and Wellness of the Republic of Botswana had already reviewed the study proposal and gave a go ahead, Appendix N and O respectively. The GGHMT, Appendix P gave permit that helped the researcher to reach out to participants who were engaged in the pilot study. IRB in research helps protect human participants and also helps researchers from making mistakes (Bloss et al., 2016). Prior to the study every participant signed an informed consent form to take part in the pilot study.

It is worth noting that no clinic staff was involved in the selection of participants. There is no worker at any clinic who was assigned to talk about the research to the visiting patients. The flyers were just place on the table inside the IDCC for anyone interested to collect, read on what it offered and make a follow up individually.

7. Validity and reliability

After a week of practice on how to use the instruments, they were now used in a pilot study. The usefulness of any test or measurement is determined by its validity and reliability (Wakins, 2018). Reliability is the consistency of measurements, simply the stability of a score in repeated measures (Wakins, 2018). The instruments such as the sphygmomanometer, weighing scale, stadiometer, segmental body composition analyzer and treadmill were properly checked for any defects and were calibrated by the qualified and certified Biomechanics laboratory technician before they could be used for the research. Calibration can help address systemic measurement error (Advanced Instructional Systems & The University of North Carolina, 2011).

There were several practice sessions on how to carry out measurements under the supervision of the trained and certified laboratory technician before conducting the pilot study. A qualified, experienced phlebotomist from the Diagnofirm Medical Laboratory was responsible

for collecting blood samples and the qualified and certified lab technician at the carried out the blood tests. The same phlebotomist and lab technician were responsible for both the pre and post-tests. The Diagnofirm Medical Laboratory also gave proof to the researcher that their laboratory was certified and accredited to conduct such tests (Appendix J)**.**

Measurement error interferes with the reproducibility of a test or score when the measurement is repeated which compromises reliability and affects the ability to measure change (Edmonds & Kennedy, 2017). There was an SF-12 health survey which could be ambiguous or unclear to some people. To ensure the questionnaires were clear and understandable to all individuals there was a Setswana and English language versions of the tool. The researcher qualified in teaching languages translated the health survey then gave it to other language experts to check if it was translated properly. To ensure that participants were not impatient to a point of getting distracted when filling the survey a short version of the health survey was used. They also submitted the forms individually that way there was a chance to check for any unanswered question before parting with them. For data analysis the researcher was the only one involved in inputting and cross checking of any missing data. Participants were observed on how they handled answering the SF-12 health survey.

Training was done at the same location, at the same time, 3 times a week, under the same instructors and supervised by the researcher. For training adherence, participants' attendance was monitored through attendance register and praised for their attendance. Communication through mobile telephone calls and messages was important during this process. It was useful for motivational talks with participants to encourage them to come for training, checking on how participants were doing, or just for participants to inform the researcher when one was not able to come for training.

Measurements were taken in the same manner in all participants during the pre and post data collection stage. The sequence was to fill in the SF-health survey, then collect their resting blood pressure, measure their height, use Bioelectrical Impedance Analysis scale for body composition, extract of blood samples and then do exercise testing. As for VO_2 max test, they all had to ensure that they did not touch the handles, or any part of the treadmill while doing the test. This helped control for posture during the test which could be helpful in reducing error of inconsistency in measurement protocol. All the instruments used were checked the day before the test and two hours before the test procedures to ensure that everything was working properly. The Diagnofirm Medical Laboratory manager and nurse were called by the researcher to remind them of the day of the test and to confirm if they will send the phlebotomist for my participants.

8. Data record sheet

The data collection sheet (figure 5) that was proposed was changed to the one presented in Appendix G because it left out some variables. It also wasted resources as it required two papers for pre and post measurement for it to be used but the current one was made such that both the pre and post measures for a particular participant are in one form at the end.

Figure 5

DATA COLLECTION SHEET

ID Number_____ Date_____

Age_____ (years) Gender a) Male_____ b) Female_____

Blood Pressure (BP) _____ (mm/Hg) Heart Rate (HR)_____b/min

Height _____ (cm)

MULTI-FREQUENCY BIOELECTRICAL IMPEDANCE ANALYZER RESULTS

Body weight _____(kg) BMI _____ (kg/m^2)

Body fat percentage _____ (%) Body fat mass _____ (kg) Segmental fat% Trunk: _____
LA _____ RA_____ LL_____
RL_____

Body muscle percentage _____ (%) Body muscle mass _____ (kg) Segmental Muscle Mass: _____
LA _____ RA_____ LL_____
RL_____

Body water % : _____ Body water: _____(kg)

Basal Metabolic Rate:_____ (kj) Basal Metabolic rate: _____(kcal)

Visceral fat rating _____ (kg/m^2)

EXERCISE TEST RESULTS

Time on tread mill _____ (s) VO_2 max _____

Data collection sheet

9. Exercise protocol

All participants were subjected to 12 weeks of moderate intensity aerobic training. The proposed weekly training program, table 11 was amended to the one in table 1. After a review of

the propose program with the qualified instructors there was need to include various exercises and for motivational purposes name the aerobic exercise training programs offered on various days. The pilot study can help identify actual potential problems that researchers can address before beginning the anticipated future study (Fahlman, Arscott & Guillot, 2018).

Table 11

The Weekly Aerobic Training Programm

Week	TTHR %	Borg RPE	Metronome b/min	Training Program frequency 3 times a week
3-4	50	9	50	-10 minutes warm up - 20 min floor aerobics training (Monday and Friday) - 20 min jog on a treadmill (Wednesday) - 10 min cool down activities
4-5	55	10	55	-10 minutes warm up -20 min floor aerobics training (Monday and Friday) -20 min stationary cycling (Wednesday) -10 min cool down activities
6-7	60	11	60	-10 minutes warm up -20 min floor aerobics training (Monday and Friday) - 20 min jog on a treadmill (Wednesday) - 10 min cool down activities
8-9	65	12	65	10 minutes warm up - 20 min floor aerobics training (Monday and Friday) - 20 min stationary cycling (Wednesday) - 10 min cool down activities
10-11	70	13	70	-10 minutes warm up - 20 min floor aerobics training (Monday and Friday) - 20 min jog on a treadmill (Wednesday) - 10 min cool down activities
12-13	75	11-13	75	-10 minutes warm up - 20 min floor aerobics (Monday and Friday) - 20 min stationary cycling (Wednesday) - 10 min cool down activities

10. Data analyses

For descriptive statistics, the researcher used means and standard deviations to summarise socio-demographics of the participants. The significant differences between variables (CD4 count, lipid profile, body composition, VO_2 max, HRQoL) at baseline and week 12 in the participants were compared using the paired t-test. All analysis was done using IBM SPSS version 24.0 software. The alpha value was set at $p < 0.05$ level of significance. But after the advice from the supervisor and assessment of other methods of data analyses the researcher had to add the use of the repeated ANOVA for the repeated measures of the SF-12 health survey.

6.11 Data Analysis

Data analyzed in the pilot study was just to gain experience on how to analyze data and to check if really the data analysis methods were appropriate for the study. The results from the pilot study cannot be generalized to the population of HIV-positive adults in the Greater Gaborone since it is not representative of the population of the Greater Gaborone area. Researchers should be cautious about reporting the results of pilot study as the pilot studies are not for testing the hypothesis and the statistical significance and the statistical significance in the study does not mean that the main trial is not required (In, 2017).

6.12 Participants' statistics

Table 11

Participants' Statistics (n = 14)

	M	SD
Age	33.6429	7.21758
Height (cm)	162.6429	7.52030

Note. M = Mean; SD = Standard Deviation.

There were 14 participants, 12 females and 2 males. The participants were of mean age and standard deviation 33.64 (7.21) respectively. There were more females who volunteered than males. The way people volunteered gave the researcher a brief insight that female could volunteer more than males for data collection.

13. Attendance register

Figure 6

Participan	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
1	1	0	0	1	1	0	1	1	1	0	0	1	0	1	0	0	1	0	1	0	1	1	1	1	1	0	1	1	0	1	1	0	1	1	0	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	0	0	0	1	1	1	0	1	0	1	0
3	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	0	1	1	1	1	0	0	0	1	0	0	1	0	1	0	1	0	1	0
4	0	1	0	1	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1	0	1	0	1	0	1	0
5	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	1	1
6	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1
7	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	1	1	0	1	0	0	1	1	1	0	0	0	1	0
8	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	0	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1
10	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	0	1	1	0	1	1	0
11	1	1	0	1	1	1	0	1	1	1	0	0	1	1	1	1	0	0	1	1	1	0	1	0	1	1	1	0	1	0	1	1	1	0	1	1
12	0	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0
13	1	1	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	0	1	1	0	1
14	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	0	1	0	1	1	1	0	1	1	0	1	1	1	1	0	1

Attendance register

Though the HIV-positive adults volunteered for the study some participants would miss on some workouts days (figure 6). Through observation the researcher noticed that they missed on the workout days of a particular instructor. The researcher then enquired from the participants why they would do that. They revealed that to them the instructor was young, short tempered and would sometimes not come during the scheduled time (the ones the instructor had to facilitate). The researcher approached relevant personnel about the issue but when people feel they are taken for granted it takes time for them to change their mindset. On the data collection stage, the researcher worked with the instructors that the pilot participants tolerated. The researcher hoped to reduce the rate at which people would miss on training and hopefully decrease any possible

dropout. The pilot study is useful since it comprise of a risk mitigation strategy to reduce the chance of failure in large project (Fraser et al., 2018).

Table 12

Paired t-test Analysis of Selected Health Characteristics of HIV- Positive Participants before and after 12 weeks of Aerobic Training (n=14)

	Mean and Std. Deviation						
	Pre-test	Post-test	Mean diff	t	df	d	Sig.
VO2 max (ml/kg/min)	35.26 (8.89)	44.92(8.01)	-9.66	-8.867	13	-2.37	.000*
CHOL/HDL	3.26(.98)	3.56(.95)	-.30	-2.137	13	-.57	.052*
BMI (kg/m2)	29.11 (7.47)	28.66 (7.24)	.45	1.452	13	.39	.170
VF	6.86 (4.15)	6.43 (3.94)	.43	1.883	13	.50	.082
BMR (kcal)	1519.07(294.94)	1485.29(267.63)	33.79	1.746	13	.47	.104
SBP(mmHg)	112.86(16.19)	114.57(12.47)	-1.71	-.434	13	-.12	.671
DBP (mmHg)	74.71(8.85)	72.29(8.99)	2.42	.922	13	.24	.373
Pulse Rate	89.71(7.48)	89.36(10.27)	.37	.211	13	.06	.836
BF (%)	38.96(16.13)	35.33(9.39)	3.64	.978	13	.26	.346
BFM (kg)	29.70(15.36)	28.94(14.26)	.76	.572	13	.15	.577
SF (%)	31.76(9.19)	31.11(9.4)	.64	.732	13	.20	.477
SFLA (%)	40.64(10.56)	39.45(11.02)	1.19	.918	13	.24	.375
SFRA (%)	41.77(12.16)	38.84(11.16)	1.94	1.208	13	.32	.248
SFLL (%)	40.39(8.17)	39.94(8.21)	.45	.432	13	.12	.673
SFRL (%)	40.39(8.33)	39.79(8.500)	.59	.590	13	.11	.565
BM (%)	61.65(8.49)	62.04(9.14)	.39	-.400	13	.11	.696
BMM (kg)	46.18(8.95)	45.69(8.23)	-.49	.484	13	-.13	.637
SMM (kg)	25.92(4.49)	25.51(4.22)	.41	.716	13	.19	.487
SMM LA (kg)	2.26(.63)	2.29(.64)	-.03	-.348	13	-.01	.734
SMM RA (kg)	2.21(.60)	2.23(.65)	-.02	-.228	13	-.06	.823
SMM LL (kg)	7.51(1.57)	7.33(1.57)	-.17	1.570	13	.42	.140
SMM RL (kg)	9.69(8.41)	9.38(7.76)	.30	1.429	13	.38	.177
BW (%)	46.64(6.31)	43.59(12.88)	3.05	1.012	13	.027	.330
BWM (kg)	37.64(10.55)	38.21(12.06)	.56	-.704	13	.19	.494
TC (mmol/L)	4.13(.74)	4.13(.74)	-.01	-.046	13	-.01	.964
HDL-C(mmol/L)	1.35(.37)	1.30(.42)	.05	1.462	13	.39	.167
T (mmol/L)	1.02(.44)	1.12(.54)	-.10	-1.068	13	-.03	.305
LDL-C(mmol/L)	2.43(.69)	2.34(.72)	-.01	-.064	13	-.02	.950
Total T-Cells CD3 (cells/uL)	1670.14(504.77)	1726.07(537.74)	-55.93	-.548	13	-.15	.593
CD4 (cells/uL)	761.86(300.34)	775.29(280.31)	-13.43	-.310	13	-.08	.761

CD4 % (%)	34.32(6.41)	33.91(7.84)	.41	.684	13	.18	.506
CD8 (cells/uL)	845.36(249.86)	1396.71(1931.74)	-551.36	-1.013	13	-.27	.330
CD4:CD8	.92(.31)	.92(.33)	.00	.045	13	.01	.965

Note. SBP = Systolic Blood pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index; BF(%) = Body Fat percentage; BFM =Body Fat Mass; SF = Segmental Fat; SFLA = Segmental Fat Left Arm; SFRA = Segmental Fat Right Arm; SFLL = Segmental Fat Left Leg; SFRL = Segmental Fat right Leg; BM = Body Muscle; BMM = Body Muscle Mass; SMMLA = Segmental Muscle Mass Left Arm; SMMRA = Segmental Muscle Mass Right Arm; SMMLL Segmental Muscle Mass Left Leg; SMMRL= Segmental Muscle Mass Right Leg; BW = Body Water; BWM = Body Water Mass; VF = Visceral Fat; BMR = Body Metabolic Rate; TC = Total Cholesterol; HDL-C = High Density Lipoprotein Cholesterol; T = triglyceride; LDL =Low Density Lipoprotein Cholesterol; t = t-value; df =degree of freedom; Sig.= significance (*p < .05).

Table 13

Paired t-test Analysis of the Physical and Mental Component Summary Measures derived from the SF-12 v1 before, after 4 weeks, 8 weeks and after 12 weeks of Aerobic Training (n=14)

	Mean and Std.deviation		Mean diff	t	Df	d	Sig.
	Pre-training	Week 4					
MCS	80.50 (16.08)	82.07 (18.11)	-1.57	-.373	13	-.10	.715
PCS	78.00(14.04)	78.64 (15.47)	-.64	-.140	13	-.04	.890
	Pre-training	Week 8					
MCS	80.50 (16.08)	84.43 (12.89)	-3.93	-1.063	13	-.28	.307
PCS	78.00 (14.04)	81.21 (12.87)	-3.21	-.661	13	-.18	.520
	Pre-training	Post-training					
MCS	80.50 (16.08)	86.57(10.52)	-6.07	-1.492	13	-.40	.160
PCS	78.00(14.04)	84.29 (11.07)	-6.29	-1.198	13	-.32	.252

Note: MCS = Mental Component Summary; PCS = Physical Component Summary.

14. Feasibility of the study

Feasibility of the study is a way of assessing the practicality of the main study and often it includes resources such as time and cost for the main study (Malmqvist, Mollas, Rose & Shevlin, 2019). Provided the amendment that took place in the pilot study was met the research

was feasible and one could carry the study out. The major constraint was money. The research proved to need a lot of money (table 14).

Table 14

The Proposed Budget of the Study

Item	Amount (Pula)	Justification
Personnel		
Airtime	P200	For communication with and follow ups with participants. Even during emergency on training for the whole data collection period.
Consumables		
Toner	P1300 x 1Black toner = P1300	To use for printing research tools.
A4 Paper	P50 (500 sheets) x 3 reams =P150	For printing research tools such as consent forms, PAR-Q, Surveys, for all participants.
First Aid Kit Box	P305	To buy first aid kit box.
First aid prepack material	P250	To buy first aid prepack material.
CD4 Count and lipid profile test	P400.40 x (38x2 of pre and post test) P400.40 x 76 = P30 430.40	For pre and post 12 weeks of testing CD4 count and lipid profile by Diagnofirm Medical Laboratory.
Travel & subsistence		
Fuel trips from block 8 plot 36129 to phase 4 BONEPWA compound and back.	P2.63/km x 30km= P78.90x 5days=P394.50	5 days will be for visits to BONEPWA from Block 8 and back, for sampling.
From block 8 plot 36129/N6 to UB (Indoor sports arena) and back.	P2.63/km x 11.5km= P30.25 x 3days of demonstration = P90.75	The next 3 days will be for meeting with participants at UB, demonstrating and explaining procedures on various training modalities including the days of pre-test and that of post-test
	P2.63/km x 11.5km=P30.25x 3 days in a week= P90.75 x 12weeks =P1089	The remaining days will be for travelling to UB from block 8 and back monitoring 12 weeks of exercise
Other		
Lab Assistant	P500 x 2 days = P1000	Lab visits during 2 weekends of pre and post 12 weeks of data collection.
Total sum:	P35 209.65	

APPENDIX B

Table A1

Mean and Percentages of the Weekly Aerobic Training Attendance up to week 12

	CG (n = 18)				NCG (n = 9)			
Week	MP	%	MA	%	MP	%	MA	%
1	17	94.44	1	5.56	7.67	85.22	1.33	14.78
2	18	100			9	100		
3	17.33	96.28	.67	3.72	8	88.89	1	11.11
4	15.67	87.06	2.33	12.94	4.33	48.11	4.67	51.89
5	16	88.89	2	11.11	7.33	81.44	1.67	18.56
6	17.33	96.28	.67	3.72	4.67	51.89	4.33	48.11
7	17	94.44	1	5.56	6.67	74.11	2.33	25.89
8	17.67	98.17	.33	1.83	6.67	74.11	2.33	25.89
9	17.67	98.17	.33	1.83	5.67	63	3.33	37
10	17.67	98.17	.33	1.83	5	55.56	4	44.44
11	17.33	96.28	.67	3.72	7.33	81.44	1.67	18.56
12	16.33	90.72	1.67	9.28	5.33	59.22	3.67	40.78

Note. TCG = Compliant group (The participants who attended 95% and above of training days); NCG = Non-compliant group (The participants who attended below 95% of the training days); MP = Mean of those present on a particular week; MA = Mean of those absent on a particular week; % = percentage of those present or those absent on a particular week.

APPENDIX C

Figure B1

Attendance Register

	Week 1			Week 2			Week 3			Week 4			Week 5			Week 6			Week 7			Week 8			Week 9			Week 10			Week 11			Week 12		
Participan	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3	Day 1	Day 2	Day 3
1	1	1	0	1	1	1	1	1	1	0	0	1	0	1	0	0	1	0	1	0	1	1	1	1	1	0	1	1	0	1	1	1	1	1	0	1
2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
3	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	0	0	0	1	1	1	0	1	0	1	0
5	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	0	1	1	1	1	0	0	0	1	0	0	1	0	1	0	1	0	1	0
6	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	0	1	0	1	1	1	0	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0	1	1	1	0	1	1	0	1	0	1	0	1	0
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	0	1	1	1	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	1	1	0	1	0	0	1	1	1	0	0	0	1	0
12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	1	1	0	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
15	1	1	1	1	1	1	1	0	1	0	1	0	1	0	1	1	0	1	1	0	1	1	0	1	1	0	1	0	1	0	1	1	1	1	0	1
16	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0
17	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
18	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	1	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	0	1	0	1	1	1	0	1	0	1	1	1	0	1	1
20	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
23	1	0	1	1	1	1	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
24	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
25	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
26	1	1	0	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
27	1	1	1	1	1	1	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Note. 1 = Present; 0 = Absent.

APPENDIX D

Table C1

Paired t-test Analysis of Health Characteristics of HIV- Positive adult Compliant Group before and after 12 weeks of Aerobic Training (n=17)

	Mean and Std. Deviation				
	Pre-tests	Post-tests	t	df	Sig
SBP(mmHg)	114.67(15.76)	113.39 (12.94)	.35	17	.729
DBP(mmHg)	74.17 (9.56	69.56 (8.10)	2.202	17	.042*
Pulse Rate	90.78 (10.33)	87.11 (12.28)	1.644	17	.119
Weight (kg)	68.69 (20.48)	66.81 (19.16)	3.632	17	.002*
BMI (kg/m2)	25.91 (6.62)	25.32 (6.22)	2.748	17	.014*
BF (%)	31.04 (7.75)	34.34 (16.15)	-.958	17	.352
BFM (kg)	22.21 (12.12)	21.96 (11.99)	.309	17	.761
SF (%)	27.11 (8.40)	26.27 (8.34)	1.203	17	.246
SFLA (%)	34.01 (10.30)	32.88 (9.95)	1.416	17	.175
SFRA (%)	33.36 (10.44)	32.26 (9.97)	1.429	17	.171
SFLL (%)	35.69 (8.59)	35.46 (8.34)	.426	17	.676
SFRL (%)	35.67 (8.57)	35.51 (8.30)	.276	17	.786
BM (%)	65.44 (7.38)	65.13 (7.47)	.282	17	.781
BMM (kg)	43.80 (10.43)	44.80 (12.06)	-.823	17	.422
SMM (kg)	24.77 (4.91)	24.37 (4.89)	1.309	17	.208
SMM LA(kg)	2.22 (.79)	2.18 (.78)	1.591	17	.130
SMM RA(kg)	2.18 (.80)	2.1611 (.80)	.889	17	.386
SMM LL (kg)	7.13 (2.39)	7.20 (1.94)	-.262	17	.797
SMM RL (kg)	7.43 (1.97)	7.29 (1.84)	1.531	17	.144
BW (%)	49.44 (5.65)	47.76 (12.03)	.713	17	.485
BWM (kg)	35.34 (10.84)	34.76 (11.55)	.553	17	.588
VF	5.17 (3.75)	4.50 (3.34)	2.380	17	.029*
BMR (kj)	5990.28(1340.97)	5885.89 (1280.54)	2.100	17	.051*
BMR (kcal)	1431.33 (320.91)	1410.33 (307.14)	1.569	17	.135
TC (mmol/L)	4.33 (.73)	4.18 (.62)	1.880	17	.077
HDL-C(mmol/L)	1.27 (.37)	1.22 (.37)	.910	17	.375
T (mmol/L)	1.05 (.42)	1.17 (.71)	-1.210	17	.243
LDL-C(mmol/L)	2.59 (.67)	2.43(.56)	1.929	17	.071
CHOL/HDL	3.60 (.87)	3.72 (.84)	-.773	17	.450
Total T-Cells	1572.17	1620.00	-.458	17	.653
CD3 (cells/uL)	(535.54)	(549.50)			
CD4 (cells/uL)	689.50 (235.57)	693.56 (238.50)	-.108	17	.916
CD4 % (%)	33.12 (6.29)	32.08 (7.26)	.959	17	.351
CD8 (cells/uL)	1277.83(2060.48)	1250.33(1721.82)	.041	17	.968
CD4:CD8	.96 (.47)	.93 (.53)	.987	17	.337
VO2 max	41.71 (7.39)	50.97 (4.55)	-7.64	17	.000*

Note. SBP = Systolic Blood pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index; BF(%) = Body Fat percentage; BFM =Body Fat Mass; SF = Segmental Fat; SFLA = Segmental Fat Left Arm; SFRA = Segmental Fat Right Arm; SFLL = Segmental Fat Left Leg; SFRL = Segmental Fat right Leg; BM = Body Muscle; BMM = Body Muscle Mass; SMMLA = Segmental Muscle Mass Left Arm; SMMRA = Segmental Muscle Mass Right Arm; SMMLL Segmental Muscle Mass Left Leg; SMMRL= Segmental Muscle Mass Right Leg; BW = Body Water; BWM = Body Water Mass; VF = Visceral Fat; BMR = Body Metabolic Rate; TC = Total Cholesterol; HDL-C = High Density Lipoprotein Cholesterol; T = triglyceride; LDL =Low Density Lipoprotein Cholesterol; t = t-value; df =degree of freedom; Sig.= significance (*p < .05) .

Table C2

Paired t-test Analysis of Health Characteristics of HIV- Positive Participants Non Compliant Group before and after 12 weeks of Aerobic Training (n=9)

	Mean and Std. Deviation				
	Pre-test	Post-test	T	df	Sig.
SBP(mmHg)	115.78 (13.41)	114.56 (12.35)	.957	8	.367
DBP (mmHg)	74.11 (7.15)	76.56 (7.45)	-1.473	8	.179
Pulse Rate	85.89 (7.01)	88.22 (6.87)	-1.311	8	.226
Weight (kg)	77.86 (17.63)	77.94 (18.14)	-.123	8	.905
BMI (kg/m2)	29.12 (6.85)	29.14 (6.89)	-.083	8	.936
BF (%)	42.59 (18.16)	36.49 (8.74)	1.089	8	.308
BFM (kg)	30.93 (13.31)	29.14 (11.73)	1.237	8	.251
SF (%)	33.67 (7.94)	33.03(8.35)	.638	8	.541
SFLA (%)	42.66 (8.84)	41.79 (10.56)	.567	8	.586
SFRA (%)	44.62 (11.32)	40.99 (10.77)	1.006	8	.344
SFLL (%)	42.34 (6.01)	41.69 (6.64)	.428	8	.680
SFRL (%)	42.21 (6.42)	41.37 (7.08)	.605	8	.562
BM (%)	60.28 (8.04)	60.58 (9.02)	-.236	8	.819
BMM (kg)	45.59 (7.01)	44.94 (5.50)	.725	8	.489
SMM (kg)	25.69 (3.73)	25.77 (2.96)	-.114	8	.912
SMM LA (kg)	2.17 (.40)	2.27 (.45)	-.840	8	.425
SMM RA (kg)	2.11 (.36)	2.18 (.46)	-.471	8	.650
SMM LL (kg)	7.19 (.82)	7.18 (.84)	.085	8	.934
SMM RL (kg)	10.58 (10.46)	10.37 (9.61)	.664	8	.526
BW (%)	45.51 (5.66)	45.14 (5.66)	.359	8	.729
BWM (kg)	35.66 (6.26)	34.61 (5.38)	.827	8	.432
VF	6.56 (3.24)	6.44 (3.17)	.555	8	.594
BMR (kj)	6271.78 (944.41)	6207.44 (837.60)	.858	8	.416
BMR (kcal)	1507.11 (237.51)	1484.22 (200.93)	1.197	8	.266
TC (mmol/L)	3.72 (.55)	3.58 (1.20)	.390	8	.707
HDL-C(mmol/L)	1.23 (.32)	1.23 (.33)	-.188	8	.856
T (mmol/L)	.89 (.28)	1.04 (.38)	-1.269	8	.240
LDL-C(mmol/L)	2.12 (.47)	2.23 (.71)	-.740	8	.480

CHOL/HDL	3.23 (.92)	3.33 (.79)	-.620	8	.553
Total T-Cells CD3 (cells/uL)	1866.56 (417.26)	1914.44 (546.91)	-.434	8	.676
CD4 (cells/uL)	910.00 (289.87)	911.78 (273.38)	-.037	8	.971
CD4 % (%)	36.56 (8.79)	36.15 (8.76)	.413	8	.690
CD8 (cells/uL)	882.11 (265.14)	923.44 (383.81)	-.648	8	.535
CD4:CD8	1.12 (.49)	1.10 (.44)	.436	8	.674
VO2 max (ml/kg/min)	31.89 (5.57)	41.98 (6.19)	-7.971	8	.000*

Note. SBP = Systolic Blood pressure; DBP = Diastolic Blood Pressure; BMI = Body Mass Index; BF(%) = Body Fat percentage; BFM =Body Fat Mass; SF = Segmental Fat; SFLA = Segmental Fat Left Arm; SFRA = Segmental Fat Right Arm; SFLL = Segmental Fat Left Leg; SFRL = Segmental Fat right Leg; BM = Body Muscle; BMM = Body Muscle Mass; SMMLA = Segmental Muscle Mass Left Arm; SMMRA = Segmental Muscle Mass Right Arm; SMMLL Segmental Muscle Mass Left Leg; SMMRL= Segmental Muscle Mass Right Leg; BW = Body Water; BWM = Body Water Mass; VF = Visceral Fat; BMR = Body Metabolic Rate; TC = Total Cholesterol; HDL-C = High Density Lipoprotein Cholesterol; T = triglyceride; LDL =Low Density Lipoprotein Cholesterol; t = t-value; df =degree of freedom; Sig.= significance (*$p < .05$) .

APPENDIX E

INFORMED CONSENT FORM

PROJECT TITLE: Aerobic-training effects on selected health characteristics of adult hiv-positive participants under Botswana Network of People Living with HIV/AIDS (BONEPWA).

Principal investigator: Thabo Muswere
(Masters Student, Physical Education Health and Recreation)

Supervisor: Prof. Onyewadume
(Associate Prof. at University of Botswana)
Phone number (s): 72112701

Phone number(s): 72133329

What you should know about this research study:

- You are given this informed consent document so that you may read about the purpose, risks, and benefits of this research study.
- You have the right to refuse to take part or agree to take part now and change your mind later.
- Please review this consent form carefully. Ask any questions before you make a decision.
- Your participation is voluntary.

PURPOSE

The purpose of the study is to compare the pre-post 12 week aerobic training effects on lipid profile, CD4 count, body composition and aerobic capacity of adult HIV-positive participants under Botswana Network of people living with HIV/AIDS. You are selected as a possible

participant in this study because you volunteered and met selection criteria. Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over.

PROCEDURES AND DURATION

If you decide to participate in this study you will be asked to complete a Physical activity readiness questionnaire (PAR-Q) which is filled to ensure that it is safe for you to take part in physical activity. If you are classified as high risk you will be asked to obtain medical clearance from your doctor proving that you can to take part in physical activity and that it is safe for you to do so. This clearance will however be at your own cost.

You will also be included in the study if you:

- Are HIV positive.
- Volunteer to participate in the study.
- Are on HAART.
- Volunteer to give blood samples for tests.
- Have not been involved in regular structured and monitored exercise for at least 3 months prior to the beginning of the exercise training.
- Have a CD4 count of or above 350 cells/mm^3.
- Are 18 years and above.
- Are not mentally and physically challenged
- Are not pregnant.

The data collected will be registered on the data form and a number will be assigned on to each participant's form for identification purpose.

You will all be placed on a 12 week aerobic training program. You will be subjected to 12 weeks of moderate intensity aerobic exercise, three times a week for 60 minutes per session at the University gymnasium. The exercise session comprise of warm up phase which include stretching exercises among others, training phase performed on either treadmills, stationary cycle or doing floor aerobics exercise and finally cool down phase. The training exercise protocol will be monitored by the researcher and the University of Botswana gymnasium instructors.

There will be pre and post 12 weeks of aerobic training exercise tests on all participants on body composition through the body composition analyzer for weight, body mass index, visceral fat, muscle mass and body fat. A full segmental analysis will be performed in less than 20 seconds. The blood sample will be requested for assessment of lipid profile which will be collected by qualified personnel and sent to Diagnofirm Medical laboratory for analysis of lipid profile and CD4 cell counts.

POTENTIAL RISKS AND DISCONFORTS

The method and the equipment that will be used during the 12 weeks of training and that of exercise testing could pose minimal risks associated with exercise. Some risks include; fatigue after exercise sessions, muscle strain and joint pain. All effort will be done to ensure that the exercises are done in a safe manner and a safe environment. The body composition analyzer for weight, body mass index, visceral fat, muscle mass and body fat is also a non-invasive technique that pose no physical damage to participants. For the blood samples a sharp pricking pain will be felt when the injection pierces the skin but will not last long.

POTENTIAL BENEFITS TO PARTICIPANTS OR SOCIETY

There will be no direct benefit to you, but your information will help lead to a decision of whether or not it is safe to include you in a study that involves exercise. As a participant in this study you will not receive any payment for your participation. None of this will be used for commercial use.

CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law, confidentiality will be maintained by means of allocating a number to your name. Access to files will only be granted to the supervisor, coordinator and me. Any published information will not reveal any names or any information that can link the result directly to you.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you decide to participate in this study, your decision will not affect your future relations with the University of Botswana, its personnel, and associated institutions. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty. Any refusal to observe and meet appointments agreed upon with the central investigator will be considered as implicit withdrawal and therefore will terminate your participation in the investigation without prior request. In this event you will not be paid anything since participation was voluntary. In the event of incapacity to fulfill the duties agreed upon your participation to the investigation will be terminated without your consent and no compensation will be offered under these circumstances.

AUTHORIZATION

You are making a decision whether or not to participate in this study. Your signature indicates that you have read and understood the information provided above, have had all your questions answered, and have decided to participate.

_____	_____	_____
Name of Research Participant	Signature of Research Participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP.

If you have any questions concerning this study or consent form beyond those answered by the investigator, including questions about the research, your rights as a research participant; or if you feel that you have been treated unfairly and would like to talk to someone other than a member of the research team please feel free to contact the Office of Research and Development, University of Botswana, Phone: Ms Dimpho Njadingwe on 355-2900, Email: research@mopipi.ub.bw, Telefax: (0267)395-7573

FOMO YA TUMALANO YA GO TSAYA KAROLO

SETLHOGO: Ditlamorago tsa go itshidila mmele mo botsogong jwa motho yo o tshelang ka mogare wa HIV a le mo lekalaneng la Botswana Network of People Living with HIV/AIDS (BONEPWA).

Mogolwane wa patlisiso: Thabo Muswere
(Masters Student, Physical Education Health and Recreation)
Nomoro ya mogala: 72133329

Mookamedi wa mmatlisisi:
Prof. Onyewadume
(Associate Prof. at University of Botswana)
Nomoro ya mogala: 72112701

Se o tshwanetseng go se itse ka patlisiso e:

- O neelwa pampiri e ya tumalano ya go tsaya karolo gore o ka bala ka mosola, dikgwetlho le dipoelo tsa patlisiso.
- O na le tshwanelo ya go gana go tsaya karolo kana go dumela jaanong kana go fetola mogopolo mo tsamaong ya nako.
- Tswee tswee bala tumalano e ya go tsaya karolo ka kelotlhoko. Botsa dipotso dipe fela pele ga o tsaya tshwetso.
- Go tsaya karolo ga gago ke ga boithaopo.

BOTLHOKWA/ MOSOLA WA PATLISISO

O kopiwa go tsaya karolo mo patlisisong ya ditlamorago tsa go itshidila mmele mo botsogong jwa motho yo o tshelang ka mogare wa HIV. Botlhokwa jwa patlisiso e, ke go kanoka ka fa go itshidila mmele go amang ka teng selekanyo sa mafura a mmele, masole a mmele, go agega ga mmele le seemo se mmele o dirisang phefo ee tlhatswegileng ka teng pele le morago ga

dibeke tse lesome le bobedi go itebagantswe thata le bomme le bo rre ba ba nang le mogare wa HIV ba le mo lekalaneng la BONEPWA. Pele ga o ka baya pampiri monwana, tlhomamisa gore o botsa ka ga sepe fela se o sa se tlhaloganyeng ka patlisiso e. O ka tsaya nako ya gago go akanya ka yone.

TSAMAISO LE SEBAKA

Fa o tsaya tshwetso ya go tsaya karolo o tla lalediwa go tlatsa fomo ya dipotso e e kanokang gore a o ka tsenelela itshidilo ya mmele. Fa go supa fa itshidilo mmele e ka go baa mo diphatseng, go tla a bo go le mo maruding a gago go bona ba bongaka pele go dira ditlhatlhobo tse di tseneletseng le go go fa tetla ya go itshidila mmele.

O ka tsaya karolo fa:

- O na le mogare wa HIV.
- O ithaopa go tsenelela patlisiso
- O nwa diritibatsi tsa mogare.
- O ithaopa go letlelela go tlhatlhobiwa ga madi a gago a mmele.
- O ise o tsenelele lenaneo la itshidilo mmele mo kgweding tse tharo tse di fetileng.
- Selekanyo sa gago sa masole a mmele se le mo go 350 cells/mm^3 kgotsa go feta re lebeletse itlhatlhobo ya gago ya bofelo ya masole a mmele.
- O tshwanetse a bo o na le dingwaga di le lesome le bofera bobedi le go feta.
- O sena bogole jwa dikarolo tsa mmele e bile tlhaloganyo ya gago e le e e itekanetseng go ka itseela dithwetso.
- O sa itsholofefa.

Fomo ya maduo a dipatlisiso e tlaabo e sena maina a gago mme go tla dirisiwa dinomoro mo go yone.

Fa o ithaopa o tla tshwanelwa ke go tsenelelaitshidilo mmeme ya lobaka lwa beke tse lesome le bobedi, ga raro mo bekeng, sebaka sa metsotso e le masome a mane go ya go goroga ko metsotsong e le masome a marataro. Nako e yotlhe o tla a bo o le ka fa tlase ga tlhokomelo ya bakatisi ba ba direlang ko go ikatisediwang teng ko University of Botswana le mogolwane wa patlisiso (nna).

Go tla nna le diteko tse di tlaa dirwang mabapi le ka fa mmele o dirang ka teng pele le morago ga ikatiso. Dipatlisiso tse e tla nna tse di kanokang selekanyo sa mafura a mmele, masole a mmele, go agega ga mmele le seemo se mmele o dirisang phefo ee tlhatswegileng ka teng. Dipatlisiso tsa madi a mmele tsone di tlaa dirwa ke ba ba rutetsweng tiro ya teng go tswa kwa go ba ditekeletso ba Diagnofirm Medical Laboratories.

DITLAMORAGO LE DIKGORELETSI

Fa re labile ikatiso le ditekeletso tsotlhe tse di tlaa dirwang fa di sa diriwe ka fa tshwanelong di ka go gobatsa. Jaanong ka dinako tsotlhe o tlaa rotloediwa go dirisa sedirisiwa sengwe le sengwe ka fa tshwanelong. O ka lapa morago ga ikatiso, mmele o ka gagamala morago ga ikatiso kgotsa ditokololo tsa nna botlhoko mo go tlwaelesegileng bogolo jang fa e le gone o simololang go itshidila mmele. Maiteko a go ikatisa mo go sireletsegileng le ko lefelong le le sireletsegileng a tla nna teng ka dinako tsotlhe. Fa o tsewa madi o ka utlwa botlhoko bogolo jang fa o tlhabiwa ka mokento mme se ke botlhoko jwa nakwana.

DIPOELO LE/KANA DIKATSO

Ga gona dituelo dipe kana dikatso dipe tse o tla di amogelang go tsenelela patlisiso e na fa e se go itse ka fa mmele wa gago o dirang ka teng mabapi le ikatiso ya mmele ka gore maduo o tla a bolelelwa ka dinako tsotlhe fa a tswa.

TSHOMARELO SEPHIRI

Sepe se se amanang le wena mo patlisisong e ke sephiri. Go tlaa dirisiwa dinomoro gona le maina a gago mo patlisisong e. Ga se mongwe le mongwe yo o tla nnang le tetla ya go amana le dipampiri tsa botlhokwa tsa patlisiso e fa e se mookamedi wa me mo dipatlisisong, mothusi wa gagwe le nna. Pampiri e e tla kwalwang kwa bofelong le maduo a yone ga e na go nankola leina laga ope.

GO ITHAOPA GO TSAYA KAROLO

Go ithaopiwa go tsaya karolo mo patlisisong e. Fa o tsaya tshwetso ya go seke go tsee karolo, ga go kake ga ama tirisano ya gago le University of Botswana mo nakong e e tlang kgotsa le makalana a a amanang le yone. Fa o tsaya tshwetso ya go tsaya karolo, o gololesegile

go ka boela morago nako nngwe le nngwe ntleng ga tuediso epe. Ga o ka gana go kopana le mmatlisisi ka nako e le e dumalaneng, go tla a tsewa e le sesupo sa gore o ikgogetse morago mme ka jalo kamano ya gago mo patlisisong e e tla busediwa morago le fa o sa fa kopo epe. Fa o palelwa kgotsa o retelelwa ke go diragatsa ditumalano tse di dumalanweng tsa go tsaya karolo mo patlisisong e, kamano ya gago mo patlisisong e e tla emisiwa o sa rerisiwa e bile o sa fiwa phimola keledi epe.

TSENELELO

O dira tshwetso ya go tsaya kgotsa go seke go tsaya karolo mo patlisisong e. Monwana wa gago o supa fa o badile e bile o tlhalogantse ditlhaloso tse o di filweng fa godimo, e bile dipotso tsa gago tsotlhe di arabesegile, gape o tsere tshwetso ya go tsaya karolo.

_____	_____	_____
Leina la mo tsaya karolo	Monwana wa mo tsaya karolo	Letsatsi
_____	_____	_____
Leina wa mogolwane wa patlisiso	Monwana wa mogolwane wa patlisiso	Letsatsi

O TLA A NEELWA PAMPIRI E NNGWE YA TUMALANO GORE O E BEE SENTLE

Fa o na le dipotso tse di amanang le patlisiso e, kgotsa tumalano e ntleng ga tse di arabilweng ke mmatlisisi, ga mmogo le dipotso ka ga patlisiso e, ditshwanelo tsa gago o le mo tsaya karolo; kana o akanya gore ga o a tsewa sentle, ka tswee-tswee utlwa o gololesegile go ka ikgolaganya le ba ofisi ya patlisiso le ditlhabololo (Research and Development) ko University of Botswana, mogala: Mme Dimpho Njadingwe on 355-2900, Email: research@mopipi.ub.bw, Telefax: (0267)395-7573

APPENDIX F

The Borg Rating of Perceived Exertion (RPE) Scale

Scales	Level of exertion
6	No exertion at all
7	
7.5	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somehow hard
14	
15	Hard (Heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Extracted from the works of Williams (2018).

APPENDIX G

DATA COLLECTION FORM

Participant no: _____

Health Characteristics	Pre-test	Post-test
Age		
Gender		
Systolic BP		
Diastolic BP		
Pulse Rate		
Height		
Weight		
Body Mass Index (BMI)		
Body Fat %		
Body Fat Mass (kg)		
Segmental Fat %		
Left Arm		
Right Arm		
Left Leg		
Right Leg		
Body Muscle %		
Body Muscle Mass (kg)		
Segmental Muscle Mass		
Left Arm		
Right Arm		
Left Leg		
Right Leg		
Body Water Mass		
Body Water %		
Visceral Fat Rating		
Basal Metabolic Rating (kj)		
Basal Metabolic Rate (kcal)		
VO_2 max		
Total Cholesterol mmol/L		
HDL Cholesterol mmol/L		
Triglycerides mmol/L		
LDL Cholesterol mmol/L		
Total CHOL/HDL Ratio		
Total T-Cells CD3		
CD4		
CD4 %		
CD8		
CD4:CD8		

APPENDIX H

Physical Activity Readiness
Questionnaire - PAR-Q
(revised 2002)

PAR-Q & YOU

(A Questionnaire for People Aged 15 to 69)

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly: check YES or NO.

YES	NO		
☐	☐	1.	**Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?**
☐	☐	2.	**Do you feel pain in your chest when you do physical activity?**
☐	☐	3.	**In the past month, have you had chest pain when you were not doing physical activity?**
☐	☐	4.	**Do you lose your balance because of dizziness or do you ever lose consciousness?**
☐	☐	5.	**Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?**
☐	☐	6.	**Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?**
☐	☐	7.	**Do you know of any other reason why you should not do physical activity?**

If you answered

YES to one or more questions

Talk with your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want — as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively. It is also highly recommended that you have your blood pressure evaluated. If your reading is over 144/94, talk with your doctor before you start becoming much more physically active.

→

DELAY BECOMING MUCH MORE ACTIVE:

- if you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- if you are or may be pregnant – talk to your doctor before you start becoming more active.

PLEASE NOTE: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed Use of the PAR-Q: The Canadian Society for Exercise Physiology, Health Canada, and their agents assume no liability for persons who undertake physical activity, and if in doubt after completing this questionnaire, consult your doctor prior to physical activity.

No changes permitted. You are encouraged to photocopy the PAR-Q but only if you use the entire form.

NOTE: If the PAR-Q is being given to a person before he or she participates in a physical activity program or a fitness appraisal, this section may be used for legal or administrative purposes.

"I have read, understood and completed this questionnaire. Any questions I had were answered to my full satisfaction."

NAME _____

SIGNATURE _____ DATE _____

SIGNATURE OF PARENT or GUARDIAN (for participants under the age of majority) _____ WITNESS _____

Note: This physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if your condition changes so that you would answer YES to any of the seven questions.

Supported by: Health Canada Santé Canada

continued on other side...

PAR-Q & YOU

(Potsoloso ya ba ba dingwga tse di lesome le botlhano go ya kwa go ba ba dingwaga tse di masome a marataro le borobabongwe.)

Go itshidila mmele gangwe le gape go monate, go tokafatsa botsogo gape bontsi jwa batho ba simolotse go itshidila mmele tsatsi le letsatsi ka ba itemogela kgang e. Go itshidila mmele go babalesegile mo go ba le bantsi. Le fa go ntse jalo, batho bangwe ba tshwanetse go ikgolaganya le dingaka tsa bone pele ga ba ka itshidila mmele.

Fa o na le maikaelelo a go itshidila mmele go fetisa jaaka gale, simolola ka go araba dipotso tse supa tse di mo lebokosong le le fa tlase. Fa o le fa dingwga tse di lesome le botlhano go ya go dingwaga tse di masome a marataro le borobabongwe potsoloso e ya PAR-Q e ka go senolela gore a o ka tlhola ba bongaka pele o simologa go itshidila. Fa dingwaga tsa gago di fetsa tse di masome a marataro le borobabongwe , o sa tlwaela go itshidila mmele, ikopanye le ba bongaka pele.

Dirisa kitso ya gago go araba dipotso tse. Tswee tswee bala dipotso ka kelotlhoko o bo o araba ka boammaruri. Tshwaa **EE** kgotsa **NNYA**

YES	NO	
☐	☐	A ngaka ya gago e kile yago raya e re o na le bothata jwa pelo le gore o ka itshidila mmele fela fa o reboletswe ke ba bongaka?
☐	☐	A o utlwa ditlhabi mo mafatlheng fa o itshidila mmele?
☐	☐	Mo kgweding e e fetileng, a o kile wa nna le ditlhabi mo mafatlheng le fa o ne o sa itshidile mmele?
☐	☐	A o tle o latlhegelwe ke maatla e le ka ntlha ya sedidi, kgotsa a o a tle o idibale.
☐	☐	A o na le bothata jwa marapo kgotsa ditokololo (dikai: mokwatla, mangole, dinoka) jo bo ka gakadiwang ke phetogo ya ka fa o itshidilang mmele ka teng.
☐	☐	A ngaka ya gago mo bogompienong o go fa melemo (sekai, water pills) ya bolwetsi jwa pelo kana motsamao wa madi a mmele?
☐	☐	A o itse mabaka mangwe a a ka go itsang go ikatisa?

Fa o arabile

EE, mo potsong e le nngwe kana tsotlhe

Ikgolaganye le ngaka ya gago ka mogala wa lotheka kana o e go mmona pele o ka simolola go itshidila mmele kana pele o tsaya karolo mo ditlhatlhobong tse di dirwang pele ga go ikatisa. Bolelela ngaka ya gago ka potsoloso ya PAR-Q le dipotso tse o di arabileng ka EE.

-O ka kgona go itshidila mmele ka fa o ratang ka teng mme fela o tshwanetse wa simolola ka bonya mme gape o oketse bokete jwa itshilolo ka bonya. Kgotsa o tla a tshwanelwa ke go dira fela tse o di tlwaetseng tse di babalesegileng mo go wena. Buisana le ngaka ya gago ka se o ka se dirang go itshidila mmele mme o sale morago dikgakololo tsa gagwe.

-Batlisisa gore o ka ishidila mmele jang o lebile mananeo a a teng, a babalesegile e bile a na le mosola mo tikologong ya gago.

FA O ARABILE NNYA mo dipotsong tsotlhe

Fa o arabile NNYA ka boammaruri mo dipotsong tsotlhe tsa PAQ-Q, o ka tlhomamisa gore o ka;

-Simolola go itshidila mmele- o ka simolola ka bonya mme o tla o ntse o oketsa mo nakong e e tlang.E ke yone tsela e e babalesegileng ya go ka itshidila.

-O ka tsaya karolo mo ditlhatlhobong tse di dirwang pele ga go itshidila-Mo ke tsela e e siameng go tlhola gore o itekanetse go le kae le go go thusa go dira lenaneo le le maleba la go itshidila mmele. Go a rotloediwa fela thata go tlhatlhoba selekanyo sa motsamao wa madi mo mmeleng. Fa selekanyo sa madi se le ko godimo ga 144/94, ikopanye le ba bongaka pele ga o ka tsaya karolo mo go itshidileng mmele.

SE ITLHAGANELE GO ITSHIDILA MMELE THATA:

-Fa o sa tsoga sentle ka ntlha ya bolwetse jwa nakwana jaaka mohikela, ema go fitlhela o fola; kgotsa

-Fa o itsholofetse- bua le ngaka ya gago pele o ka simolola go dira/bereka go feta selekanyo se o se tlwaetseng.

ELA TLHOKO: Fa seemo sa botsogo jwa gago se fetoga mo le dikarabo tse o di fileng di fetoga go nna EE mo dipotsong tse o di arabileng, bolelela mokatisi kgotsa mookamedi wa itshidilo mmele wa gago.

Botsa gore a o ka fetola ka fa o itshidilang ka teng.

Tiriso ya PAR-Q : Ba lekalana la The Canadian Society for Exercise Physiology Canada le badiri ka bone ga ba tsee boikarabelo jwa motho yo o itshidilang mme ebile fa godimo ga moo fa go na le pelaelo epe morago ga go araba dipotso tsena ikopanye le ba bongaka.

Ga go letlelelwe go fetola sepe .O letlelelwa go dirisa moriti wa fomo yotlhe fela fa o e dirisa jaaka e ntse

ITSE GORE: Fa PAR-Q e neetswe motho pele ga a ka itshidila mmele kgotsa tsaya karolo mo ditlhatlhobong tse di dirwang pele ga go go itshidila mmele. Tsetlana e e ka dirisiwa fa pele ga ba melao kgotsa mo go tsa bodiredi.

"Ke badile dipotso tsotlhe, ke di tlhalogantse e bile ke tladitse pampiri ya dipotsolos. Ke arabile dipotso tsotlhe ka boammaruri."

LEINA_____

MONWANA_____ LETSATSI_____

Monwana wa Motsadi (fa ngwana a sa lekana go itseela ditshwetso) _____ MOSUPI_____

ITSE GORE: Fomo ena e nna mo tirisong mo sebakeng sa kgwedi tse di lesome le bobedi fela go tswa ko letsatsing le e neng e tladiwa ka lone gape e latlha boleng fa go nna le phetogo e e felelang e dira gore o arabe EE mo dipotysong tse supa tse o setseng o di arabile

APPENDIX I

SF-12 Health Survey

This survey asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. **Answer each question by choosing just one answer**. If you are unsure how to answer a question, please give the best answer you can.

1. **In general, would you say your health is**:

☐1 Excellent ☐2 Very good ☐3 Good ☐4 Fair ☐5 Poor

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	YES, limited a lot	YES, limited a little	NO, not limited at all
2. **Moderate activities** such as moving a table, pushing a vacuum cleaner, bowling, or playing golf.	☐1	☐2	☐3
3. Climbing **several** flights of stairs.	☐1	☐2	☐3

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

	YES	NO
4. **Accomplished less** than you would like.	☐1	☐2
5. Were limited in the **kind** of work or other activities.	☐1	☐2

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

	YES	NO
6. **Accomplished less** than you would like.	☐1	☐2
7. Did work or activities **less carefully than usual**.	☐1	☐2

8. **During the past 4 weeks, how much did pain interfere with your normal work (including work outside the home and housework)?**

☐1 Not at all ☐2 A little bit ☐3 Moderately ☐4 Quite a bit ☐5 Extremely

These questions are about how you have been feeling during the past 4 weeks.
For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks…

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
9. Have you felt calm & peaceful?	☐1	☐2	☐3	☐4	☐5	☐6
10. Did you have a lot of energy?	☐1	☐2	☐3	☐4	☐5	☐6
11. Have you felt down-hearted and blue?	☐1	☐2	☐3	☐4	☐5	☐6

12. **During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?**

☐1 All of the time ☐2 Most of the time ☐3 Some of the time ☐4 A little of the time ☐5 None of the time

Patient name: Date: PCS: MCS:

Visit type (circle one)
Preop 6 week 3 month 6 month 12 month 24 month Other:_____

SF-12 PATLISISO YA BOTSOGO

Mo patlisisong e go kopiwa megopolo ya gago ka botsogo jwa gago. Kitso e e tlaa dirisiwa go batlisisa ka fa o ikutlwang /tsogang ka teng le gore o kgona go dira sentle ditiro tsa gago tsa letsatsi le letsatsi. **Araba potso nngwe le nngwe ka go tlhopha karabo e le nngwe fela**. Tswee tswee sekaseka ka botlalo mme o fe potso nngwe le nngwe karabo ya maemo a ntlha e e lolameng.

1.Ka kakaretso, o ka re botsogo jwa gago bo : Siame

☐1. Fela thata ☐ 2.Thata ☐ 3.Bo fa gare ☐4. Bo a nametsa ☐ 5. Bo a tlhobaetsa

Dipotso tse di latelang ke ka ditiro tse o ka di dirang tsatsi le letsatsi . A botsogo jwa gago bo a kgoreletsa mo ditirong tse? Fa go ntse jalo bo ka kgoreletsa go le kae?

	EE, bo nkgoreletsa go le gonnye	EE, bo nkgoreletsa thata	NNYA, ga bo nkgoreletse gotlhelele
2.**Ditiro tse di motlhofo** jaaka go sutisa tafole, go dirisa dilo tse di phepafatsang, go tshameka bolo.	☐ 1	☐ 2	☐ 3
3.Go tsamaya mo bodilong jo bo palamelelang (stairs)	☐ 1	☐ 2	☐ 3

Mo di bekeng tse nne tse di fetileng , a o kile wa nna le dikgwetlho tse di latelang mabapi le go bereka ga gago kgotsa ditiro tsa gago tsa letsatsi le letsatsi e le ka mabaka a botsogo?

	EE	NNYA
4.**O reteletswe ke go dira go gaisa** jaaka o ne o eleditse	☐ 1	☐ 2
5.O kgoreletsegile/ reteletswe e le ka **mabaka** a tiro ya gago kana a sele	☐ 1	☐ 2

Mo dibekeng tse nne tse di fetileng, a o kile wa itemogela nngwe ya dikgwetlho tse di latelang mabapi le tiro ya gago le ditiro tse dingwe e le ka ntlha ya tobekano ya maikutlo (jaaka go tlhobaela le kutlobotlhoko ee tseneletseng)?

	EE	NNYA
6.O **berekile ka selekano se se kwa tlase** ga sa gale.	☐ 1	☐ 2
7.O berekile **ka kelotlhoko le kelelelo e kwa tlase** gona le jaaka dinako tsotlhe.	☐ 1	☐ 2

8.**Mo dibekeng tse nne tse di fetileng, o kgoreleditswe ke botlhoko jwa mmele go le kae mo tirong ya gago (go akaretsa ditiro tsa lelwapa le tse di kwa ntle ga lelwapa la gago)**

☐Ga gona ☐Go le gonnye ☐ Mo go lekanetseng ☐ Kgapetsa kgapetsa ☐Mo go feteletseng.

Dipotso tse di latelang di batlisisa ka botsogo jwa gago mo dibekeng tse nne tse di fetileng. Mo potsong nngwe le nngwe, neela karabo ee tlhalosang ka fa o ntseng o ikutlwa ka teng.

Ke ga kae mo bekeng tse nne tse di fetileng…

	Nako tsotlhe	Bontsi jwa nako	Mo go lekanetsen	Dinako dingwe	Go le gonnye	Ga gona
9. O ikutlw o na le kagiso o wetse mowa	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
10. O na le maatla mme o le matlhagatlhaga?	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
11. O ikutlwa o kgobegile marapo o utlwile botlhoko	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

12.**Mo dibekeng tse nne tse di fetileng, ke ga kae botsogo jwa gago jwa mmele le tlhakatlhakano maikutlo a gago di kgoreleditseng go tsalana ga gago le ba bangwe (jaaka go etela ditsala, masika, fela jalo)?**

☐ 1.Nako tsotlhe ☐2.Bontsi jwa nako ☐3.Go se kalo kalo ☐ 4.Nako tse dingwe ☐ 5.Go le gonnye ☐ 6.Ga gona nako epe

Leina la motsaa karolo:_____ Letsatsi_____PSC: _____ MSC:_____

Mohuta wa loeto/ itekodiso (goloka e le nngwe)

Preop Beke tse tharo Kgwedi tse tharo Kgwedi tse thataro Ngwaga Ngwaga tse pedi Tse dingwe

APPENDIX J

CERTIFICATE OF ACCREDITATION

DIAGNOFIRM MEDICAL LABORATORIES GABORONE
Registration No: CO89/1221

Facility Accreditation Number: MED 012

is a SADCAS accredited Medical Laboratory
provided that all SADCAS conditions are complied with

This certificate is valid as per the scope stated in the accompanying schedule of accreditation, Annexure "A", bearing the above accreditation number for

MEDICAL TESTING LABORATORY
CHEMISTRY, CYTOLOGY, ENDOCRINOLOGY, HAEMATOLOGY, HISTOPATHOLOGY, MICROBIOLOGY, SEROLOGY AND VIROLOGY

The facility is accredited in accordance with the recognized International Standard

ISO 15189:2012

The accreditation demonstrates technical competency for a defined scope and the operation of a laboratory quality management system

SADCAS is a subsidiarity organization of SADC. A memorandum of understanding between SADC and SADCAS serves as the basis for the recognition of SADCAS by SADC Member States as a multi-economy accreditation body

This certificate has been issued under the SADCAS/SANAS Twinning Partnership Arrangement

Mrs Maureen P Mutasa
SADCAS Chief Executive Officer

Effective Date (Issue No: 1): 25 June 2015
Certificate Expires: 24 June 2020

SADCAS
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY ACCREDITATION SERVICE

ANNEXURE A

SCHEDULE OF ACCREDITATION

Laboratory Accreditation Number: MED 012 (ISO 15189:2012)

Permanent Address of Laboratory: Diagnofirm Medical Laboratories Gaborone Plot 12583 Nyerere Drive, Middle Star Gaborone Botswana **Postal Address:** Private Bag 283 Gaborone Botswana **Tel** : +267 395 0007 **Cell** : +26774728985 **Fax** : +267 395 7980 **Email** : qcmanager@diagofirm.co.bw	**Technical Signatories** : As authorized by the Head of the Laboratory **Nominated Representative** : William Abram **Issue No** : 03 **Date of issue** : 13 June 2017 **Expiry Date** : 24 June 2020

DISCIPLINE/SAMPLE TYPE	TYPES OF TESTS	EQUIPMENT/METHOD
CHEMISTRY		
Serum	Alanine Aminotransferase (ALT)	Abbott Architect
Serum	Albumin	Abbott Architect
Serum	Alkaline Phosphatase	Abbott Architect
Serum	Amylase	Abbott Architect
Serum	Apolipoprotein A1	Abbott Architect
Serum	Apolipoprotein B	Abbott Architect
Serum	Aspartate Aminotransferase (AST)	Abbott Architect
Serum	Bicarbonate (CO2)	Abbott Architect
Serum	Bilirubin Direct	Abbott Architect
Serum	Bilirubin Total	Abbott Architect
Serum	Calcium (Total)	Abbott Architect
Serum	Chloride	Abbott Architect
Serum	Cholesterol (HDL)	Abbott Architect
Serum	Cholesterol (LDL) Calculated	Abbott Architect
Serum	Cholesterol (Total)	Abbott Architect
Serum	Cholesterol (Total)/Cholesterol (HDL) ratiocalculated	Abbott Architect
Serum	C-Reactive Protein (CRP) High Sensitive	Abbott Architect

ANNEXURE A

SADCAS
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY ACCREDITATION SERVICE

Laboratory Accreditation No: MED 012 (ISO 15189:2012)
Issue No: 03
Date of Issue: 13 June 2017
Date of Expiry: 24 June 2020

DISCIPLINE/SAMPLE TYPE	TYPES OF TESTS	EQUIPMENT/METHOD
CHEMISTRY (cont'd)		
Serum	Creatine Kinase (CK)	Abbott Architect
Serum	Creatine Kinase MB (CKMB)	Abbott Architect
Serum, Urine	Creatinine	Abbott Architect
Serum	Ferritin	Abbott Architect
Serum	Gamma GlutamylTransferase (GGT)	Abbott Architect
Serum	Globulins (calculated)	Abbott Architect
Plasma, CSF, Urine	Glucose	Abbott Architect
Whole blood	Glycosylated Haemoglobin HbA1c	Abbott Architect
Serum	Iron	Abbott Architect
Serum	Lactate Dehydrogenase (LDH)	Abbott Architect
Serum	Lipoprotein (a)	Abbott Architect
Serum	Magnesium	Abbott Architect
Serum	Phosphate	Abbott Architect
Serum	Potassium	Abbott Architect
Serum	Protein (Total)	Abbott Architect
Serum	Sodium	Abbott Architect
Serum	Transferrin	Abbott Architect
Serum	Triglycerides	Abbott Architect
Serum	Urate (Uric acid)	Abbott Architect
Serum	Urea	Abbott Architect
Urine	Protein	Abbott Architect
CYTOLOGY		
Smears, Fluids, Brushings, Aspirates	Gynae Cytology, Non-gynae Cytology, Fine Needle Aspirations	Manual Method
ENDOCRINOLOGY		
Serum	Alpha Feto Protein	Bio Merieux Mini Vidas
Serum	Beta Human Chorionic Gonadotropin (bHCG)	Abbott Architect
Serum	CA 125	Bio Merieux Mini Vidas
Serum	CA 15.3	Bio Merieux Mini Vidas
Serum	CA 19.9	Bio Merieux Mini Vidas
Serum	Carcinoembryonic Antigen (CEA)	Bio Merieux Mini Vidas
Serum	Estradiol (E2)	Abbott Architect
Serum	Folate	Abbott Architect

SADCAS
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY ACCREDITATION SERVICE

ANNEXURE A

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Issue No: 03
Date of Issue: 13 June 2017
Date of Expiry: 24 June 2020

DISCIPLINE/SAMPLE TYPE	TYPES OF TESTS	EQUIPMENT/METHOD
ENDOCRINOLOGY (cont'd)		
Serum	Follicle Stimulating Hormone	Abbott Architect
Serum	Free T3	Abbott Architect
Serum	Free T4	Abbott Architect
Serum	Insulin	Abbott Architect
Serum	Luteinizing Hormone	Abbott Architect
Plasma	Pro Brain Natriuretic Peptide (pro BNP)	Bio Merieux Mini Vidas
Serum	Progesterone	Abbott Architect
Serum	Prolactin	Abbott Architect
Serum	Prostate Specific Antigen (PSA)	Abbott Architect
Serum	Sex Hormone Binding Globulin (SHBG)	Abbott Architect
Serum	Total testosterone	Abbott Architect
Serum	Thyroid Stimulating Hormone (TSH)	Abbott Architect
Serum	Vitamin B12	Abbott Architect
Serum	Anti-Thyroglobulin Antibodies(Anti Tg)	Abbott Architect
Serum	Anti-Microsomal (Anti-Thyroid Peroxidase) Anti TPO	Abbott Architect
Serum	Cortisol	Abbott Architect
Serum	DHEA-S	Abbott Architect
Serum	Free PSA	Abbott Architect
HAEMATOLOGY		
Plasma	Activated Partial Thromboplastin Time (APTT)	Stago satellite
Whole Blood	Blood Grouping (ABO and Rh(D))	Manual Method
Whole Blood	CD3	Beckman Coulter Aquios
Whole Blood	CD4	Beckman Coulter Aquios
Whole Blood	CD4%	Beckman Coulter Aquios
Whole Blood	CD8	Beckman Coulter Aquios
Whole Blood	CD4:CD8 ratio Calculated	
Plasma	D-Dimer (Fibrin Degradation Product)	Bio Merieux Mini Vidas
Whole Blood	Erythrocyte Sedimentation Rate (ESR)	Beckman Coulter Alifax
Whole Blood	Full Blood Count and Differential Count	Mindray BC5800 Analyser
Plasma	International Normalised Ratio (INR)	Stago
Whole Blood	Malaria antigens	Manual Method
Whole Blood	Malaria Smears	Manual Method
Whole Blood	ESR	Manual Method
Plasma	INR, PT	Stago satellite

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SOUTHERN AFRICAN DEVELOPMENT COMMUNITY ACCREDITATION SERVICE

ANNEXURE A

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Date of Expiry: 24 June 2020

DISCIPLINE/SAMPLE TYPE	TYPES OF TESTS	EQUIPMENT/METHOD
HISTOPATHOLOGY		
All general Histology Specimens	Microtomy H & E Routine Staining Special stains(Histochemical)	Manual Method
SEROLOGY		
Serum	Antistreptolysin O Titre (ASOT)	Manual Method
Serum, Urine	Beta Human Chorionic Gonadotropin (bHCG) Screen	Manual
Serum	C-Reactive Protein(CRP) Qualitative	Manual
Serum	Cytomegalovirus (CMV) IgG	Abbott Architect
Serum	Cytomegalovirus (CMV) IgM	Abbott Architect
Serum	Helicobacter Pylori	Manual Method
Serum	Hepatitis A IgG	Abbott Architect
Serum	Hepatitis A IgM	Abbott Architect
Serum	Hepatitis B Core Antibody	Abbott Architect
Serum	Hepatitis B Surface Antigen (HBsAg)	Manual Method
Serum	Hepatitis B Surface Antibody (AUSAB)	Abbott Architect
Serum	Hepatitis C Virus antibody	Abbott Architect
Serum	HIV Confirmation	Abbott Architect
Serum	HIV Rapid	Manual Method
Serum	Immunoglobulin E (Allergen Specific)	Abbott Architect
Serum	Infectious Mononucleosis	Manual Method
Serum	Rheumatoid Factor (RF)	Manual Method
Serum	Rubella IgG	Abbott Architect
Serum	Rubella IgM	Abbott Architect
Serum	RPR	Manual Method
Serum	Toxoplasma IgG	Abbott Architect
Serum	Toxoplasma IgM	Abbott Architect
Serum	Treponema Pallidum Haemagglutination (TPHA)	Manual Method
Whole Blood	Troponin I	Manual Method
VIROLOGY		
Plasma	Molecular Amplification (HIV Viral Loads	Bio Merieux EasyMag/easyQ

SADCAS
SOUTHERN AFRICAN DEVELOPMENT COMMUNITY ACCREDITATION SERVICE

ANNEXURE A

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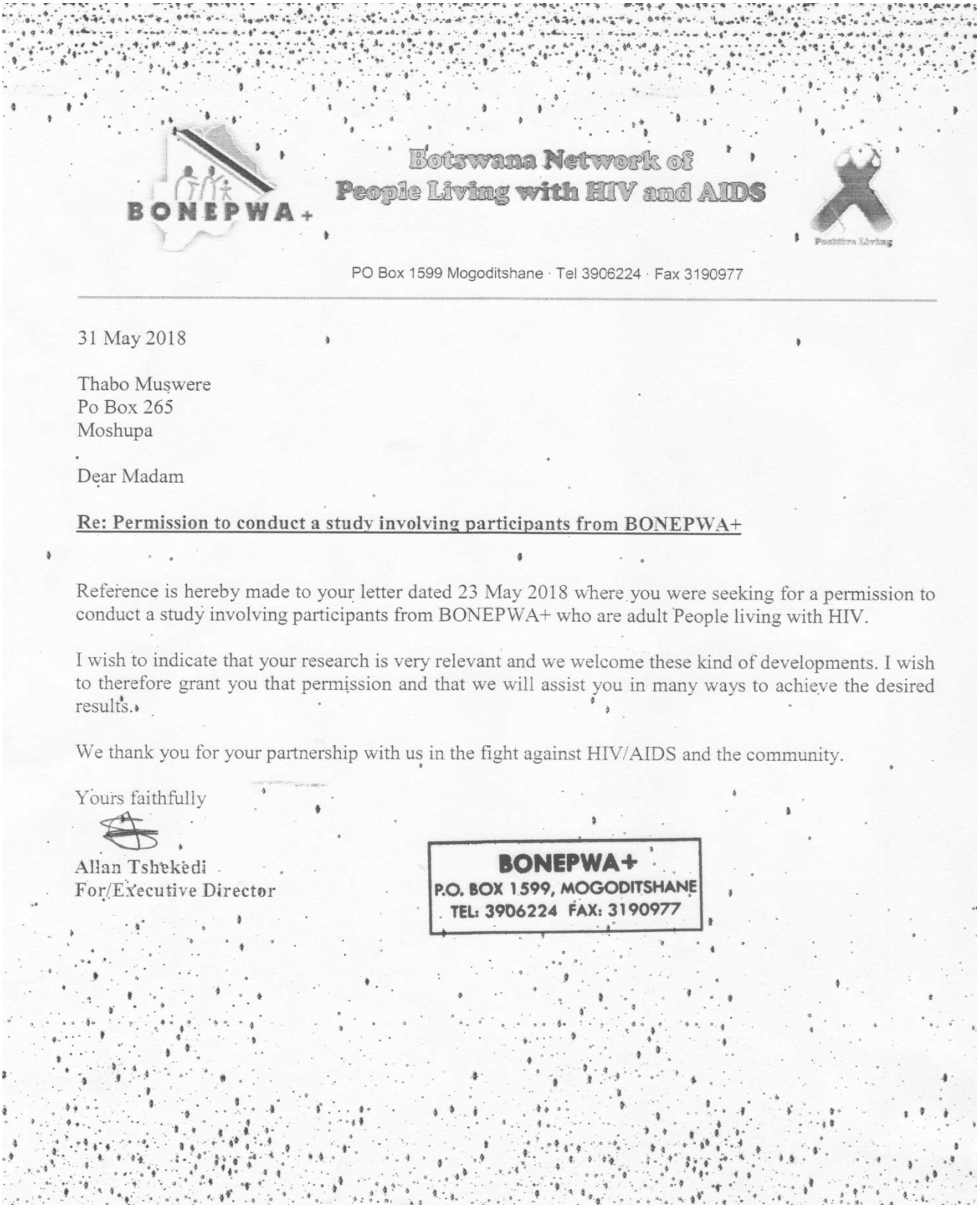
Issue No: 03
Date of Issue: 13 June 2017
Date of Expiry: 24 June 2020

DISCIPLINE/SAMPLE TYPE	TYPES OF TESTS	EQUIPMENT/METHOD
MICROBIOLOGY		
Urine	Wet preparation: cells,casts,crystals,parasites	Manual Method-Microscopy
Pus Swabs, Ear, Eye,Throat,Wound, Nasal,HVS	Gram Stain	Manual Method-Microscopy
Sputum	Ziehl Neelsen	Manual Method-Microscopy
Urine	Macroscopy	Manual Method
Urine	Chemistry: Glucose,Ketones,pH,S.G,Protein,Bilirubin, Blood	Manual Method/Clinitek Status
Pus Swabs, Ear, Eye,Throat,Wound, Nasal,HVS, Urine	Culture on Selective and General Medium	Manual Method
	Antimicrobial Sensitivity Testing	Manual Method- Modified Kirby Bauer
	Bacterial Identification Techniques	
	Biochemical Tests	
	Catalase	
	Coagulase	
	Oxidase	
	Electronic RapID Compendium(ERIC)	

Jeanne Françoise Ranorovelo
SADCAS Technical Manager

APPENDIX K



BONEPWA+

Botswana Network of
People Living with HIV and AIDS

Positive Living

PO Box 1599 Mogoditshane · Tel 3906224 · Fax 3190977

31 May 2018

Thabo Muswere
Po Box 265
Moshupa

Dear Madam

Re: Permission to conduct a study involving participants from BONEPWA+

Reference is hereby made to your letter dated 23 May 2018 where you were seeking for a permission to conduct a study involving participants from BONEPWA+ who are adult People living with HIV.

I wish to indicate that your research is very relevant and we welcome these kind of developments. I wish to therefore grant you that permission and that we will assist you in many ways to achieve the desired results.

We thank you for your partnership with us in the fight against HIV/AIDS and the community.

Yours faithfully

Allan Tshekedi
For/Executive Director

BONEPWA+
P.O. BOX 1599, MOGODITSHANE
TEL: 3906224 FAX: 3190977

APPENDIX L

P O Box 265
Moshupa

23 May 2018

UNIVERSITY OF BOTSWANA
DEPARTMENT OF CULTURE, SPORTS AND RECREATION
2018 -05- 23
DIRECTOR'S OFFICE

The Director
University of Botswana Culture, Sports and Recreation
P Bag 0022
Gaborone

Dear Sir

RE: REQUEST FOR A PERMISSION TO USE THE GYMS IN THE INDOOR SPORTS CENTER FOR MY RESEARCH, EXERCISE PROGRAMS

The letter serves as a request to use the gyms in the indoor sports center for my research especially for the 12 weeks of aerobic exercise programs. I am Thabo Muswere, a Master's student at University of Botswana from the Department of Physical Education Health and Recreation, student number 201001950. I defended my proposal on the 11 May 2018 and the research topic is: **Aerobic training effects on selected health characteristics of adult HIV-positive individuals under BONEPWA, Gaborone.**

The study will be comparing the individuals pre-post 12 weeks aerobic training effects on lipid profile, CD4 count, body composition and aerobic capacity. The facility and any equipment will be properly used with close monitoring. All necessary ethical clearance and requirements in a human study of this nature will be strictly adhered to.

There is an attached support letter from my supervisor. The selection of participants and the 12 weeks of exercise will only commence after the University of Botswana Office of Research and The Ministry of Health has given a go ahead. Hopefully my request will be considered.

Yours sincerely

T. Muswere

Thabo Muswere

Cell number: 72133329

Email: thabomuswere@rocketmail.com

APPROVED

UNIVERSITY OF BOTSWANA
DEPARTMENT OF CULTURE, SPORTS AND RECREATION
2018 -06- 01
DIRECTOR'S OFFICE

23/5/2018

UNIVERSITY of BOTSWANA

Faculty of Education
DEPARTMENT OF PHYSICAL EDUCATION, HEALTH & RECREATION
Corner of Notwane & Mobuto Road
Private Bag 00702
Gaborone
BOTSWANA

Telephone: [267] 3555219/5241
Fax [267]3185096/3554874
Website: www.ub.bw

Mr. Raj Rathedi,
The Director of Culture, Sports & Recreation,
University of Botswana
P.Bag 0022,
Gaborone.

21st May, 2018

Dear Sir,

PERMISSION TO CONDUCT A STUDY

This serves to confirm that Ms Thabo Muswere, Student No. 201001950, is a Master's student of the Department of Physical Education, University of Botswana. She has just successfully defended her proposal and ready to go into the field to conduct her research on **Aerobic-training effects on selected health characteristics of adult HIV-positive individuals under BONEPWA,** Gaborone. I therefore request your permission, on her behalf, to use the gyms in the Campus Indoor Sports Centre for her exercise programs for a duration of 12 weeks.

The objective of the study is to compare the pre-post 12 week aerobic training effects on lipid profile, CD4 count, body composition and aerobic capacity of adult HIV-positive individuals on highly active antiretroviral therapy. The study will specifically compare the effects of 12 weeks of aerobic training against baseline data of participants' body mass index (BMI), visceral fat, % body fat, muscle mass, VO_2 max, CD4 count, total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL), triglyceride levels and stress hormones. The rate at which the fitness acquired diminishes after the training will also be noted.

All necessary ethical consideration required in a human study of this nature will be strictly adhered to. We assure you that the facilities and equipment would be properly used.

Sincerely,

Prof. I.U. Onyewadume

APPENDIX M

Faculty of Education
Corner of Notwane & Mobuto Road
Private Bag 00702
Gaborone
BOTSWANA

Telephone: [267] 3552397
Fax: [267] 3185096
E-mail: educaio@mopipi.ub.bw
Website: www.ub.bw

22nd June, 2018

The Director,

Office of Research & Development,

University of Botswana,

Gaborone.

Dear Sir,

LETTER OF SUPPORT FOR MS. THABO MUSWERE'S RESEARCH

I write to support the research application forwarded to your office, for ethical consideration, by Ms. Thabo Muswere. The topic of the research proposal is: **AEROBIC-TRAINING EFFECTS ON SELECTED HEALTH CHARACTERISTICS OF ADULT HIV-POSITIVE INDIVIDUALS UNDER BONEPWA, GABORONE.**

I would be pleased should you approve her proposal to enable her conduct the study.

Sincerely,

Prof. I.U. Onyewadume

(Supervisor)

APPENDIX N

Office of the Deputy Vice Chancellor (Academic Affairs)

Office of Research and Development

Corner of Notwane and Mobuto Road, Gaborone, Botswana

Pvt Bag 00708 Gaborone Botswana

Tel: [267] 355 2900
Fax: [267] 395 7573
E-mail: research@mopipi.ub.bw

Ref: UBR/RES/IRB/SOC/GRAD/131

4th September, 2018

UNIVERSITY OF BOTSWANA Office of Research & Development 2018 -09- 04 P/BAG UB 00704 GABORONE TEL:+267 3552900/2902 FAX: +267 3957573 email: research@mopipi.ub.bw

The Permanent Secretary
Ministry of Health and Wellness
Private Bag 0038
Gaborone, Botswana

RE: REQUEST FOR EXPEDITED REVIEW OF A RESEARCH PROPOSAL SUBMITTED BY MS.THABO MUSWERE

Since it is a requirement that everyone undertaking research in Botswana should obtain a Research Permit from the relevant arm of Government, The Office of Research and Development at the University of Botswana has been tasked with the responsibility of overseeing research at UB including facilitating the issuance of Research Permits for all UB Researchers inclusive of students and staff.

I am writing this letter in support of an application for a Research Permit Ms Thabo Muswere, a master's student from the Department of Physical Education, Faculty of Education, University of Botswana. Ms Muswere has proposed to conduct a study titled **"The Aerobic-Training Effects on Selected Health Characteristics of Adult-HIV-Positive Individuals under Botswana network of People Living with HIV/AIDS (BONEPWA), Gaborone".** The objective of the proposed study is to compare the pre-post 12 week aerobic training effects on lipid profile, CD4 count, body composition and aerobic activity of adult HIV-positive individuals on highly active antiretroviral therapy under BONEPWA. It is hoped that the findings of this study will add to the scant knowledge on HIV and aerobic exercise. The findings could also help health professionals and other stakeholders to design aerobic therapy interventions in adult HIV-positive individuals as well as develop awareness among the patients to recognize the value of exercise.

The Office of Research and Development is satisfied with the process for data collection, analysis and the intended utilization of findings from this research. We will appreciate your kind and timely consideration of this application.

We thank you for your usual cooperation and assistance

Sincerely,

Dr. M. Kasule
Assistant Director Research Ethics Office of Research and Development

Encls: Completed Application for Research Permit
Research Proposal
Informed Consent document
Data collection tools
Comments from UB/IRB

APPENDIX O

PRIVATE BAG 0038
GABORONE
BOTSWANA
REFERENCE:

REPUBLIC OF BOTSWANA
MINISTRY OF HEALTH AND WELLNESS

TEL: (+267) 363 2500
FAX: (+267) 391 0647
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD

REFERENCE NO: HPDME: 13/18/1 **24th September 2018**

Health Research and Development Division

Thabo Muswere
University of Botswana
Private Bag 00708
Gaborone

Dear Thabo Muswere

PERMIT: **AEROBIC-TRAINING EFFECTS ON SELECTED HEALTH CHARACTERISTICS OF ADULT HIV-POSITIVE INDIVIDUALS UNDER BONEPWA**

Your application for a research permit for the above stated research protocol refers. We note that your proposal has been reviewed and approved by University of Botswana Review Board.

Permission is therefore granted to conduct the above mentioned study. This approval is valid for a period of 1 year effective 24th September 2018.

This permit does not however give you authority to collect data from the selected site(s) without prior approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research and Development Division in the Ministry of Health and Wellness for consideration and approval.

Furthermore, you are requested to submit at least one hardcopy and an electronic copy of the report to the Health Research, Ministry of Health Wellness within 3 months of completion of the study. Approval is for academic fulfillment only. Copies should also be submitted to all other relevant authorities.

Thank you for your cooperation and your commitment to the protection of human subjects in research.

Yours faithfully

Ms S. Mosweunyane
for /PERMANENT SECRETARY

MINISTRY OF HEALTH RESEARCH DIVISION
2018 -09- 24
P/BAG 0038
GABORONE
REPUBLIC OF BOTSWANA

APPENDIX P

TELEPHONE: 363 2574
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TELEX: 2818 CARE BD

Republic of Botswana

MINISTRY OF HEALTH & WELLNESS
PRIVATE BAG 0038
GABORONE

REF: GGDHMT 2/27 V (25)

02 April 2019

Thabo Muswere
P.O Box 265
Moshupa

Dear Sir/Madam

RE: REQUEST FOR PERMISSION TO DRAW PARTICIPANTS

The above subject matter refers.

Permission has been granted for you to draw participants for your study titled: **Aerobic-training effects on selected health characteristics of adult HIV-positive individuals under BONEPWA, Gaborone**.

This exercise should however not disrupt patients care. You will be expected to follow all existing research ethics principles.

By copy of this letter the Nurse in-charge of all clinics in Gaborone are informed of your intensions and asked to provide access and support.

Thank you

Dr. M. Mogatle
Ag. Head - Greater Gaborone District Health Management Team

Cc: Nurse in-charge all clinics

MINISTRY OF HEALTH
RMU
2019 -04- 02
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